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AGENDA

I. Call to Order
II. Chairman Comments
III. Announcements
IV. Self-Introductions
V. Review and Approval of Agenda
VI. Approval of Minutes from Previous Meeting (Via Teleconference on April 9, 2020)
VII. Report of UMC A2L Task Group (Chair)
VIII. Report of UMC Legionella Task Group (Chair)
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XI. Next scheduled meeting (May 2 - May 5, 2022)
XII. Adjournment
TENTATIVE ORDER OF DISCUSSION
2021 PROPOSED CODE CHANGES TO THE UNIFORM MECHANICAL CODE

The following is the tentative order of discussion on which the proposed changes will be discussed at the Technical Committee Meeting. Proposed code changes that are grouped together are those that are both indented and separated by lines. Indented proposed code changes are those being discussed out of numerical order.

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Proposals

Item #: 001
UMC 2024  Section: 103.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

103.0 Duties and Powers of the Authority Having Jurisdiction.

103.2 Liability. The Authority Having Jurisdiction charged with the enforcement of this code, acting in good faith and without malice in the discharge of the Authority Having Jurisdiction’s duties, shall not thereby be rendered personally liable for damage that accrues to persons or property as a result of an act or by reason of an act or omission in the discharge of such duties. A suit brought against the Authority Having Jurisdiction or employee because of such act or omission performed in the enforcement of provisions of this code shall be defended by legal counsel provided by this jurisdiction until final termination of such proceedings. When the Authority Having Jurisdiction has not acted in good faith or has acted with malice, such jurisdiction shall be rendered liable.

SUBSTANTIATION:
While the AHJ has the authority to enforce this code, it does not allow a free reign to approve unauthorized, prohibited, hazardous, or otherwise unsafe systems to be installed. The AHJ or person(s) making such decisions should be held liable, including their jurisdictions. AHJs are government or private entities that have the force of law behind them. The AHJ may be a federal, state, local, or other regional department or individual such as a building official, fire chief, fire marshal, labor department, health department, or others having statutory authority.
Proposals

Item #: 002
UMC 2024  Section: 104.3.1

SUBMITTER: Adam Segura
Self

RECOMMENDATION:
Revise text

104.0 Permits.

104.3.1 Construction Documents. Construction documents, engineering calculations, diagrams, and other data shall be submitted in two or more sets, or in a digital format where permitted by the Authority Having Jurisdiction, with each application for a permit. The construction documents, computations, and specifications shall be prepared by, and the mechanical system designed by, a registered design professional. Construction documents shall be drawn to scale with clarity to identify that the intended work to be performed is in accordance with the code.

Exception: The Authority Having Jurisdiction shall be permitted to waive the submission of construction documents, calculations, or other data where the Authority Having Jurisdiction finds that the nature of the work applied for is such that reviewing of construction documents is not necessary to obtain compliance with the code.

SUBSTANTIATION:
While paper documentation is still used in the field, digital versions of documentation are also permitted by jurisdictions. The addition of this language will eliminate the paper documents from being printed where not necessary and will allow faster submission of documents where digital format is allowed and accepted.
Proposals

Item #: 003
UMC 2024 Section: 104.4.5

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

104.0 Permits.

104.4 Permit Issuance. (remaining text unchanged)

104.4.5 Suspension or Revocation. The Authority Having Jurisdiction shall be permitted to, in writing, with written notification, to suspend or revoke a permit issued under the provisions of this code where the permit is issued in error or on the basis of incorrect information supplied or in violation of other ordinance or regulation of the jurisdiction.

SUBSTANTIATION:
The phrasing of Section 104.4.5 is being revised for clarity as the language is awkwardly written.
Proposals

Item #: 004
UMC 2024  Section: Chapter 2

SUBMITTER:  IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

CHAPTER 2
DEFINITIONS

203.0  – A –
Anodeless Riser. An assembly of steel-cased plastic pipe used to make the transition between plastic piping installed underground and metallic piping installed aboveground. [NFPA 54:3.3.4 3.3.3]

Appliance, Fan-Assisted Combustion System. An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber or heat exchanger. [NFPA 54:3.3.5.4 3.3.95.2]

Appliance Categorized Vent Diameter/Area. The minimum vent diameter/area permissible for Category I appliances to maintain a nonpositive vent static pressure when tested in accordance with nationally recognized standards. [NFPA 54:3.3.6 3.3.5]

204.0  – B –
Broiler. A general term including broilers, salamanders, barbecues, and other devices cooking primarily by radiated heat, excepting toasters. [NFPA 54:3.3.45 3.3.14]

205.0  – C –
Chimney. One or more passageways, vertical or nearly so, for conveying flue or vent gases to the outdoors. [NFPA 54:3.3.48 3.3.17]

Chimney, Factory-Built. A chimney composed of listed factory-built components assembled in accordance with the manufacturer's installation instructions to form the completed chimney. [NFPA 54:3.3.18.2 3.3.17.2]

Chimney, Masonry. A field-constructed chimney of solid masonry units, bricks, stones, listed masonry chimney units, or reinforced Portland cement concrete, lined with suitable chimney flue liners. [NFPA 54:3.3.18.3 3.3.17.3]

Chimney, Metal. A field-constructed chimney of metal. [NFPA 54:3.3.48.4 3.3.17.4]

Clothes Dryer. An appliance used to dry wet laundry by means of heat. [NFPA 54:3.3.19 3.3.18]

Clothes Dryer, Type 1. Primarily used in family living environment. May or may not be coin-operated for public use. [NFPA 54:3.3.19.1 3.3.18.1]

Clothes Dryer, Type 2. Used in business with direct intercourse of the function with the public. May or may not be operated by public or hired attendant. May or may not be coin-operated. [NFPA 54:3.3.19.2 3.3.18.2]

Combustion Chamber. The portion of an appliance within which combustion occurs. [NFPA 54:3.3.24 3.3.20]

Conversion Burner, Gas. A unit consisting of a burner and its controls utilizing gaseous fuel for installation in an appliance originally utilizing another fuel. [NFPA 54:3.3.47.2 3.3.16.2]

206.0  – D –
Direct Gas-Fired Nonrecirculating Industrial-Air Heater Heating and Forced Ventilation Appliances for Commercial and Industrial Application. A nonrecirculating industrial air heater direct gas-fired heating and forced ventilation appliance in which all of the products of combustion generated by the appliance are released into the outdoor airstream being heated. [NFPA 54:3.3.56.4 3.3.56.2]

Direct Gas-Fired Recirculating Industrial Air Heater Heating and Forced Ventilation Appliances for Commercial and Industrial Application. An air recirculating heater direct gas-fired heating and forced ventilation appliance in which all of the products of combustion generated by the appliance are released into the airstream being heated. [NFPA
Direct Vent Appliances. Appliances that are constructed and installed so that all air for combustion is derived directly from the outdoors and all flue gases are discharged to the outdoors. [NFPA 54:3.3.5.3 3.3.4.2]

Draft Hood. A nonadjustable device built into an appliance, or made a part of the vent connector from an appliance, that is designed to:

1. Provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood.
2. Prevent a backdraft from entering the appliance.
3. Neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance. [NFPA 54:3.3.34 3.3.30]

Effective Ground-Fault Current Path. An intentionally constructed, low impedance electrically conductive path designed and intended to carry current under ground-fault conditions from the point of a ground fault on a wiring system to the electrical supply source and that facilitates the operation of the overcurrent protective device or ground-fault detectors. [NFPA 54:3.3.34 3.3.33]

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

Excess Flow Valve (EFV). A valve designed to activate when the fuel gas passing through it exceeds a prescribed flow rate. [NFPA 54:3.3.99.3 3.3.98.3]

Quick-Disconnect Device, Fuel Gas. A hand-operated device that provides a means for connecting and disconnecting 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 3.3.27.3]

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 3.3.101]

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 54:3.3.5.10.1]

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 54:3.3.5.10.2]

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 54:3.3.5.10.3]

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 54:3.3.5.10.4]

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 2 is being revised to the latest edition of NFPA 54-2021.
Proposals

Item #: 005
UMC 2024  Section: Chapter 2

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 96 Extract Update

RECOMMENDATION:
Revise text

204.0  – B –
Baffle Plate. An object placed in or near an appliance to change the direction or retard the flow of air, air-fuel mixtures, or flue gases. [NFPA 96:3.3.8]

205.0  – C –
Confined Space. A room or space having a volume less than 50 cubic feet per 1000 British thermal units per hour (Btu/h) (4.83 m$^3$/kW) of the aggregate input rating of all fuel-burning appliances installed in that space. (NFPA 96:3.3.47.2)

208.0  – F –
Fire Resistance Rating. The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with ASTM E119 or UL 263. [NFPA 96:3.3.25]

Fume Incinerators. Devices using intense heat or fire to break down, oxidize, or both, vapors and odors contained in gases or air being exhausted into the atmosphere. ([NFPA 96:3.3.27])

214.0  – L –
Liquid-Tight. Constructed and performing in such a way that prevents the passage of liquid at any temperature. [NFPA 96:3.3.35]

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

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]

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 2 is being revised to the latest edition of NFPA 96-2021.
Proposals

Item #: 006
UMC 2024 Section: 203.0

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

203.0 – A –

Air Exfiltration. Leakage of air from a conditioned space(s) to an unconditioned space(s) or to the outdoors through openings in the building envelope, often attributable to wind pressure, stack pressure, or positive pressurization of the building. Also known as air leakage.

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

SUBSTANTIATION:
It is critical to understand the pressures that occur on buildings which cause air infiltration and exfiltration. There are three major pressures: wind pressure, stack pressure, and fan/building pressure. The added definitions address the types and causes of air infiltration and exfiltration.

(1) Wind pressure tends to pressurize a building positively on the side it is hitting, and as the wind goes around the corner of the building it speeds up considerably, creating especially strong negative pressure at the corners and less strong negative pressure on the rest of the building walls and roof. Wind pressure on buildings is significant in calculating energy or moisture-related air leakage in buildings.

(2) Stack effect can move large volumes of air through a building envelope. It is caused by a difference in atmospheric pressure at the top and bottom of a building due to temperature. Temperature variation causes a difference in the weight of the columns of air indoors vs. outdoors. In the winter, the warm air in a heated building is lighter (less dense) than the cold air outside the building. That warm air bubble wants to rise up and out. When it does, the flow of air leaving the top of the building draws cold air into cracks at the bottom. The reverse occurs in warm climates with air-conditioning.

(3) Fan pressure is caused by HVAC system pressurization. Fan pressures can create negative pressure on the building envelope, drawing in cool, dry air in the winter and hot, humid air in the summer. Alternatively, positive fan pressures push warm, moist air into the building envelope in the winter, depositing condensation on surfaces within wall and roof enclosures.
Proposals

Item #: 007

UMC 2024  Section: 203.0

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

203.0 – A –
Air-Handling Unit. A blower or fan used for the purpose of distributing supply air to a room, space, zone, or area.

SUBSTANTIATION:
The term “zone” is commonly used to describe an area served by an Air-Handling Unit (AHU). Therefore, along with the list of “room,” “space,” and “area,” the term “zone” is being added to clarify that an AHU also serves supply air to a “zone.”
Item #: 008

UMC 2024  Section: 203.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

203.0  – A –
Air, Recirculated. *Air that is removed from a conditioned space, mixed with outside air, and reused as supply air.*

SUBSTANTIATION:
The term “recirculated air” is used in the code but is not currently defined. Recirculated air is air that was used to condition space and removed from the space, mixed with fresh outdoor air, and reused as supply air in either the space of origin or other conditioned space. Therefore, this definition clearly states what recirculated air is as it is used in the code.
Proposals

Item #: 009
UMC 2024  Section: 203.0, 207.0, 218.0, E 503.6.5.3, E 503.6.5.4

SUBMITTER:  Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

203.0  – A –
Air, Return. Air from the conditioned area space that is returned through ducts or plenums to the conditioning equipment for reconditioning.
Air, Supply. Air being conveyed to a conditioned area space through ducts or plenums from a heat exchanger of a heating, cooling, absorption, or evaporative cooling system.

207.0  – E –
Evaporative Cooling System. Equipment intended or installed for the purpose of environmental cooling by an evaporative cooler from which the conditioned air is distributed through ducts or plenums to the conditioned area space.

218.0  – P –
Portable Evaporative Cooler. An evaporative cooler that discharges the conditioned air directly into the conditioned area space without the use of ducts and can be readily transported from place to place without dismantling any portion thereof.

E 503.6.5.3 System Balancing. Construction documents shall require that HVAC systems be balanced in accordance with generally accepted engineering standards. Construction documents shall require that a written balance report be provided to the building owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area space exceeding 5000 square feet (464.52 m²). \{ASHRAE 90.1:6.7.2.3.1\}

E 503.6.5.4 System Commissioning. HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50 000 square feet (4645.15 m²) conditioned area space, except warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems shall be provided by the designer in plans and specifications. \{ASHRAE 90.1:6.7.2.4\}

(below shown for reference only)

205.0  – C –
Conditioned Space. An area, room, or space normally occupied and being heated or cooled for human comfort by any equipment.

SUBSTANTIATION:
This proposal changes all phrasing of “conditioned area” to “conditioned space” as there is no definition for “conditioned area” but there is a definition for “conditioned space.”
Proposals

Item #: 010
UMC 2024  Section: 203.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

203.0 – A –
Air, Transfer. Air that is relocated from one conditioned space to another space through ducts, plenums, or transfer grills.

SUBSTANTIATION:
The term “transfer air” is used in the UMC but is not defined. A definition is needed to clarify what transfer air is. The proposed term is clear and consistent with how the term “transfer air” is used in the industry.
Proposals

Item #: 011
UMC 2024 Section: 203.0, 205.0, 206.0, 207.0, 218.0

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

[The terms are being relocated only]

205.0 – C –
Closed Combustion Solid-Fuel-Burning Appliance. A heat-producing appliance that employs a combustion chamber that has no openings other than the flue collar, fuel-charging door, and adjustable openings provided to control the amount of combustion air that enters the combustion chamber.

206.0 – D –
Direct Vent Appliances. Appliances that are constructed and installed so that all air for combustion is derived directly from the outdoors and all flue gases are discharged to the outdoors. [NFPA 54:3.3.5.3]

207.0 – E –
Electric Heating Appliance. A device that produces heat energy to create a warm environment by the application of electric power to resistance elements, refrigerant compressors, or dissimilar material junctions.

218.0 – P –
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.

203.0 – A –
Appliance. A device that utilizes an energy source to produce light, heat, power, refrigeration, air conditioning, or compressed fuel gas. This definition also shall include a vented decorative appliance.

Closed Combustion Solid-Fuel-Burning Appliance. A heat-producing appliance that employs a combustion chamber that has no openings other than the flue collar, fuel-charging door, and adjustable openings provided to control the amount of combustion air that enters the combustion chamber.

Direct Vent Appliances. Appliances that are constructed and installed so that all air for combustion is derived directly from the outdoors and all flue gases are discharged to the outdoors. [NFPA 54:3.3.5.3]

Electric Heating Appliance. A device that produces heat energy to create a warm environment by the application of electric power to resistance elements, refrigerant compressors, or dissimilar material junctions.

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.

SUBSTANTIATION:
This code change relocates the definitions of “Closed Combustion Solid-Fuel-Burning Appliance,” “Direct Vent Appliances,” “Electric Heating Appliance,” and “Portable Heating Appliance” to below “Appliance” for ease of locating the terms. Simple cleanup.
Proposals

Item #: 012

UMC 2024  Section: 203.0

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

203.0  – A –
Appliance. A device that utilizes fuel or electricity as an energy source to produce light, heat, power, refrigeration, or air conditioning, or compressed fuel gas. This definition also shall include a-vented decorative appliances and electric storage or tankless water heaters.

SUBSTANTIATION:
The change removes enforceable language that is not permitted in a definition per the Manual of Style. The update also removes “compressed fuel gas” as it is used out of context and is now addressed under “fuel.”

Furthermore, the additional language to the “Appliance” definition reintroduces electric water heaters into the mechanical code.
Proposals

Item #: 013
UMC 2024  Section: 203.0

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Add new text

203.0 – A –
Appliance. A device that utilizes an energy source to produce light, heat, power, refrigeration, air conditioning, or compressed fuel gas. This definition also shall include a vented decorative appliance.

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

SUBSTANTIATION:
This code change adds a definition for “Vented Appliance” as the term is used in the code but is currently not defined. The proposed definition clearly describes the term.
Proposals

Item #: 014
UMC 2024  Section: 203.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

203.0  – A –

**Authorized Personnel. Any person who is designated by the appointing authority.**

SUBSTANTIATION:
A definition is being added for "Authorized Personnel" as the term is used several times in the code but not currently defined. See Sections 1104.4, 1106.10, 1106.11, 1112.11.2, 1305.1, and 1308.10.5.
Proposals

Item #: 015

UMC 2024 Section: 204.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

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

SUBSTANTIATION:
A new definition for “Backflow” is being added as the term is currently used in the code but not defined. The definition correlates with the existing definition in the UPC.
Proposals

Item #: 016
UMC 2024 Section: 203.0, 204.0, 210.0, 214.0, 215.0, 218.0, 225.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

[The terms are being relocated only]

203.0 – A –
Automatic Boiler. A boiler equipped with certain controls and limit devices.

204.0 – B –
Boiler, High-Pressure. A boiler for generating steam at gauge pressures in excess of 15 psi (103 kPa), or for heating water to a temperature in excess of 250°F (121°C) or at a gauge pressure in excess of 160 psi (gauge pressure of 1103 kPa). [NFPA 211:3.3.14.2]

210.0 – H –
Hot-Water-Heating Boiler. A boiler having a volume exceeding 120 gallons (454 L), a heat input exceeding 200,000 Btu/h (58.6 kW), or an operating temperature exceeding 210°F (99°C) that provides hot water to be used externally to itself.

214.0 – L –
Low-Pressure Hot-Water-Heating Boiler. A boiler furnishing hot water at pressures not exceeding 160 psi (1103 kPa) and at temperatures not exceeding 250°F (121°C).

Low-Pressure Steam-Heating Boiler. A boiler furnishing steam at pressures not exceeding 15 psi (103 kPa).

215.0 – M –
Miniature Boiler. A power boiler having an internal shell diameter of 16 inches (406 mm) or less, a gross volume of 5 cubic feet (0.14 m³) or less, a heating surface of 20 square feet (1.86 m²) or less (not applicable to electric boilers), and not exceeding 100 psi (689 kPa).

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.

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

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).

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

225.0 – W –
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).

204.0 – B –
Boiler. A closed vessel used for heating water or liquid, or for generating steam or vapor by direct application of heat from combustible fuels or electricity.
**Automatic Boiler.** A boiler equipped with certain controls and limit devices.

**Boiler, High-Pressure.** A boiler for generating steam at gauge pressures in excess of 15 psi (103 kPa), or for heating water to a temperature in excess of 250°F (121°C) or at a gauge pressure in excess of 160 psi (gauge pressure of 1103 kPa). [NFPA 211:3.3.14.2]

**Hot-Water-Heating Boiler.** A boiler having a volume exceeding 120 gallons (454 L), a heat input exceeding 200 000 Btu/h (58.6 kW), or an operating temperature exceeding 210°F (99°C) that provides hot water to be used externally to itself.

**Low-Pressure Hot-Water-Heating Boiler.** A boiler furnishing hot water at pressures not exceeding 160 psi (1103 kPa) and at temperatures not exceeding 250°F (121°C).

**Low-Pressure Steam-Heating Boiler.** A boiler furnishing steam at pressures not exceeding 15 psi (103 kPa).

**Miniature Boiler.** A power boiler having an internal shell diameter of 16 inches (406 mm) or less, a gross volume of 5 cubic feet (0.14 m$^3$) or less, a heating surface of 20 square feet (1.86 m$^2$) or less (not applicable to electric boilers), and not exceeding 100 psi (689 kPa).

**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.

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

**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).

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

**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).

**SUBSTANTIATION:**

This code change relocates the definitions relating to boilers below the definition of "Boiler" for ease of use in locating boiler-related terms.
Proposal 4:
A definition for Chilled Water does not currently exist in the Code. This new definition will assist users who may be unfamiliar with hydronic cooling and especially radiant cooling where there may be multiple temps.
Proposals

Item #: 018
UMC 2024  Section: 205.0

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

205.0 — C —
Conditioned Space. An area, room, or space normally occupied and being heated or cooled for human comfort by any appliance or equipment.

SUBSTANTIATION:
The definition of “conditioned space” should be revised as a conditioned space is not always “normally occupied” and is not always for “human comfort.” For example, computer rooms or data rooms can be conditioned spaces, but are not used for human comfort, rather they are for maintaining suitable temperatures for the functionality of the computer equipment.
Proposals

Item #: 019

UMC 2024  Section: 206.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

206.0  – D –
Design Pressure. The maximum allowable pressure for which a specific part of a system is designed.

SUBSTANTIATION:
The UMC references the term “Design Pressure” throughout the code, however there is no definition. A definition is needed for clarity. The code change correlates with the USHGC. This is necessary to ensure correlation between the codes.
Proposals

Item #: 020
UMC 2024  Section: 206.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

206.0  – D –
Direct Exchange (DX). A ground-source heat pump that circulates a refrigerant through a closed-loop system. Also known as direct expansion unit or direct expansion system.

SUBSTANTIATION:
The term Direct Exchange (DX) is used in both Appendix E and Appendix F of the UMC. The term is also known as direct expansion unit or direct expansion system. Therefore, a definition is being added to Chapter 2 that also correlates with the USHGC.
Proposals

Item #: 021
UMC 2024  Section: 206.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

206.0       – D –
Drain. A pipe that carries waste or waterborne wastes in a building drainage system.

Drainage System. Includes all the piping within public or private premises that conveys sewage, storm water, or other liquid wastes to a legal point of disposal, but does not include the mains of a public sewer system or a public sewage treatment or disposal plant.

SUBSTANTIATION:
The new definitions are being added as the terms are currently used in the code but not defined. Furthermore, the definitions correlate with the existing definitions in the UPC.
Proposals

Item #: 022

UMC 2024 Section: 206.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

206.0 – D –
**Dual Purpose Water Heater.** An appliance utilized as a heat source for both space heating and domestic hot water applications.

SUBSTANTIATION:
UMC Sections 1002.5, 1202.3, 1203.2, 1207.3, and 1219.1 reference Dual Purpose Water Heaters. Therefore, a definition for the term is being added to clarify what a dual purpose water is and the intent of the code.
Proposals

Item #: 023
UMC 2024  Section: 206.0, 207.0, 209.0, 218.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

[The terms are being relocated only]

207.0  – E –
Environmental Air Duct. Ducting used for conveying air at temperatures not exceeding 250°F (121°C) to or from occupied areas of any occupancy through other than heating or air-conditioning systems, such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust ducts, and domestic-type clothes dryer exhaust ducts.

209.0  – G –
Grease Ducts. A containment system for the transportation of air and grease vapors that is designed and installed to reduce the possibility of the accumulation of combustible condensation and the occurrence of damage if a fire occurs within the system. [NFPA 96:3.3.20.2]

218.0  – P –
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).

206.0  – D –
Duct. A tube or conduit for transmission of air, fumes, vapors, or dust. This definition shall not include:
(1) A vent, vent connector, or chimney connector.
(2) A tube or conduit wherein the pressure of the air exceeds 1 psi (7 kPa).
(3) The air passages of listed self-contained systems.

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

Grease Ducts. A containment system for the transportation of air and grease vapors that is designed and installed to reduce the possibility of the accumulation of combustible condensation and the occurrence of damage if a fire occurs within the system. [NFPA 96:3.3.20.2]

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).

SUBSTANTIATION:
This code change relocates the definitions of “Environmental Air Duct,” “Grease Ducts,” and “Product-Conveying Duct” to below “Duct” for ease of locating the terms. Simple cleanup.
Proposals

Item #: 024

UMC 2024 Section: 206.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

206.0 – D –

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

SUBSTANTIATION:
There is currently no definition in the UMC for duct sealing.
Proposals

Item #: 025
UMC 2024 Section: 206.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

206.0 – D –
Duct Sealing Classes.
Seal Class A. All transverse joints, longitudinal seams, duct wall, and screw penetrations.
Seal Class B. All transverse joints and longitudinal seams.
Seal Class C. Transverse joints.

SUBSTANTIATION:
I would like to add definitions for the various seal classes as outlined in SMACNA Duct Construction Standards. This is important to understand the joints and seams that shall be sealed to prevent air leakage in duct systems.
Proposals

Item #: 026
UMC 2024  Section: 207.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

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

SUBSTANTIATION:
There has been confusion for years about combining bathroom exhaust ducts with locker room exhaust ducts, shower room exhaust ducts, and/or janitor’s closet exhaust ducts. The proposed code change would eliminate confusion regarding which exhaust ducts are permitted to be interconnected.
Proposals

Item #: 027

UMC 2024  Section: 207.0

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

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

SUBSTANTIATION:
The term “expansion tank” is used throughout the UMC along with provisions for such tanks. These types of tanks provide protection because they accept the increase in thermal fluid volume as a result of thermal expansion. They also assist in system startup and operation by acting as a mechanism which accepts entrained air. The provided definition is necessary as it pertains to various systems within the UMC and clarifies that these tanks are meant to protect such closed systems from excessive pressures.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 028
UMC 2024  Section: 208.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

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

(below shown for reference only)

208.0  – F –
Fire Wall. A wall separating buildings or subdividing a building to prevent the spread of the fire and having a fire resistance rating and structural stability. [NFPA 96:3.3.26]
Fire Partition. An interior wall or partition of a building that separates two areas and serves to restrict the spread of fire but does not qualify as a fire wall.

SUBSTANTIATION:
The terms “fire wall” and “fire partition” are used and defined in the UMC. However, the term “fire barrier” is also used in the UMC but is not defined. This code change adds a clear definition for “fire barrier” for completeness in the code.
Proposals

Item #: 029
UMC 2024  Section: 208.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

208.0 – F –
Flue Collar. That portion of an appliance designed for the attachment of a draft hood, vent connector, or venting system. [NFPA 54:3.3.44]

SUBSTANTIATION:
A new definition for “Flue Collar” is being added as the term is currently used in the code but not defined. The definition correlates with NFPA 54 and the existing definition in the UPC.
Proposals

Item #: 030
UMC 2024  Section: 209.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

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

Fuel Gas. Natural, manufactured, liquefied petroleum, or a mixture of these.
Flue Gas. Products of combustion with excess air in appliance flues or heat exchangers.
Liquefied Petroleum Gas (LP-Gas). Means and includes a material composed predominantly of any of the following hydrocarbons or mixtures of them: propane, propylene, butanes (normal butane or isobutane), and butylenes. When reference is made to liquefied petroleum gas in this code, it shall refer to liquefied petroleum gases in either the liquid or gaseous state.
Utility Gas. See Fuel Gas.

SUBSTANTIATION:
Definitions are being added for “Gas,” “Flue Gas,” and “Utility Gas” to add clarity to the code. The definitions for the terms are consistent with industry standards. The definitions for “Fuel Gas” and “Liquefied Petroleum Gas (LP-Gas)” are being relocated to under the new definition of “Gas.”
Proposals

Item #: 031
UMC 2024  Section: 209.0

SUBMITTER: Karan Kapila
Self

RECOMMENDATION:
Revise text

209.0 — G —
Gas Piping. An installation of pipe, valves, or fittings that are used to convey fuel gas, installed on any premises or in a building, but shall not include:
(1) A portion of the service piping.
(2) An approved piping connection 6 feet (1829 mm) or less in length between an existing gas outlet and a gas appliance in the same room with the outlet.

(above shown for reference only)

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)]

1312.0 Appliance and Equipment Connections to Building Piping.
1312.3.1 Indoor. Indoor gas hose connectors shall be used only to connect laboratory, shop, and ironing appliances requiring mobility during operation and installed in accordance with the following:
(1) An appliance shutoff valve shall be installed where the connector is attached to the building piping.
(2) The connector shall be of minimum length and shall not exceed 6 feet (1829 mm).
(3) The connector shall not be concealed and shall not extend from one room to another or pass through wall partitions, ceilings, or floors. [NFPA 54:9.6.2(1)]

SUBSTANTIATION:
The change is removing the term “shall” from the definition for “Gas Piping” as the IAPMO Manual of Style indicates that definitions shall not be written in mandatory language.

The language in (1) in not necessary as it is already covered under the 1302.1 (General) indicating that gas piping systems extend from the point of delivery.

The change also removes (2), the “limit of 6 feet” and “within the same room” for gas connectors as it does not belong in a definition. Furthermore, the limit of 6 feet is already addressed in Section 1312.3.1 (Indoor) for nonmetallic gas hose connectors.
Proposals

Item #: 032
UMC 2024  Section: 209.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

209.0 – G –
Grade. A reference plane representing the average finished ground level adjoining the building at exterior walls.

SUBSTANTIATION:
A new definition for “Grade” is being added as the term is currently used in the code but not defined.
Proposals

Item #: 033
UMC 2024  Section: 209.0

SUBMITTER: Bruce A Pfeiffer
Retired - City of Topeka

RECOMMENDATION:
Add new text

209.0 – G –

**Groundwater.** Water that exists beneath the Earth's surface. Originating as rainfall or snow and ice melt, the precipitation infiltrates the soil replenishing the groundwater system. The water may remain below grade in aquifers or underground streams or make its way back to the surface to feed streams, rivers or lakes.

SUBSTANTIATION:
The term groundwater is used multiple times in the Code. A definition will clarify the intent of the applicable Code sections using the term.
Item #: 034
UMC 2024  Section: 210.0

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Add new text

210.0  – H –

**Health Care Facility.** An occupancy used for medical or other health-related treatment or care of four or more persons where occupants are mostly incapable of self-preservation due to age, physical or mental disability, or because of security measures not under the occupants’ control. They include hospitals, clinics, outpatient care centers, nursing facilities, long-term care facilities, and specialized care centers. This definition shall include all waiting rooms, hallways, private rooms, semiprivate rooms, and wards within health care facilities.

SUBSTANTIATION:
A definition for “Health Care Facility” is unaccounted for in the latest edition of the UMC. The proposed definition addresses the health care industry use of the term while synchronizing with industry classifications, such as the Life Safety Code. The U.S. health care infrastructure is a complex system of facilities. Specialized clinics and outpatient centers have appeared to help ease the burden on hospitals, and more long-term care facilities are rising up to accommodate patients who need months or years of assisted healing. These facilities collaborate to deliver high-quality health care to patients and communities as a result of adhering to the Uniform Mechanical Code.
Proposals

Item #: 035

UMC 2024  Section: 205.0, 206.0, 210.0

SUBMITTER: David Dias  
Sheet Metal Workers Local 104

RECOMMENDATION:

Revise text

[The terms are being relocated only]

205.0 – C –
**Compensating Hood.** A hood for commercial food heat-processing equipment that has an outside-air supply with air delivered below or within the hood. Where makeup air is diffused directly into the exhaust within the hood cavity, it becomes a short-circuit hood.

206.0 – D –
**Draft Hood.** A nonadjustable device built into an appliance, or made a part of the vent connector from an appliance, that is designed to:
(1) Provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood.
(2) Prevent a backdraft from entering the appliance.
(3) Neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance. [NFPA 54:3.3.31]

210.0 – H –
**Hood.** An air-intake device connected to a mechanical exhaust system for collecting and removing grease-laden vapors, fumes, smoke, steam, heat, or odors from commercial food heat-processing equipment.

**Compensating Hood.** A hood for commercial food heat-processing equipment that has an outside-air supply with air delivered below or within the hood. Where makeup air is diffused directly into the exhaust within the hood cavity, it becomes a short-circuit hood. **Draft Hood.** A nonadjustable device built into an appliance, or made a part of the vent connector from an appliance, that is designed to:
(1) Provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood.
(2) Prevent a backdraft from entering the appliance.
(3) Neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance. [NFPA 54:3.3.31]

**Fixed Baffle.** A listed unitary exhaust hood design where the grease removal device is a nonremovable assembly that contains an integral fire-activated water-wash fire-extinguishing system listed for this purpose. [NFPA 96-2014:3.3.33.1]

**Type I.** A kitchen hood for collecting and removing grease and smoke.

**Type II.** A general kitchen hood for collecting and removing steam, vapor, heat, or odors.

SUBSTANTIATION:
This code change relocates the definitions of “Compensating Hood” and “Draft Hood” to below “Hoods” for ease of locating the terms. Simple cleanup.
Proposals

Item #: 036
UMC 2024  Section: 210.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

210.0  – H –
"Horizontal. A material that is installed in a horizontal position or which makes an angle of less than 45 degrees (0.79 rad) with the horizontal."

SUBSTANTIATION:
A definition is being added for the term “Horizontal” as there has been confusion regarding the term. The new definition is being added as the term is currently used in the code but not defined. The definition correlates with the existing definition of “Horizontal Pipe” in the UPC.
Item #: 037

UMC 2024  Section: 212.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

212.0 – J –

**Joint, Heat Fusion.** A joint used in some thermoplastic systems to connect the pipe to fittings or pipe lengths to apply heat and pressure to the components to form a bond between the materials. This joining method includes butt-fusion, socket-fusion, and electro-fusion.

SUBSTANTIATION:
A new definition for “Heat Fusion Joint” is being added as it is currently used in the code but not defined. See Sections 1211.11, 1308.5.8.2, and F 201.6.2. Section F 104.4.1.1 lists butt-fusion, socket-fusion, and electro-fusion as acceptable heat fusion methods. The definition is based on the existing definition in the UPC with improvements.
Proposals

Item #: 038
UMC 2024  Section: 212.0

SUBMITTER: Donald (DJ) Berger
Self

RECOMMENDATION:
Revise text

212.0  – J –
Joint, Press-Connect Elastomeric. A permanent mechanical removable or non-removable joint consisting of an elastomeric seal or an elastomeric seal and corrosion-resistant grip ring. The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer.

SUBSTANTIATION:
The word “Press-Connect” describes one type of technology using elastomeric materials for the joint seal. By revising the definition with the word “Elastomeric” this definition may be expanded to include similar joining technologies employing an elastomeric material for its seal, e.g., push-fit, grooved, bolted, compression repair couplings, etc. The words “permanent mechanical” are inconsistent with other “permanent” and “mechanical” joint definitions within this section of the 2021 UMC. By revising the definition with the removal of the phrase “The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer,” the definition would be inclusive of similar joining technologies employing elastomeric materials. This revision would provide additional consistency within the code as the 2021 UMC has specific sections that provide information on how joints are to be made.
Proposals

Item #: 039
UMC 2024  Section: 214.0

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

214.0 – L –
Listed (Third Party Certified). Equipment or materials included in a list published by a listing agency (accredited conformity assessment body) that maintains periodic inspection of current production of listed equipment or materials and whose listing states either that the equipment or material complies with approved standards or has been tested and found suitable for use in a specified manner. Terms used to identify listed equipment, products, or materials include “listed,” “certified,” or other terms as determined appropriate by the listing agency.

SUBSTANTIATION:
The proposed revision to the definition for “Listed” recognizes that listing organizations may use other terms to identify “listed” equipment, products, or materials. An example of other terms used that meet the definition of “listed” include “certified.” The term “certified” is a more globally recognized term used by listing organizations compared to the term “listed.”
Proposals

Item #: 040
UMC 2024  Section: 214.0

SUBMITTER: Lance MacNevin, P.Eng.
            Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

214.0       – L –
Load. The heat output of the storage during discharge. The product of the mass flowrate, specific thermal capacity, and temperature increase of the water or heat transfer fluid as it passes through a system.

SUBSTANTIATION:
A definition is needed in the UMC for the term “Load,” which is used in throughout the code. The change correlates with the USHGC. This is necessary to ensure correlation between the codes.
Proposals

Item #: 041

UMC 2024 Section: 214.0, 216.0, 316.12, 316.13

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

214.0 – L –
Limited-Combustible Material. Refers to a building construction material that does not comply with the definition of
noncombustible material with limited burning characteristics that, in the form in which it is used, has a potential for
combustion and does not comply with the definition of noncombustible material. heat value not exceeding 3500 British
thermal units per pound-force (Btu/lb) (8141 kJ/kg), where tested in accordance with NFPA 259, and includes either of
the following:

(1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 of
an inch (3.2 mm), that has a flame-spread index not greater than 50.

(2) Materials, in the form and thickness used, having neither a flame-spread index greater than 25 nor evidence of
continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the
material on any plane would have neither a flame-spread index greater than 25 nor evidence of continued progressive
combustion, where tested in accordance with ASTM E84.

216.0 – N –
Noncombustible Material. As applied to building construction material, means a material that in the form in which it is
used is either one of the following:

(1) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or
release flammable vapors when subjected to fire or heat. Materials that are reported as passing ASTM E136 are considered
noncombustible material.

(2) Material having a structural base of noncombustible material as defined in item 1 above, with a surfacing material
not over 1/8 of an inch (3.2 mm) thick that has a flame-spread index not higher than 50.

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

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

316.12 Limited-Combustible Material. Limited combustible material shall have a potential heat value not exceeding
3500 British thermal units per pound-force (Btu/lb) (8141 kJ/kg), where tested in accordance with NFPA 259, and shall
include either of the following:

(1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 of an inch (3.2
mm), that has a flame-spread index not greater than 50.

(2) Materials, in the form and thickness used, having neither a flame-spread index greater than 25 nor evidence of continued
progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane
would have neither a flame-spread index greater than 25 nor evidence of continued progressive combustion, where tested in
accordance with ASTM E84.

316.13 Noncombustible Material. Noncombustible material shall meet one of the following:

(1) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or
release flammable vapors when subjected to fire or heat. Materials that comply with the requirements of ASTM E136 shall be
considered noncombustible material.
(2) Material having a structural base of noncombustible material as defined in item 1 above, with a surfacing material not over 1/8 of an inch (3.2 mm) thick that has a flame-spread index not higher than 50.

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

Note: ASTM E84, ASTM E136, and NFPA 259 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The definitions of Limited-Combustible Material and Noncombustible Material contain mandatory language. Requirements should not be located within definitions as definitions are not enforceable. Therefore, the current definitions should be relocated to the body of the code. Furthermore, the revised definitions are more concise and the appropriate standards for classifying such materials are better suited in Chapter 3.
Proposals

Item #: 042
UMC 2024 Section: 215.0

SUBMITTER: Shane Peters
City of Santa Monica

RECOMMENDATION:
Add new text

215.0 – M –
Mid-Story Guide. A support designed to keep piping in alignment, located half-way between floors or a floor and ceiling.

(below shown for reference only)

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>TYPES OF JOINTS</th>
<th>HORIZONTAL</th>
<th>VERTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast</td>
<td>Lead and Oakum</td>
<td>5 feet, except 10 feet where 10 foot lengths are installed(^1, 2, 3)</td>
<td>Base and each floor, not to exceed 15 feet</td>
</tr>
<tr>
<td></td>
<td>Compression Gasket</td>
<td>Every other joint, unless over 4 feet then support each joint(^1, 2, 3)</td>
<td>Base and each floor, not to exceed 15 feet</td>
</tr>
<tr>
<td>Cast-Iron Hubless Shielded Coupling</td>
<td>Shielded Coupling</td>
<td>Every other joint, unless over 4 feet then support each joint(^1, 2, 3)</td>
<td>Base and each floor, not to exceed 15 feet</td>
</tr>
<tr>
<td>Copper &amp; Copper Alloys</td>
<td>Soldered, Brazed, Threaded, or Mechanical</td>
<td>11/2 inches and smaller, 6 feet; 2 inches and larger, 10 feet</td>
<td>Each floor, not to exceed 10 feet(^5)</td>
</tr>
<tr>
<td>Steel Pipe for Water DWV</td>
<td>Threaded or Welded</td>
<td>3/4 inch and smaller, 10 feet; 1 inch and larger, 12 feet</td>
<td>Every other floor, not to exceed 25 feet(^5)</td>
</tr>
<tr>
<td>Steel Pipe for Gas</td>
<td>Threaded or Welded</td>
<td>1/2 inch, 6 feet; 3/4 inch and 1 inch, 8 feet; 11/4 inches and larger, 10 feet</td>
<td>1/2 inch, 6 feet; 3/4 inch and 1 inch, 8 feet; 11/4 inches every floor level</td>
</tr>
<tr>
<td>Schedule 40 PVC and ABS</td>
<td>Solvent Cemented</td>
<td>All sizes, 4 feet; allow for expansion every 30 feet(^3)</td>
<td>Base and each floor; provide mid-story guides; provide for expansion every 30 feet</td>
</tr>
<tr>
<td>CPVC</td>
<td>Solvent Cemented</td>
<td>1 inch and smaller, 3 feet; 11/4 inches and larger, 4 feet</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
<tr>
<td>CPVC-AL-CPVC</td>
<td>Solvent Cemented</td>
<td>1/2 inch, 5 feet; 3/4 inch and 1 inch, 1 inch, 6 inches; 1 inch, 6 feet</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
<tr>
<td>Lead</td>
<td>Wiped or Burned</td>
<td>Continuous Support</td>
<td>Not to exceed 4 feet</td>
</tr>
<tr>
<td>Steel Mechanical</td>
<td></td>
<td>In accordance with standards acceptable to the Authority Having Jurisdiction</td>
<td></td>
</tr>
<tr>
<td>PEX</td>
<td>Cold Expansion, Insert and Compression</td>
<td>1 inch and smaller, 32 inches; 11/4 inches and larger, 4 feet</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
<tr>
<td>PEX-AL-PE</td>
<td>Metal insert and metal compression</td>
<td>1/2 inch 3/4 inch 1 inch () All sizes 98 inches</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
<tr>
<td>PE-AL-PE</td>
<td>Metal insert and metal compression</td>
<td>1/2 inch 3/4 inch 1 inch () All sizes 98 inches</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
<tr>
<td>PE-RT</td>
<td>Insert and Compression</td>
<td>1 inch and smaller, 32 inches; 11/4 inches and larger, 4 feet</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>Fusion weld (socket, butt, saddle, electrofusion), threaded</td>
<td>1 inch and smaller, 32 inches; 11/4 inches and larger, 4 feet</td>
<td>Base and each floor; provide mid-story guides</td>
</tr>
</tbody>
</table>
For SI unit: 1 inch = 25.4 mm, 1 foot = 304.8 mm

**Notes:**
1. Support adjacent to joint, not to exceed 18 inches (457 mm).
2. Brace not to exceed 40 feet (12 192 mm) intervals to prevent horizontal movement.
3. Support at each horizontal branch connection.
4. Hangers shall not be placed on the coupling.
5. Vertical water lines shall be permitted to be supported in accordance with recognized engineering principles with regard to expansion and contraction, where first approved by the Authority Having Jurisdiction.

**SUBSTANTIATION:**
The term is used several times in Table 313.3 but not defined in the code. This will assist the end user on the intent of such term.
Proposals

Item #: 043
UMC 2024 Section: 218.0, 1406.3.3, Table 1701.1

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

218.0 – P –
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.

1406.0 Pipe, Tubing, and Fittings.

1406.3 Special Requirements for HPP Gases. (remaining text unchanged)

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

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 CFR 1910.1000</td>
<td>Air Contaminants</td>
<td>Air Quality</td>
<td>1406.3.3</td>
</tr>
</tbody>
</table>

Note: 29 CFR 1910.1000 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The definition of "PEL (Permissible Exposure Limit)" contains mandatory language. Requirements should not be located within definitions. Therefore, the last sentence from the definition is being relocated to Section 1406.3.3 as the exposure limits for Toxic and Hazardous substances are listed in OSHA 29 CFR 1910.1000 Tables Z-1, Z-2, and Z-3.
Proposals

Item #: 044

UMC 2024   Section: 218.0

SUBMITTER: Phil Pettit
            Control Air Conditioning Corporation
            Rep. Self

RECOMMENDATION:
Add new text

218.0   – P –
Power Ventilator, Dryer Exhaust Duct. A fan used to boost airflow through a clothes dryer duct. Also known as a dryer booster fan.

(below shown for reference only)

504.4.2.1 Length Limitation. Unless otherwise permitted or required by the dryer manufacturer’s instructions and approved by the Authority Having Jurisdiction, domestic dryer moisture exhaust ducts shall not exceed a total combined horizontal and vertical length of 14 feet (4267 mm), including two 90 degree (1.57 rad) elbows. A length of 2 feet (610 mm) shall be deducted for each 90 degree (1.57 rad) elbow in excess of two.

Exception: Where an exhaust duct power ventilator, in accordance with Section 504.4.2.3, is used, the maximum length of the dryer exhaust duct shall be permitted to be in accordance with the dryer exhaust duct power ventilator manufacturer’s installation instructions.

504.4.2.3 Exhaust Duct Power Ventilators. Dryer exhaust duct power ventilators for single residential clothes dryers shall be listed and labeled in accordance with UL 705 and installed in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
A definition is being added for “power ventilators” for clothes dryers. The term is used in the code and clarity is needed as to what these devices are. Power ventilators for clothes dryers are referenced in the exception to Section 504.4.2.1 (Length Limitation) and Section 504.4.2.3 (Exhaust Duct Power Ventilators).
Proposals

Item #: 045

UMC 2024  Section: 203.0, 210.0, 221.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

221.0  – S –
**Supports.** Supports, hangers, and anchors are devices for properly supporting and securing pipe, duct, and equipment.

203.0  – A –
**Anchors.** See Supports.

210.0  – H –
**Hangers.** See Supports.

(below shown for reference only)

1310.3.5 Hangers, Supports, and Anchors. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and equipment and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of MSS SP-58. [NFPA 54:7.2.6.1]

SUBSTANTIATION:
The new definitions are being added as the terms are currently used in the code but not defined. See Section 1310.3.5. The definitions correlate with the existing definitions in the UPC.
Proposals

Item #: 046
UMC 2024  Section: 222.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

222.0 – T –
Thermosiphon. The natural circulation of fluids due to temperature differential.

SUBSTANTIATION:
Section 1212.10 references the term “thermosiphoning,” however there is no definition. A definition is needed for clarity. The code change correlates with the USHGC. This is necessary to ensure correlation between the codes.
Item #: 047
UMC 2024 Section: 223.0, 802.10.1.1, 802.10.1.2

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

223.0 – U –
Unconditioned Space. An area, room, or space not being heated or cooled by any equipment.

802.10.1.1 Unconditioned Area Space. Where the vent connector used for an appliance having a draft hood or a Category I appliance is located in or passes through an unconditioned area space, attic, or crawl space, that portion of the vent connector shall be listed Type B, Type L, or listed vent material having equivalent insulation qualities.

Exception: Single-wall metal pipe located within the exterior walls of the building and located in an unconditioned area space other than an attic or a crawl space having a local 99 percent winter design temperature of 5°F (-15°C) or higher [NFPA 54:12.11.2.2].

802.10.1.2 Residential-Type Appliances. Vent connectors for residential-type appliances shall comply with the following:
(1) Vent connectors for listed appliances having draft hoods, appliances having draft hoods and equipped with listed conversion burners, and Category I appliances that are not installed in attics, crawl spaces, or other unconditioned areas spaces shall be one of the following:
(a) through (f) (remaining text unchanged)
(2) (remaining text unchanged)

Exception: Listed insulated vent connectors shall be installed in accordance with the manufacturer’s installation instructions. [NFPA 54:12.11.2.3].

(below shown for reference only)

Conditioned Space. An area, room, or space normally occupied and being heated or cooled for human comfort by any equipment.

SUBSTANTIATION:
This proposal adds a definition for “unconditioned space." Furthermore, the proposal modifies the term “unconditioned area” to “unconditioned space” as the term “unconditioned space” is consistent with the definition of “conditioned space” that already exists in the code.
Proposals

Item #: 048
UMC 2024  Section: 224.0

SUBMITTER: Adam Segura
Self

RECOMMENDATION:
Add new text

224.0  — V —
Vacuum Relief Valve. A device that automatically allows air to enter the piping system to prevent conditions that could siphon water from the system and prevent excessive vacuum in a pressure vessel.

(below shown for reference only)

1005.5 Vacuum Relief Valve. Hot-water heating systems that are subjected to a vacuum while in operation or during shutdown shall be protected with a vacuum relief valve. Where the piping configuration, equipment location, and valve outlets are located below the boiler elevation, the system shall be equipped with a vacuum relief valve at the highest point.

SUBSTANTIATION:
The proposed language adds the definition of a vacuum relief valve as used in a plumbing or mechanical system. The valve is not only protecting the pressure vessel from excessive vacuum, but also preventing conditions that could siphon the water from system and possibly cause damage to water heater and equipment. See Section 1005.5 (Vacuum Relief Valve).
Proposals

Item #: 049
UMC 2024  Section: 224.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

224.0  – V –
Valve, Isolation. A valve that isolates one piece of equipment from another.

SUBSTANTIATION:
A new definition for “Isolation Valve” is being added as it is currently used in the code but not defined. The definition correlates with the existing definition in the UPC.
Proposals

Item #: 050
UMC 2024 Section: 224.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

224.0 – V –
Valve, Zone. A valve that controls the gas or vacuum to a particular area.

SUBSTANTIATION:
A new definition for “Zone Valve” is being added as it is currently used in the code but not defined. See Section 1214.5. The definition correlates with the existing definition in the UPC.
Proposals

Item #: 051

UMC 2024 Section: 222.0, 224.0

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

222.0 – T –
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.

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

[The terms below are being relocated only]

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.

SUBSTANTIATION:
The code change adds a definition for “Vent” to improve the code as well as relocates and combines the existing vent types for ease of locating the terms.
Proposals

Item #: 052
UMC 2024 Section: 224.0

SUBMITTER: Bob Adler
Self

RECOMMENDATION:
Revise text

224.0 – V –
Vent Connector, Gas. That portion of a gas-venting system that connects a listed gas appliance beginning at the draft hood or flue collar to a gas vent and is installed within the space or area in which the appliance is located.

SUBSTANTIATION:
A simple definition of a vent connector is elusive. You will know it when you see it, but accurately defining it is difficult. However, we can state specifically where it begins and that it remains in the space where it begins.
Proposals

Item #: 053
UMC 2024  Section: 224.0

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

224.0 – V –
**Vertical.** A material that is installed in a vertical position or that makes an angle of not more than 45 degrees (0.79 rad) with the vertical.

SUBSTANTIATION:
A definition is being added for the term “Vertical” as there has been confusion regarding the term. The new definition is being added as the term is currently used in the code but not defined. The definition correlates with the existing definition of “Vertical Pipe” in the UPC.
Proposals

Item #: 054
UMC 2024  Section: 225.0

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

225.0 – W –
Water Hammer. A hydraulic shock that occurs within a pressurized piping system when the fluid flow within the system is suddenly stopped and the fluid momentum is broken.

SUBSTANTIATION:
A definition for the term “water hammer” is being added. The term is used in Chapter 12 (See Section 1201.3) and Appendix F (See Section F 101.9). The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 055
UMC 2024  Section: 225.0

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

225.0  – W –
Whole House Fan. A fan used for ventilating a building or space primarily to exhaust air from the conditioned space typically through an attic.

(below shown for reference only)

E 502.11 Whole House Fans. Whole house exhaust fans shall have insulated louvers or covers which close where the fan is off. Covers or louvers shall have an insulation value of not less than R-4.2, and shall be installed in accordance with the manufacturer's installation instructions. The attic openings shall be sufficient to accommodate the ventilation capacity of the whole house fan. The operation of the whole house fan shall be considered in determining the adequacy of providing combustion air in accordance with this code.

SUBSTANTIATION:
A definition is being added for “whole house fans.” The term is used in the code and clarity is needed as to what these systems are. Section E 502.11 (Whole House Fans) addresses whole house fans. These fans pull air in from open windows and exhausts it through the attic and roof. These systems provide good attic ventilation in addition to whole house cooling.
Proposals

Item #: 056
UMC 2024  Section: Chapter 3

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

303.0 Installation.

303.5 **Movement Restraining Device.** Movement of appliances with casters shall be limited by a restraining device installed in accordance with the connector and appliance manufacturer’s installation instructions. [NFPA 54:9.6.1.4]

303.8.5 **Electrical Power.** All appliances **Appliances** requiring an external source of electrical power for its operation shall be installed in accordance with NFPA 70, provided with the following:
(1) A readily accessible electrical disconnecting means within sight of the appliance that completely de-energizes the appliance.
(2) A 120-V ac grounding-type receptacle outlet on the roof adjacent to the appliance on the supply side of the disconnect switch. [NFPA 54:9.4.2.3]

303.9 **Avoiding Strain on Gas Piping.** Appliances shall be supported and connected to the piping so as not to exert undue strain on the connections. [NFPA 54:9.4.1.16]

303.10 **Clearances to Combustible Materials.** Appliances and their vent connectors shall be installed with clearances from combustible material so their operation does not create a hazard to persons or property. Minimum clearances between combustible walls and the back and sides of various conventional types of appliances and their vent connectors are specified in Chapter 8 and Chapter 9, or NFPA 211. [NFPA 54:9.2.2] Where not provided in this code, listed and unlisted equipment or appliances shall be installed to maintain the required clearances for servicing and to combustible construction in accordance with the listing and the manufacturer’s installation instructions.

303.11 **Installation in Commercial Garages.** Appliances installed in commercial garages shall be in accordance with Section 303.11.1 through Section 303.11.2.

303.11.1 **Parking Structures.** Appliances installed in enclosed, basement, and underground parking structures shall be installed in accordance with NFPA 88A. [NFPA 54:9.1.11.1]

303.11.2 **Repair Garages.** Appliances installed in repair garages shall be installed in accordance with NFPA 30A. [NFPA 54:9.1.11.2]

304.0 **Accessibility for Service.**

304.4 **Appliances in Attics and Under-Floor Spaces.** An attic or under-floor space in which an appliance is installed shall be accessible through an opening and passageway not less than the largest component of the appliance, and not less than 22 inches by 30 inches (559 mm by 762 mm). [NFPA 54:9.5.1]

304.3.1 **Access from the Inside.** Buildings of more than 15 feet (4572 mm) in height shall have an inside means of access to the roof unless other means acceptable to the Authority Having Jurisdiction are used. [NFPA 54:9.4.3.2]

304.4.4 **Lighting and Convenience Outlet.** A permanent 120 V receptacle outlet and a luminaire shall be installed near the appliance. The switch controlling the luminaire shall be located at the entrance to the passageway. [NFPA 54:9.5.3]
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 installed 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/ft^3) (128 kg/m^3) 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 1.0 British thermal unit inch per hour square foot degree Fahrenheit [Btu/(h•ft•°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 shall not 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.

Notes:

1. A – Equals the clearance with no protection specified in Table 802.7.3.3 and Table 904.2.2 and in the sections applying to various types of equipment.
2. B – Equals the reduced clearance permitted in accordance with Table 303.10.1.
3. The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.
For SI units: 1 inch = 25.4 mm

Notes:
1. Masonry walls can be attached to combustible walls using wall ties.
2. Spacers should not be used directly behind appliance or connector.

FIGURE 303.10.1(2)
WALL PROTECTOR CLEARANCE REDUCTION SYSTEM
[NFPA 54: FIGURE 403.2.3(b) 10.3.3.3(b)]

For SI units: 1 inch = 25.4 mm
Note: NFPA 70 and NFPA 211 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 3 is being revised to the latest edition of NFPA 54-2021.
Proposals

Item #: 057

UMC 2024   Section: 302.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

302.0 Materials – Standards and Alternates.

302.2 Alternate Materials and Methods of Construction Equivalency. Unless specifically prohibited, Nothing in this code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this code. Technical documentation shall be submitted to the Authority Having Jurisdiction to demonstrate equivalency. The Authority Having Jurisdiction shall have the authority to approve or disapprove the system, method, or device for the intended purpose.

However, the exercise of this discretionary approval by the Authority Having Jurisdiction shall have no effect beyond the jurisdictional boundaries of said Authority Having Jurisdiction. An alternate material or method of construction so approved shall not be considered as in accordance with the requirements, intent, or both of this code for a purpose other than that granted by the Authority Having Jurisdiction where the submitted data does not prove equivalency.

SUBSTANTIATION:
Section 302.2 grants authority to AHJ's to approve materials or products at their discretion. However, Section 302.2 places an obligation on the AHJ to approve only those alternate materials or products which comply "with the intent of this code," which are "at least the equivalent of that prescribed in this code," and are not specifically prohibited elsewhere in the code.
Item #: 058

UMC 2024  Section: 304.1

SUBMITTER: Bruce A Pfeiffer  
Retired - City of Topeka

RECOMMENDATION:
Revise text

304.0 Accessibility for Service.

304.1 General. All appliances shall be located with respect to building construction and other equipment so as to permit access to repair or replacement of the appliance. Sufficient clearance shall be maintained to permit removal of the appliance; cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where necessary; the adjustment and cleaning of burners and pilots; and the proper functioning of explosion vents, if provided. For attic installation, the passageway and servicing area adjacent to the appliance shall be floored. ([NFPA 54:9.2.1])

Unless otherwise specified, not less than 30 inches (762 mm) in depth, width, and height of working space shall be provided.

Exception: A platform shall not be required for unit heaters or room heaters.

SUBSTANTIATION:
The Code requires access for the repair of appliances in Section 304.1, but does not require access for the removal of appliances without the need to remove building construction or other appliances.
Proposals

Item #: 059
UMC 2024 Section: 304.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

304.0 Accessibility for Service.
304.1 General. All appliances shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient A clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where necessary; the adjustment and cleaning of burners and pilots; and the proper functioning of explosion vents, if provided. For attic installation, the passageway and servicing area adjacent to the appliance shall be floored in accordance with Section 304.4. [NFPA 54:9.2.1]

Unless otherwise specified, a clearance of not less than 30 inches (762 mm) in depth, width, and height of working space shall be provided maintained.

Exception: A platform shall not be required for unit heaters or room heaters.

(below shown for reference only)

304.0 Accessibility for Service.

304.4 Appliances in Attics and Under-Floor Spaces. An attic or under-floor space in which an appliance is installed shall be accessible through an opening and passageway not less than the largest component of the appliance, and not less than 22 inches by 30 inches (559 mm by 762 mm).

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

304.4.2 Width of Passageway. The passageway shall be unobstructed and shall have solid flooring not less than 24 inches (610 mm) wide from the entrance opening to the appliance. [NFPA 54:9.5.1.2]

304.4.3 Work Platform. A level working platform not less than 30 inches by 30 inches (762 mm by 762 mm) shall be provided in front of the service side of the appliance. [NFPA 54:9.5.2]

Exception: A working platform need not be provided where the furnace is capable of being serviced from the required access opening. The furnace service side shall not exceed 12 inches (305 mm) from the access opening.

304.4.4 Lighting and Convenience Outlet. A permanent 120 V receptacle outlet and a luminaire shall be installed near the appliance. The switch controlling the luminaire shall be located at the entrance to the passageway. [NFPA 54:9.5.3]

SUBSTANTIATION:
The change is a cleanup of the language to improve Section 304.1. The term “sufficient” is being removed as it is poor code language.
Proposals

Item #: 060

UMC 2024  Section: 304.4.1

SUBMITTER: Phillip H Ribbs  
PHR Consultants

RECOMMENDATION:  
Revise text

304.0 Accessibility for Service.

304.4 Appliances in Attics and Under-Floor Spaces. (remaining text unchanged)

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

SUBSTANTIATION:
This code change would limit the length of a passageway that is 6 feet high or more to a maximum length of 50 feet to remove the conflict between the building/residential code. There is currently no limit or provisions for a distance for a passageway greater than 6 feet in height.
Proposals

Item #: 061
UMC 2024  Section: 305.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

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]]

Exception: Flammable vapor ignition resistant (FVIR) appliances.

SUBSTANTIATION:
Several years ago, this language was added at the end of the sentence. As more of these appliances are now equipped with Flammable Vapor Ignition Resistant (FVIR) technology it seems that moving it to an exception makes sense to make sure it is not overlooked.
Proposals

Item #: 062
UMC 2024 Section: 305.1

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

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 heating elements, switches,
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]

SUBSTANTIATION:
Requirements for electric water heaters have been missing since the 2003 UPC. The reasons for this may no longer
exist and are perhaps unimportant. The fact is that electric water heaters are still installed by plumbers and still
need inspections. What document do plumbers and inspectors seek for these installation requirements?

Elements and switches (thermostats) are just as dangerous as burners and burner ignition devices, perhaps more
so with the advent of FVIR for gas burning water heaters.
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 and energy storage systems (ESS) installed in garages, warehouses, or other areas subject to mechanical damage shall be guarded against such damage by being installed behind protective barriers designed to resist, deflect, or visually deter vehicle impact in accordance with Section 305.1.4 or by being elevated or located out of the normal path of vehicles, defined as a line perpendicular to the garage vehicle opening to the back wall extending 36 inches (914 mm) to either side along the back wall and to a height of 48 inches (1219 mm). (See Figure 305.1.4)

Exception: Where the clear height of the vehicle garage opening is equal to or less than 90 inches (2286 mm), ESS installed at least 36 inches (914 mm) above the finished floor shall not be subject to vehicle impact protection requirements.

305.1.4 Protective Barriers. Where appliances and ESS are in the normal driving path of vehicle travel, a protective barrier shall be provided in accordance with Section 305.1.4.1, Section 305.1.4.2, or Section 305.1.4.3. (See Figure 305.1.4)

305.1.4.1 Bollards. Where installed, construction of bollards shall be in accordance with one of the following:
(1) 48 inches in length by 3 inches in diameter (1219 mm x 76 mm). Schedule 80 steel pipe embedded in a concrete pier 12 inches (305 mm) deep and 6 inches (152 mm) in diameter, with 36 inches (914 mm) of pipe exposed, filled with concrete, and spaced at intervals not exceeding 60 inches (1524 mm). Each bollard shall be located not less than 6 inches (152 mm) from an ESS.
(2) 36 inches in height by 3 inches in diameter (914 mm x 76 mm). Schedule 80 steel pipe fully welded to an 8 inch by 8 inch by ¼ inch (203 mm x 203 mm x 6.4 mm) thick steel plate and bolted to a concrete floor by means of four ½ inch (12.7 mm) concrete anchors with not less than 3 inches (76 mm) of embedment. Spacing shall not exceed 60 inches (1524 mm). Each bollard shall be located not less than 6 inches (152 mm) from the ESS.
(3) Pre-manufactured steel pipe bollards shall be filled with concrete and anchored in accordance with the manufacturer's installation instructions. Spacing between bollards shall not exceed 60 inches (1524 mm). Each bollard shall be located not less than 6 inches (152mm) from the ESS.

305.1.4.2 Wheel Barriers. Where installed, construction of wheel barriers shall be in accordance with one of the following:
(1) 6 inches in height by 6 inches in width (152 mm x 152 mm), wheel stop made of concrete or polymer, anchored to the concrete floor at intervals of not less than 36 inches (914 mm) and located not less than 54 inches (1372 mm) from the ESS. Not less than two ½ inch (12.7 mm) diameter concrete anchors with 3 inches (76 mm) of embedment per wheel stop shall be used. Spacing between wheel stops shall not exceed 36 inches (914 mm).
(2) Pre-manufactured wheel stops shall be anchored in accordance with the manufacturer’s installation instructions.

305.1.4.3 Other Approved Methods. Protective barriers installed 24 inches (610 mm) above grade and designed to resist a 2000 pound-force (8896 N) impact in the direction of vehicle travel shall be permitted.
FIGURE 305.1.4
PROTECTIVE BARRIERS FOR ESS

SUBSTANTIATION:
This change addresses the need for a clearly defined area in which a residential garage ESS installation would be within the normal path of vehicles. The existing language has led to widely varying interpretations and enforcement of impact protection. The proposed language has been added to define this area and set the expectation that the barriers are intended to deflect, resist, or visually deter an impact.

Figure 3.5.1.4 is being added to illustrate the zones in which a typical residential garage ESS installation would trigger the need for impact protection. The prescriptive barrier and post designs proposed represent protection from the assumed impact scenarios expected in a private residential garage where the building and fire codes speak more towards commercial installations.

The current UMC language leaves AHJs and installers with no guidelines for retrofit bollards designed to deter vehicle operators from carelessly striking the ESS units. The proposed language now allows for possible retrofitting where a floor mounted bollard may serve as a viable option for ESS protection. With this new language, designers, installers, and code officials will benefit from more explicit guidance within Section 305.1.1.

The limitation with bollard installation is mostly in the concrete to base plate connection. The average garage concrete slab will fall within these specifications: 2500 - 4000 psi concrete with 5" min thickness. Using 1/2" epoxy anchors, this equates to roughly a 2 mph impact that could be sustained without significant damage to the bollard.
This is aligned with a standard 4.5" bollard with 1/8" wall thickness and an 8" x 8" x 3/8" base plate. More strength requires a larger base plate, as the limitation is the connection to the concrete. The bolt down bollard specified in this proposal will take a 2000 lb impact, 24" off the ground with no damage, given 3000 psi concrete. More than 6" of permanent deflection would require a very significant force, and then only touching the face of the ESS. This seems to be a reasonable level of protection and clearance distance.
Proposals

Item #: 064

UMC 2024  Section: 305.5

SUBMITTER: David Mann
CA State Pipe Trades Council

RECOMMENDATION:
Revise text

305.0 Location.

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 or 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 3/4 of an inch (20 mm) diameter drain to an approved location. The terminating end of the drainpipe shall be readily visible. Such pan shall be not less than 11/2 inches (38 mm) in depth.

SUBSTANTIATION:
The proposed change will clarify that Section 305.5 is applicable to all water heaters, regardless of the type of water heater. The intent of the section is to prevent damage from occurring in the surrounding vicinity of the water heater should a leak occur.
Proposals

Item #: 065
UMC 2024 Section: 305.5

SUBMITTER: Bob Adler
Self

RECOMMENDATION:
Revise text

305.0 Location.

305.5 Drainage Pan. Where an water heater appliance or equipment 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 appliance or equipment, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater appliance or equipment in accordance with the following:
(1) The drainage pan shall be provided with not less than 3/4 of an inch (20 mm) diameter drain to an approved location.
(2) Such The drainage pan shall be not less than 1 1/2 inches (38 mm) in depth.
(3) Where a drain pan pipe is installed, the material of the piping shall be rated for the temperature rating of the appliance or equipment and shall be approved for use with the liquid being discharged.

SUBSTANTIATION:
The new text will add provisions which clarify that piping used on hot water applications shall be rated for such temperatures as there are drain lines to be used for cold water applications only.
Proposals

Item #: 066
UMC 2024  Section: 305.6

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Add new text

305.0 Location.

305.6 Outdoor Locations. Appliances installed in outdoor locations shall be in accordance with the following:
(1) Listed for outdoor installation.
(2) Provided with approved protection from the outdoor environmental factors that can affect the operation, durability, or safety of such appliances and in accordance with the manufacturer’s installation instructions.
(3) Outdoor cooking appliances shall comply with Section 923.0.

(below shown for reference only)

923.0 Outdoor Cooking Appliances.
923.1 Listed Units. Listed outdoor cooking appliances shall be installed in accordance with their listing and the manufacturer’s installation instructions.
923.2 Unlisted Units. Unlisted outdoor cooking appliances shall be installed outdoors with clearances to combustible material of not less than 36 inches (914 mm) at the sides and back and not less than 48 inches (1219 mm) at the front. In no case shall the appliance be located under overhead combustible construction. [NFPA 54:10.19.2]

SUBSTANTIATION:
Additional provisions for protection of appliances located outdoors are being added for public health and safety. Outdoor appliances are commonly used and additional code language is needed to improve the code.
Proposals

Item #: 067
UMC 2024 Section: 308.0, 308.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

305.0 Location.

308.0 305.6 Improper Prohibited Locations.
308.1 305.6.1 General. Piping, appliances, 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.
   Unless permitted elsewhere in this code, fuel-burning appliances shall not be installed in, or in a space that communicates with, the following:
(1) Bedrooms
(2) Bathrooms
(3) Toilet rooms
(4) Storage rooms
(5) Surgical rooms

Exception: Central heating boilers and furnaces in accordance with Section 904.0.

(below shown for reference only)

303.2 Closet or Alcove Installations. Central heating furnaces and boilers installed in closets or alcoves shall be listed for such installation. Central heating furnaces not listed for closet or alcove installation shall be installed in a room or space having a volume not less than 12 times the total volume of the furnace. Central heating boilers not listed for closet or alcove installation shall be installed in a room or space having a volume 16 times the volume of the boiler. Where the ceiling height of the room or space exceeds 8 feet (2438 mm), the volume shall be calculated on the basis of an 8 foot (2438 mm) height.
   The installation clearances shall be in accordance with the appliance listing, shall not be reduced, and shall be installed in accordance with Section 904.1.

904.0 Central Heating Boilers and Furnaces.
904.1 Location. Central heating furnace and low-pressure boiler installations in bedrooms or bathrooms shall comply with one of the following:
(1) Central heating furnaces and low-pressure boilers shall be permitted to be installed in a closet located in the bedroom or bathroom, provided the closet is equipped with a listed, gasketed door assembly, and a listed self-closing device. The self-closing door assembly shall comply with the requirements of Section 904.1.1. The door assembly shall be installed with a threshold and bottom door seal and shall comply with the requirements of Section 904.1.2. Combustion air for such installations shall be obtained from the outdoors. The closet shall be for the exclusive use of the central heating furnace or low-pressure boiler.
(2) Central heating furnaces and low-pressure boilers shall be of the direct vent type.

904.1.1 Self-Closing Doors. Self-closing doors shall swing easily and freely, and shall be equipped with a self-closing device to cause the door to close and latch each time it is opened. The closing mechanism shall not have a hold-open feature.

904.1.2 Gasketing. Gasketing on gasketed doors or frames shall be furnished in accordance with the published listings of the door, frame, or gasketing material manufacturer.
   Exception: Where acceptable to the Authority Having Jurisdiction, gasketing of noncombustible or limited-combustible
Central heating furnaces and low-pressure boilers shall be provided with clearances in accordance with Section 904.2.1 through Section 904.2.7.

904.2.1 Listed Units. Listed central heating furnaces and low-pressure boilers shall be installed with clearances in accordance with the terms of their listings and the manufacturer's installation instructions.

904.2.2 Unlisted Units. Unlisted central heating furnaces and low-pressure boilers shall be installed with clearances from combustible material not less than those specified in Table 904.2.2. [NFPA 54:10.3.2.2]

904.2.3 Listed and Unlisted Units. Listed and unlisted central heating furnaces and low-pressure boilers shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 303.10.1 and Figure 303.10.1(1) through Figure 303.10.1(3), and such reduction is allowed by the manufacturer's installation instructions. [NFPA 54:10.3.2.3]

904.2.4 Front Clearance. Front clearance shall be sufficient for servicing the burner and the furnace or boiler. [NFPA 54:10.3.2.4]

904.2.5 Adjacent to Plaster or Noncombustible Materials. Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 inches (51 mm) or less. [NFPA 54:10.3.2.5]

904.2.6 Interference. The clearances to these appliances shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. [NFPA 54:10.3.2.6]

904.2.7 Central Heating Furnaces. Central heating furnaces other than those listed in Section 603.13.2 or Section 603.13.3 shall have clearances from the supply ducts of not less than 18 inches (457 mm) from the furnace plenum for the first 3 feet (914 mm), then 6 inches (152 mm) for the next 3 feet (914 mm) and 1 inch (25.4 mm) beyond 6 feet (1829 mm). [NFPA 54:10.3.2.9]

904.3 Assembly and Installation. A central heating boiler or furnace shall be installed in accordance with the manufacturer's instructions in one of the following manners:

(1) On a floor of noncombustible construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof.

(2) On fire-resistive slabs or arches having no combustible material against the underside thereof.

Exceptions:

(1) Appliances listed for installation on a combustible floor.

(2) Installation on a floor protected in an approved manner. [NFPA 54:10.3.3]

904.3.1 Under-Floor Installation. Furnaces installed in an under-floor area of the building shall be in accordance with the Section 904.3.1.1 through Section 904.3.1.3.

904.3.1.1 Supported by Ground. Where a furnace is supported by the ground, it shall be installed on a concrete slab not less than 3 inches (76 mm) above the adjoining ground level.

904.3.1.2 Supported from Above. Where a furnace is supported from above, a clearance of not less than 6 inches (152 mm) shall be provided from finished grade.

904.3.1.3 Excavation. Where excavation is necessary to install a furnace, it shall be installed in accordance with Section 303.11.

904.4 Temperature or Pressure Limiting Devices. Steam and hot water boilers, respectively, shall be provided with approved automatic limiting devices for shutting down the burner(s) to prevent boiler steam pressure or boiler water temperature from exceeding the maximum allowable working pressure or temperature. Safety limit controls shall not be used as operating controls. [NFPA 54:10.3.4]

904.5 Low-Water Cutoff. All water boilers and steam boilers shall be provided with an automatic means to shut off the fuel supply to the burner(s) if the boiler water level drops below the lowest safe water line. In lieu of the low-water cutoff, water tube or coil-type boilers that require forced circulation to prevent overheating and failure shall have an approved flow sensing device arranged to shut down the boiler when the flow rate is inadequate to protect the boiler against overheating. [NFPA 54:10.3.5]

904.6 Steam Safety and Pressure Relief Valves. Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or pressure relief valves of appropriate discharge capacity and conforming with ASME requirements. A shutoff valve shall not be placed between the relief valve and the boiler or on discharge pipes between such valves and the atmosphere. [NFPA 54:10.3.6]

904.6.1 Discharge. Relief valves shall be piped to discharge near the floor. [NFPA 54:10.3.6.1]

904.6.2 Size. The entire discharged piping shall be at least the same size as the relief valve discharge piping. [NFPA 54:10.3.6.2]

904.6.3 End Connections. Discharge piping shall not contain threaded end connection at its termination point. [NFPA 54:10.3.6.3]

904.7 Refrigeration Coils. The installation of refrigeration coils shall comply with the following requirements:

(1) A refrigeration coil shall not be installed in conjunction with a forced air furnace where circulation of cooled air is provided by the furnace blower, unless the blower has sufficient capacity to overcome the external static pressure resistance imposed by the duct system and refrigeration coil at the air flow rate for heating or cooling, whichever is greater.

(2) Furnaces shall not be located upstream from refrigeration coils, unless the refrigeration coil is designed or equipped so as not to develop excessive temperature or pressure.
(3) Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid condensation in the heating element, unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be sufficiently tight to prevent any circulation of cooled air through the furnace.

(4) Means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element. [NFPA 54:10.3.8]

904.8 Cooling Units Used with Heating Boilers. Boilers, where used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler. [NFPA 54:10.3.9.1]

904.8.1 Exposed to Refrigerated Air Circulation. Where hot water heating boilers are connected to heating coils located in air-handling units where they can be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. [NFPA 54:10.3.9.2]

904.9 Furnace (Upright and Horizontal). Upright furnaces shall be permitted to be installed in an attic, furred, or under-floor space exceeding 5 feet (1524 mm) in height, provided the required listings and furnace and duct clearances are observed. Horizontal furnaces shall be permitted to be installed in an attic, furred, or under-floor space, provided the required listings and furnace and duct clearances are observed.

904.10 Solid-Fuel-Fired Furnaces. Factory-built solid fuel-fired furnaces shall comply with UL 391 and shall be installed in accordance with the manufacturer’s installation instructions.

904.11 Oil-Fired Central Furnaces. Oil-fired central furnaces shall comply with UL 727 and shall be installed in accordance with the manufacturer’s installation instructions.

904.12 Commercial or Industrial Gas Heaters. Commercial or industrial gas-fired heaters shall comply with UL 795 and shall be installed in accordance with the manufacturer’s installation instructions.

904.13 Electric Central Furnaces. Electric central heating furnaces shall comply with UL 1995 or UL 60335-2-40 and shall be installed in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
The code change provides a list of spaces where fuel burning appliances shall not be installed for public health and safety. For example, Section 303.2 allows central heating furnaces and boilers installed in closets or alcoves shall be listed for such installation.
Proposals

Item #: 068

UMC 2024 Section: 310.0, 310.1, 310.7

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

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 using an indirect waste pipe. The waste pipe shall have a slope of not less than 1/8 inch per foot (10.4 mm/m) or 1 percent slope and shall be of approved corrosion-resistant material not smaller than the outlet size in accordance with Section 310.3 or Section 310.4 for air-cooling coils or condensing appliances, respectively. Condensate or wastewater shall not drain over a public way.

310.7 Plastic Fittings. Female plastic screwed fittings shall be used with male plastic male fittings and plastic male threads.

SUBSTANTIATION:
The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Item #: 069
UMC 2024  Section: 310.1.1, Table 1701.1

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.
310.1 Condensate Disposal. (remaining text unchanged)
310.1.1 Condensate Pumps. Where approved by the Authority Having Jurisdiction, condensate pumps shall be
installed in accordance with the manufacturer’s installation instructions. Pump discharge shall rise vertically to a point
where it is possible to connect to a gravity condensate drain and discharged to an approved disposal point. Each
condensing unit shall be provided with a separate sump and interlocked with the equipment to prevent the equipment
from operating during a failure. Separate pumps shall be permitted to connect to a single gravity indirect waste where
equipped with check valves and approved by the Authority Having Jurisdiction. Motor operated condensate pumps rated
600 volts or less shall be listed and labeled in accordance with CSA C22.2 No. 108 or UL 778.

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</tr>
</tbody>
</table>

(Note: CSA C22.2 No. 108 and UL 778 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 310.1.1 is being modified to include CSA C22.2 No. 108 and UL 778 as the standards apply to liquid pumps
and is consistent with the language in Section 1208.1. Various manufacturers are currently making condensate
pumps which are being listed to these standards. The standards cover construction, markings, testing, bonding, and
enclosures for liquid pumps including condensate pumps. Including these listings further enhances the code.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure
correlation between the codes.)
Proposals

Item #: 070
UMC 2024  Section: 310.2

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.

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

1. A water level detecting device that will shut off the equipment or appliance in the event the primary drain is blocked.
2. An additional watertight pan of corrosion-resistant material, with a separate drain line, installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain.
3. An additional separate drain line at a level that is higher than the primary drain line connection of the drain pan.
4. An additional watertight pan of corrosion-resistant material with a water level detection device installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain and to shut off the equipment.

The additional pan or the additional drain line connection shall be provided with a drain pipe of not less than 3/4 of an inch (20 mm) nominal pipe size, discharging at a point that is readily observed.

SUBSTANTIATION:
The recommended change will assist in identifying whether the condensate waste is coming from the primary or secondary drain. If there is condensate coming from the secondary line, it must be investigated.

The addition of "separate" is to ensure that the primary and secondary are not tied together.

It used to have proposed language to make sure it was visible and marked, but it was removed.
Proposals

Item #: 071
UMC 2024  Section: 310.2, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.

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

(1) A water level detecting device listed and labeled to UL 508 that will shut off the equipment or appliance in the event the primary drain is blocked.

(2) An additional watertight pan of corrosion-resistant material, with a separate drain line, installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain.

(3) An additional drain line at a level that is higher than the primary drain line connection of the drain pan.

(4) An additional watertight pan of corrosion-resistant material with a water level detection device listed and labeled to UL 508 installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain and to shut off the equipment.

The additional pan or the additional drain line connection shall be provided with a drain pipe of not less than 3/4 of an inch (20 mm) nominal pipe size, discharging at a point that is readily observed.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tbody>
<tr>
<td>UL 508-2018</td>
<td>Industrial Control Equipment</td>
<td>Control Equipment</td>
<td>310.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 508 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Water level detecting devices need to properly function where used as part of the protection method for condensate overflow. UL 508 is the standard used for listing and labeling of these types of devices.
Proposals

Item #: 072
UMC 2024  Section: 310.3.2

SUBMITTER: Amie Rodio
Self

RECOMMENDATION:
Add new text

310.0 Condensate Wastes and Control.

310.3 Condensate Waste Pipe Material and Sizing. (remaining text unchanged)

310.3.2 Material. Condensate waste pipes shall be constructed of DWV materials in accordance with the plumbing code.

SUBSTANTIATION:
There is currently no direction for acceptable piping material for condensate waste pipe in the code. This code change adds provisions for condensate waste pipe materials to assist the installer and AHJ with installation of condensate waste pipe. The UPC, Table 701.2, lists the acceptable materials for condensate lines.
Proposals

Item #: 073

UMC 2024  Section: 310.5

SUBMITTER: Arnie Rodio  Self

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.

310.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly, except where permitted in Section 310.6, to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, mop sinks, leach pits, or the tailpiece of plumbing fixtures. A condensate drain shall be trapped in accordance with the appliance manufacturer’s instructions or as approved.

SUBSTANTIATION:
The change clarifies that mop sinks are an option for indirect connections for condensate waste pipes. Condensate drainage through mop sinks is common and will assist the end user in installing indirect waste piping.
Proposals

Item #: 074

UMC 2024  Section: 310.5

SUBMITTER: Arnie Rodio
 Self

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.

310.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly—except where permitted in Section 310.6—to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, or leach pits, or the tailpiece of plumbing fixtures. A condensate drain shall be trapped in accordance with the appliance manufacturer’s instructions or as approved. Exception: Direct connections in accordance with Section 310.6.

(below shown for reference only)

310.6 Condensate Waste From Air-Conditioning Coils. Where the condensate waste from air-conditioning coils discharges by direct connection to a lavatory tailpiece or to an approved accessible inlet on a bathtub overflow, the connection shall be located in the area controlled by the same person controlling the air-conditioned space.

SUBSTANTIATION:
The first sentence of Section 310.5 starts with indirect connection and then gives the exception. The change relocates language in Section 310.5 to an exception for clarity and to ensure it is not overlooked. Such “direct” connection to the tailpiece is covered in Section 310.6. Additionally, the term “tailpiece of plumbing fixtures” is grouped with the list of locations allowed for “air gap” or “air breaks.” A connection to a tailpiece of a plumbing fixture is neither through an air break or air gap.
Proposals

Item #: 075
UMC 2024  Section: 310.5

SUBMITTER: Bruce A Pfeiffer
Retired - City of Topeka

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.

310.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly, except where permitted in Section 310.6, to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, leach pits, or the tailpiece of plumbing fixtures. Condensate from roof top air conditioning units shall be permitted to drain indirectly into a roof drain. A condensate drain shall be trapped in accordance with the appliance manufacturer’s instructions or as approved.

SUBSTANTIATION:
Condensate is essentially distilled water, low in mineral content and when pure is neutral (pH7). Condensate in contact with air is slightly acidic (approximately pH 5.6) due to dissolved carbon dioxide (CO2)(COX2). The same applies to rainwater.
Proposals

Item #: 076

UMC 2024  Section: 310.7

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.

310.7 Female Plastic Fittings Connections. Female plastic screwed fittings shall be used with plastic male fittings and plastic male threads. Female plastic threaded connections shall not be allowed to be used when threaded onto a male metallic connection.

SUBSTANTIATION:
It is common practice for installers to use female plastic fittings in installations where a male metal outlet is. This is common on condensate pans and HVAC units. It is often use at water services where a metal nipple is used. This issue is that this type of installation often cracks and then leaks or floods. When the female fitting is over tightened (which is hard not to do as there is no way to really torque it) it creates a stress on the fitting. Plastic products relieve stress by cracking. It is also important that this be in the general regulations as a clearly prohibited practice.
Proposals

Item #: 077
UMC 2024  Section: 310.7.1

SUBMITTER: Amie Rodio
Self

RECOMMENDATION:
Add new text

310.0 Condensate Wastes and Control.

310.7.1 ABS/PVC Transition Connections. Except as provided in the plumbing code, PVC and ABS pipe and fittings shall not be solvent welded to any other unlike material.

SUBSTANTIATION:
The current language allows for a single transition from ABS to PVC or PVC to ABS exterior of the structure. Transition glue is not being represented to be allowable to make transition joints between ABS and PVC anywhere in the building. This code change clarifies that this practice is not approved. I have seen residences where the below slab plumbing was PVC and then the above slab plumbing all PVC with the joints being made with transition glue. This is an improper use of the product. It is important that this be in the general regulations as a prohibited practice.
Proposals

Item #: 078

UMC 2024  Section: 311.2 - 311.4

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

311.0 Heating or Cooling Air System.

311.2 Air Filters. Air filters shall be installed in a heating, cooling, or makeup air system. Media-type air filters shall comply with UL 900. Electrostatic and high efficiency particulate filters shall comply with Section 936.0.

Exceptions:
(1) Air filters used in systems serving single guest rooms or dwelling units shall not be required to be a listed filter.
(2) Air filters used in listed appliances and in accordance with the manufacturer’s instructions.

311.3 Prohibited Sources. Outside or return air for a heating or cooling air system shall not be taken from the following locations:
(1) Less than 10 feet (3048 mm) in distance from an appliance vent outlet, a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside-air inlet.
(2) Less than 10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway.
(3) A hazardous or insanitary location, or a refrigeration machinery room as defined in this code.
(4) An area, the volume of which is less than 25 percent of the entire volume served by such system, unless there is a permanent opening to an area the volume of which is equal to 25 percent of the entire volume served.

Exception: Such openings where used for a heating or cooling air system in a dwelling unit shall be permitted to be reduced to not less than 50 percent of the required area, provided the balance of the required return air is taken from a room or hall having not less than three doors leading to other rooms served by the furnace.
(5) A closet, bathroom, toilet room, kitchen, garage, boiler room, furnace room, or unconditioned attic.
(6) Rooms or spaces containing a fuel-burning appliance therein. Where such room or space serves as source of return-air.

Exceptions:
(1) This shall not apply to fireplaces, fireplace appliances, residential cooking appliances, direct vent appliances, enclosed furnaces, and domestic-type clothes dryers installed within the room or space.
(2) This shall not apply to a gravity-type or listed vented wall heating or cooling air system.
(3) This shall not apply to a blower-type heating or cooling air system installed in accordance with the following requirements:
(a) Where the return air is taken from a room or space having a volume exceeding 1 cubic foot (0.03 m³) for each 10 Btu/h (0.003 kW) fuel input rating of fuel-burning appliances therein.
(b) Not less than 75 percent of the supply air is discharged back into the same room or space.
(c) Return-air inlets shall not be located within 10 feet (3048 mm) from an appliance firebox or draft diverter in the same enclosed room or confined space.
(7) Return air shall not be taken from indoor swimming pool enclosures and associated deck areas.

Exceptions:
(a) Where the air from such spaces is dehumidified.
(b) Dedicated HVAC systems serving only such spaces.
(8) Return air from one dwelling unit shall not discharge into another dwelling unit through the heating or cooling air system.

311.4 Return-Air Limitations. Return air from one dwelling unit shall not discharge into another dwelling unit through the heating or cooling air system.
SUBSTANTIATION:
The current wording in Section 311.2 is incorrect and misleading as it can be interpreted that air filters are not required to be installed in dwelling units. The exception is being corrected to clarify that air filters are indeed required in dwelling units, but they do not need to be listed.

Additional return air limitations are also being added to Section 311.3 to address missing return air prohibited sources, such as swimming pool enclosures, garages, boiler rooms, furnace rooms, and unconditioned attics. Section 311.4 is also being combined with Section 311.3 since they cover the same topic.
Proposals

Item #: 079
UMC 2024  Section: 311.2.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Add new text

311.2 Air Filters. Air filters shall be installed in a heating, cooling, or makeup air system. Media-type air filters shall comply with UL 900. Electrostatic and high efficiency particulate filters shall comply with Section 936.0.

Exceptions:
(1) Systems serving single guest rooms or dwelling units shall not require a listed filter.
(2) Air filters used in listed appliances and in accordance with the manufacturer’s instructions.

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

SUBSTANTIATION:
This code change would make air filters with a MERV of 13 or higher the requirement based on the ASHRAE measurement scale test method. MERV 13 air filters or better are already required by many jurisdictions. Since 2019, California Title 24, Part 6 has had the MERV 13 requirement for air filters. Many jurisdictions require MERV 14 rating in central ventilation systems. MERV 13 filters are beneficial because they are able to remove particles of lower-rated filters, plus smoke, bacteria, droplet nuclei (from a sneeze), smog, and aerosols. Indoor air pollution can cause health problems and one of the best ways to lower the risk of airborne contaminants in occupied spaces is to comply with the MERV 13 requirement. The AHJ can still require other minimum MERV ratings as necessary on a case-by-case basis.
Proposals

Item #: 080

UMC 2024  Section: 313.0 - 313.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

313.0 Hangers, and Supports, and Anchors.

313.1 General. Piping, tubing, appliances, and appurtenances shall be supported in accordance with this code, the manufacturer’s installation instructions, and in accordance with the Authority Having Jurisdiction. Seismic restraints shall be as required by the building code.

313.2 Material. Hangers, supports, and anchors shall be of sufficient strength to support the weight of the pipe or tubing and its contents. Piping or tubing shall be isolated from incompatible materials.

SUBSTANTIATION:
The proposed text is adding seismic restraints to ensure these provisions are not overlooked when designing in areas prone to seismic conditions. Additionally, Section 313.0 and Section 313.2 are being modified as the sections address hangers, supports, and anchors.
Proposals

Item #: 081
UMC 2024  Section: 313.1, Table 1701.1

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

313.0 Hangers and Supports.
313.1 General. Piping, tubing, appliances, and appurtenances shall be supported in accordance with this code, the manufacturer's installation instructions, and in accordance with the Authority Having Jurisdiction. Pipe hangers, supports, and anchors used for fuel gas shall be in accordance with Section 1310.3.5. Pipe support hangers and hooks shall comply with IAPMO PS 95.

(below shown for reference only)

1310.3.5 Hangers, Supports, and Anchors. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and equipment and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of MSS SP-58. [NFPA 54:7.2.6.1]

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<td>IAPMO PS 95-2018</td>
<td>Pipe Support Hangers and Hooks</td>
<td>Hangers and Supports</td>
<td>313.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO PS 95 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Pipe hangers and supports must meet the requirements of Section 1310.3.5 for fuel gas piping, which references MSS SP-58, or IAPMO PS 95 for support handers and hooks. Therefore, a reference to Section 1310.3.5 and the IAPMO PS 95 standard are being added for completeness.
Proposals

Item #: 082

UMC 2024 Section: 314.1, Table 1701.1

SUBMITTER: Benjamin Lipscomb
National Comfort Institute

RECOMMENDATION:
Revise text

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
(6) National Balancing Council Procedural Standards
(7) National Comfort Institute Air Balancing Procedures (air balancing for systems up to 20 tons capacity)
(8) National Comfort Institute Residential Air Balance Procedural Standards (air balancing for residential systems)

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<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
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<tr>
<td>NCI-2015</td>
<td>National Comfort Institute Air Balancing Procedures</td>
<td>Balancing</td>
<td>314.1(7)</td>
</tr>
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</table>

Note: The NCI standards do not meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

Note: The NBC standard was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
National Comfort Institute has certified thousands of test and balance professionals nationwide and has over 1,600 individuals with currently active TAB certifications. The omission of NCI and NBC standards in IAPMO UMC 2021 puts these professionals at a disadvantage when their credentials are questioned due to the absence of NCI/NBC in the mechanical code. We understand that the UMC does not designate required TAB certifications, but rather acceptable methods. Therefore, we are submitting our TAB procedures for inclusion in the list of acceptable methods. The attached NCI-NBC IAPMO UMC Code Inclusion Letter provides additional background and context for our proposal. Please start with this attachment when reviewing our proposal.

[Supporting documentation is provided in KAVI for TC review]
Proposals

Item #: 083

UMC 2024  Section: 314.2

SUBMITTER: Phil Pettit  
Control Air Conditioning Corporation  
Rep. Self

RECOMMENDATION:
Add new text

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

314.2 Air System Balancing. Each supply air outlet and zone terminal device shall be equipped with means for air balancing. Discharge dampers used for air system balancing shall not be used on constant air volume (CAV) fans and variable air volume (VAV) fans with motors 10 hp (7.5 kW) or more. Air systems shall be balanced in a manner to minimize throttling losses. For fans with system power exceeding 1 hp (0.74 kW), the fan speed shall be adjusted to meet design flow conditions.

Exceptions: Damper throttling shall be permitted for air system balancing with fan motors of 1 hp (0.74 kW) or less.

SUBSTANTIATION:
Additional air balancing conditions are being added to expand on the UMC section for balancing (Section 314.0). Air balancing is common across the country and is enforced on new HVAC installations due to code and utility program changes. In some areas, air balancing requirements are stretched to meet minimum compliance while others are strictly followed. In some mechanical designs, you will find a Variable Air Volume (VAV) system. This is the opposite of a Constant Air Volume (CAV) system. A VAV system will condition (heat or cool) a space by varying the airflow and using a constant temperature, while a CAV system conditions a space with a constant air flow and varying temperature. VAV and CAV boxes will have different balance procedures and the additional requirements will assist in calibrating boxes to meet design CFM requirements.
Proposals

Item #: 084

UMC 2024  Section: 314.2, Table 1701.1

SUBMITTER: Lance MacNevin, P.Eng.
        Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

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

314.2 Hydronic System Balancing. Hydronic systems shall be equipped with means for balancing and flow control in accordance with Chapter 12 of this code or the Uniform Solar, Hydronics and Geothermal Code (USHGC).

| TABLE 1701.1
| REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

Note: IAPMO/ANSI USHGC 1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 314.1 states that hydronic systems shall be balanced, however, there is no direction for locating such requirements. Chapter 12 of the UMC and Chapters 3 and 4 of the Uniform Solar, Hydronics and Geothermal Code (USHGC) contain hydronic system balancing requirements. Therefore, it is recommended that the UMC send users of the code to UMC Chapter 12 or the USHGC for balancing requirements for hydronic systems.
Proposals

Item #: 085
UMC 2024  Section: 315.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

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.

SUBSTANTIATION:
The above ASCE standard is being deleted as the promulgator will not provide IAPMO with a copy of their standard as required in accordance with Section 5.0 of the IAPMO Guidelines for Referencing Mandatory Standards. The ASCE standard should be deleted as it cannot be reviewed for applicability. For informational purposes, Section 5.0 of the Guidelines for Referencing Mandatory Standards is shown as follows: “5.0 Procedure for Updating Mandatory Standards. Standards shall be kept current with that of the source document by administratively sending requests for updates to the standard promulgator. Updates shall be accomplished via a proposal or a comment during the regular revision process of the document.”
Proposals

Item #: 086
UMC 2024  Section: 316.6, Table 1701.1

SUBMITTER: Bruce A Pfeiffer  
Retired - City of Topeka

RECOMMENDATION:
Revise text

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

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 1 1/2 inches (38 mm) beyond the outside diameter of the pipe or tubing. Steel nail plates shall be in accordance with IAPMO IGC 193. Fuel gas piping shall be protected in accordance with Exception: See Section 1310.4.3.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 193-2019</td>
<td>Safety Plates, Plate Straps, Notched Plates and Safety Collars</td>
<td>Safety Plates</td>
<td>316.6</td>
</tr>
</tbody>
</table>

( порtions of table not shown remain unchanged)

Note: IAPMO IGC 193 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The section is being revised to add the existing standard for safety plates for the protection of concealed pipes running through the framing of a building. These plates are used in the industry on a daily basis and the standard will ensure such plates meet minimum safety requirements. Additionally, fuel gas tubing is required to be protected by specific requirements in Section 1310.4.3 which may include steel plates. Therefore, not an exception.
Proposals

Item #: 087
UMC 2024 Section: 317.2, 317.2.1

SUBMITTER: Armando Barragan
Self

RECOMMENDATION:
Revise text

317.0 Trenching, Excavation, and Backfill.

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. The length of the tunneling shall be the distance required to clear the obstacle above. 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.

317.2.1 Tunnels. Pipe installed in tunnels via tunneling or jacking shall be protected from uneven loading. Supporting structures, walls, and ceilings shall be designed to withstand the earth loads and account for earth movement and settling.

SUBSTANTIATION:
Where pipe is to be installed by jacketing or tunneling to clear a slab, driveway, or other paved area, such tunnels should not be longer than necessary, as it is difficult to refill with the appropriate backfill in longer tunnels. Furthermore, a new section is being added to address the earth loads that must be taken into account for any tunneling and to account for any earth settlement in order to protect the piping within.
Proposals

Item #: 088

UMC 2024  Section: Chapter 4, Table 1701.1

SUBMITTER: IAPMO Staff - Update Extracts
ASHRAE 62.1 Extract Update

RECOMMENDATION:
Revise text

402.2 Natural Ventilation Procedure. Natural ventilation systems shall be comply with the requirements of either Section 402.2.1 through Section 402.2.1.6(A) or Section 402.2.2. Designers shall provide interior air barriers, insulation, or other means that separate naturally ventilated spaces from mechanically cooled spaces to prevent high-dew-point outdoor air from coming into contact with mechanically cooled surfaces. [ASHRAE 62.1:6.4]

402.2.1 Prescriptive Compliance Path. Any zone designed in accordance with this section for natural ventilation shall include a mechanical ventilation system 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:
   (1) Zones in buildings that have all of the following:
      (a) Natural ventilation openings that comply with the requirements of Section 402.2.1 through Section 402.2.1.6 and are permanently open or have controls
      (b) Controls that prevent the natural ventilation openings from being closed during periods of expected occupancy, or natural ventilation openings that are permanently open.
   (2) Zones that are not served by heating or cooling equipment. [ASHRAE 62.1:6.4.1]

402.2.1.1 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 parallel to the floor, the ceiling height \( H \) to be used in Section 402.2.3 through Section 402.2.5 shall be the minimum ceiling height in the zone.

402.2.1.2 Floor Area to be Ventilated. Spaces, or portions of spaces, to be the naturally ventilated area in zones or portions of zones shall be located within extend from the openings to a distance based on the ceiling height, as determined in accordance with Section 402.2.1.1, Section 402.2.1.3, Section 402.2.2, Section 402.2.2.1, Section 402.2.2.2, or Section 402.2.2.3. For spaces with operable wall openings shall be in accordance with the requirements of Section 402.2.2.2. For spaces with ceilings that are not parallel to the floor, the ceiling height shall be determined in accordance with Section 402.2.1.1. [ASHRAE 62.1:6.4.1.2]

402.2.1.3 Single Side Opening. For spaces with operable openings only one side of the space zone, the naturally ventilated area shall extend to a distance not greater than 2 times the height of the ceiling from the operable openings shall be not more than 2 \( H \), where \( H \) is the ceiling height. [ASHRAE 62.1:6.4.1.3]

402.2.1.4 Double Side Opening. For spaces with operable openings on two opposite sides of the space zone, the naturally ventilated area shall extend between distance from the operable openings shall be not more than 5 \( H \), where \( H \) is the ceiling height separated by a distance not greater than 5 times the height of the ceiling. [ASHRAE 62.1:6.4.1.4]

402.2.1.5 Corner Openings. For spaces with operable openings on two adjacent sides of a space zone, the distance from the operable openings shall be not more than 5\( H \) 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 6.4.1.5]

### 402.2.2 Location and Size of Openings

Spaces or portions of spaces served by the ventilation system shall be have a permanently open airflow path to openings directly connected to the outdoors. The minimum flow rate to the zone shall be determined in accordance with Section 403.2.1. 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). This flow rate shall be used to determine the required openable area of openings, accounting only for buoyancy-driven flow. Wind-driven flow shall be used only where it can be demonstrated that the minimum flow rate is provided during all occupied hours. Openings shall be sized in accordance with Section 402.2.1.6(A). Permanently open airflow path shall include, but not be limited to, pathways that would allow airflow unimpeded by partitions, walls, and furnishings. [ASHRAE 62.1:6.4.2 6.4.1.6]

### 402.2.1.6(A) Sizing Openings

Where the zone is ventilated using a single opening or multiple single openings located at the same elevation, the openable area as a percent of the net occupiable floor area shall be greater than or equal to the value indicated in Table 402.2.6.1(1). Where the zone is ventilated using two openings located at different elevations or multiple pairs of such openings, the openable area as a percent of the net occupiable floor area shall be greater than or equal to the value indicated in Table 402.2.6.1(2).

Where openings are obstructed by louvers or screens, the openable area shall be based on the net free area of the opening. Where interior zones, or portions of zones, without direct openings to the outdoors are ventilated through adjoining zones, the openable area shall be permanently unobstructed and have a free area of not less than twice the percent of occupiable floor area used to determine the opening size of adjacent exterior zones, or 25 ft² (2.3 m²), whichever is greater. Table 402.2.6.1(1) and Table 402.2.6.1(2) are based on buoyancy-driven flow and shall not address thermal comfort. [ASHRAE 62.1:6.4.1.6]

### 402.2.2 Engineered System Compliance Path

For an engineered natural ventilation system, the following shall be included:

1. Determine hourly environmental conditions, including outdoor air dry-bulb temperature, dew-point temperature, outdoor concentration of contaminants, including PM2.5, PM10, and ozone where data are available; wind speed and direction; and internal heat gains during expected hours of natural ventilation.
2. Determine the effect of pressure losses along natural ventilation airflow paths on the resulting flow rates, including inlet openings, air transfer grills, ventilation stacks, and outlet openings during representative conditions of expected natural ventilation system use.
3. Quantify natural ventilation airflow rates of identified airflow paths accounting for wind induced and thermally induced driving pressures during representative conditions of expected natural ventilation system use.
4. Design to provide outdoor air in quantities sufficient to result in acceptable IAQ as established under Section 403.2.1 or ASHRAE 62.1 during representative conditions of expected natural ventilation system use. [ASHRAE 62.1:6.4.2]

### 402.2.7 Control and Accessibility

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

### 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, except that the ventilation rates from ASHRAE/ASHE 170 shall be used for the occupancy categories, as applicable. [ASHRAE 62.1:6.2.4 6.2.1]

### 403.2.1 Breathing Zone Outdoor Airflow

The outdoor airflow required in the breathing zone (Vbz) 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.

\[ Vbz = Rp^2Pz + Ra^2Az \] (Equation 403.2.1)

Where:

- \( Az \) = zone floor area, the net occupiable floor area of the ventilation zone, square feet (m²).
- \( Pz \) = zone population, the number of people in the ventilation zone during typical usage.
- \( Rp \) = outdoor airflow rate required per person as determined from Table 402.1.
- \( Ra \) = outdoor airflow rate required per unit area as determined from Table 402.1. [ASHRAE 62.1:6.2.2.4 6.2.1.1]

### 403.2.2 Zone Air Distribution Effectiveness

The zone air distribution effectiveness (\( Ez \)) shall be not greater than the default value determined in accordance with Table 403.2.2. [ASHRAE 62.1:6.2.2.2 6.2.1.2]

### 403.2.2.1 Stratified Air Distribution Systems

A stratified air distribution system shall be designed in accordance with Section 403.2.2.1.1 through Section 403.2.2.2.2, or the zone air distribution effectiveness (\( Ez \)) shall be determined in accordance with ASHRAE 62.1. [ASHRAE 62.1:6.2.1.2.1]

### 403.2.2.1.1 Supply Air

Cool air shall be at least 4°F (2°C) less than the average room air temperature. [ASHRAE 62.1:6.2.1.2.1.1]

### 403.2.2.1.2 Return Air

The return air openings or pathways shall be located not less than 9 ft (2.8 m) above the floor. [ASHRAE 62.1:6.2.1.2.1.2]
403.2.2.1 Stratification. The zone shall not contain any devices that mechanically mix the air, and shall be protected from impinging airstreams from adjacent ventilation zones. [ASHRAE 62.1:6.2.1.2.1.3]

403.2.2.2 Personalized Ventilation Systems. A personalized ventilation system shall be designed in accordance with the following subsections, or the zone air distribution effectiveness \( (E_z) \) shall be determined in accordance with ASHRAE 62.1. [ASHRAE 62.1:6.2.1.2.2]

403.2.2.2.1 Personalized Air. The personalized air shall be distributed in the breathing zone and designed such that the velocity is equal to or less than 50 fpm (0.25 m/s) at the head/face region of the occupant. [ASHRAE 62.1:6.2.1.2.2.1]

403.2.2.2.2 Return Air. The return air openings or pathways shall be located more than 9 ft (2.8 m) above the floor. [ASHRAE 62.1:6.2.1.2.2.2]

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]

\[
V_{oz} = \frac{V_{bz}}{E_z} \quad \text{Equation 403.2.3}
\]

403.3 Single-Zone Systems. For ventilation systems where one or more air handlers supply a mixture of outdoor air and recirculated air to only one ventilation zone, the outdoor air intake flow \( (V_{ot}) \) shall be determined in accordance with Equation 403.3. [ASHRAE 62.1:6.2.3]

\[
V_{ot} = V_{oz} \quad \text{Equation 403.3}
\]

403.4 One Hundred Percent Outdoor Air Systems. For ventilation systems where one or more air handlers supply only outdoor air to one or more ventilation zones, the outdoor air intake flow \( (V_{ot}) \) shall be determined in accordance with Equation 403.4. [ASHRAE 62.1:6.2.4]

\[
V_{ot} = S_{all\ zones} V_{oz} \quad \text{Equation 403.4}
\]

403.5 Multiple-Zone Recirculating Systems. For ventilation systems where one or more air handlers supply a mixture of outdoor air and recirculated air to more than one ventilation zone, the outdoor air intake flow \( (V_{ot}) \) shall be determined in accordance with Section 403.5.1 through Section 403.5.2. [ASHRAE 62.1:6.2.4.4]

403.5.1 Uncorrected Outdoor Air Intake. The uncorrected outdoor air intake \( (V_{ou}) \) flow shall be determined in accordance with Equation 403.5.1. [ASHRAE 62.1:6.2.5.1]

\[
V_{ou} = D S_{all\ zones} (R_p\cdot P_z) + S_{all\ zones} (R_a\cdot A_z) \quad \text{(Equation 403.5.1)}
\]

403.5.1.1 Occupant Diversity. The occupant diversity ratio \( (D) \) shall be determined in accordance with Equation 403.5.1.1 to account for variations in population within the ventilation zones served by the system.

\[
D = \frac{P_s}{S_{all\ zones} P_z} \quad \text{(Equation 403.5.1.1)}
\]

Where the system population \( (P_s) \) is the total population in the area served by the system.

**Exception:** Alternative methods to account for occupant diversity shall be permitted, provided that the resulting \( (V_{ou}) \) value is not less than that determined in accordance with Equation 403.5.1. [ASHRAE 62.1:6.2.5.1.1]

403.5.1.2 System Ventilation Efficiency. The system ventilation efficiency \( (E_v) \) shall be determined in accordance with Section 403.5.1.3 for the simplified procedure or Section 404.0 for the alternate procedure. These procedures also establish zone minimum primary airflow rates for VAV systems. [ASHRAE 62.1:6.2.5.2]

403.5.1.3 Simplified Procedure for System Ventilation Efficiency. System ventilation efficiency \( (E_v) \) shall be determined in accordance with Equation 403.5.1.3(1) or Equation 403.5.1.3(2). [ASHRAE 62.1:6.2.5.3]

\[
E_v = 0.88\cdot D + 0.22 \quad \text{for} \quad D < 0.60 \quad \text{[Equation 403.5.1.3(1)]}
\]

\[
E_v = 0.75 \quad \text{for} \quad D = 0.60 \quad \text{[Equation 403.5.1.3(2)]}
\]

403.5.1.4 Zone Minimum Primary Airflow. For each zone, the minimum primary airflow \( (V_{pz-min}) \) shall be determined in accordance with Equation 403.5.1.4. [ASHRAE 62.1:6.2.5.3.2]

\[
V_{pz-min} = V_{oz} \cdot 1.5 \quad \text{(Equation 403.5.1.4)}
\]

403.5.2 Outdoor Air Intake. The design outdoor air intake flow \( (V_{ot}) \) shall be determined in accordance with Equation 403.5.2. [ASHRAE 62.1:6.2.5.4]

\[
V_{ot} = \frac{V_{ou}}{E_v} \quad \text{(Equation 403.5.2)}
\]
403.6 Design for Varying Operating Conditions. Ventilation systems shall be designed to be capable of providing not less than the minimum ventilation rates required in the breathing zone where the zones served by the system are occupied, including all full- and part-load conditions. The minimum outdoor air intake flow shall be permitted to be less than the design value at part-load conditions. [ASHRAE 62.1:6.2.6.4 6.2.5 – 6.2.5.1]

403.6.1 Short-Term Conditions. Where it is known that peak occupancy will be of short duration, ventilation will be varied or interrupted for a short period of time, or both, the design shall be permitted to be based on the average conditions over a time period (T) determined by Equation 403.6.1.

\[
T = \frac{3v}{V_{bz}} \text{ (Equation 403.6.1)}
\]

Where:
\[
T = \text{averaging time period, minutes.}
\]
\[
v = \text{the volume of the ventilation zone where averaging is being applied, cubic foot (m}^3\text{).}
\]
\[
V_{bz} = \text{the breathing zone outdoor airflow calculated in accordance with Equation 403.2.1 and design value of the zone population (Pz), cubic foot per minute (CFM) (m}^3/\text{min).}
\]

Acceptable design adjustments based on this optional provision including the following:
(1) Zones with fluctuating occupancy: The zone population (Pz) shall be permitted to be averaged over time (T).
(2) Zones with intermittent interruption of supply air: The average outdoor airflow supplied to the breathing zone over time (T) shall not be less than the breathing zone outdoor airflow (Vbz) calculated using Equation 403.2.1.
(3) Systems with intermittent closure of the outdoor air intake: The average outdoor air intake over time (T) shall not be less than the minimum outdoor air intake (Vot) calculated using Equation 403.3, Equation 403.4, or Equation 403.5.2 403.5.1 as applicable. [ASHRAE 62.1:6.2.6.2 6.2.5.2]

403.8 Dynamic Reset. The system shall be permitted to be designed to reset the outdoor air intake flow (Vot), the space or ventilation zone airflow (Voz) as operating conditions change, or both. [ASHRAE 62.1:6.2.7 6.2.6]

403.9 Air Classification and Recirculation. Air shall be classified, and its recirculation shall be limited in accordance with Section 403.9.1 through Section 403.9.4. [ASHRAE 62.1:5.18.3.2 Recirculated air shall not be taken from prohibited locations in accordance with Section 311.3.

Air (return, transfer, or exhaust air) leaving each space or location shall be designated at an expected air-quality classification not less than that shown in Table 402.1, Table 403.7, or Table 403.9 or as approved by the Authority Having Jurisdiction. Air leaving spaces or locations that are not listed in Table 402.1, Table 403.7, or Table 403.9 shall be designated with the same classification as air from the most similar space or location listed in terms of occupant activities and building construction. [ASHRAE 62.1:5.18.1]

Exception: Air from spaces where environmental tobacco smoke (ETS) is present. (Classification of air from spaces where ETS is present is not addressed. Spaces that are expected to include ETS do not have a classification listed in Table 402.1.) [ASHRAE 62.1:5.18.1]

403.9.1 Class 1 Air. Recirculation or transfer of Class 1 air to other spaces any space shall be permitted. [ASHRAE 62.1:5.18.3.1]

403.9.2 Class 2 Air. Recirculation of Class 2 air within the space of origin shall be permitted. Recirculation or transfer of Class 2 air to other Class 2 or Class 3 spaces shall be permitted, provided that the other spaces are used for the same or similar purpose or task and involve the same or similar pollutant sources as the Class 2 space. Transfer of Class 2 air to toilet rooms shall be permitted. Recirculation or transfer of Class 2 air to Class 4 spaces shall be permitted. Class 2 air shall not be recirculated or transferred to Class 1 spaces. Where When using an energy recover device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air, and the recirculated-Exhaust air transfer ratio of Class 2 air shall not exceed 10 percent of the outdoor air intake flow at the design static pressure differential as defined in AHRI 1060. [ASHRAE 62.1:5.18.3.2 5.18.3.2 – 5.18.3.2.5]

403.9.3 Class 3 Air. Recirculation of Class 3 air within the space of origin shall be permitted. Class 3 air shall not be recirculated or transferred to any other spaces. Where When using an energy recover device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air, and the recirculated-Exhaust air transfer ratio of Class 3 air shall not exceed 5 percent of the outdoor air intake flow at the design static pressure differential as defined in AHRI 1060. [ASHRAE 62.1:5.18.3.3 5.18.3.3 – 5.18.3.3.2]

403.9.4 Class 4 Air. Class 4 air shall not be recirculated or transferred to any other space or be recirculated within the space of origin. [ASHRAE 62.1:5.18.3.4]

404.1 General System Ventilation Efficiency. This section presents an alternative procedure for calculating the system ventilation efficiency (Ev) for multiple zone recirculating systems that shall be used when Section 403.5.1.3 is not used: The system ventilation efficiency shall equal the lowest zone ventilation efficiency among the ventilation zones.
served by the air handler in accordance with Equation 404.1. [ASHRAE 62.1:A1.3] This section presents an alternative procedure for calculating the system ventilation efficiency \((Ev)\) for multiple zone recirculating systems that shall be used when Section 403.5.1.3 is not used.

\[
Ev = \text{minimum } (Ev_z) \text{ (Equation 404.1)}
\]

**404.2 Average Outdoor Air Fraction.** The average outdoor air fraction \((X_s)\) for the ventilation system shall be determined in accordance with Equation 404.2.

\[
X_s = \frac{V_{ou}}{V_{ps}} \text{ (Equation 404.2)}
\]

The uncorrected outdoor air intake \((V_{ou})\) shall be determined in accordance with Section 403.5.1, and the system primary airflow \((V_{ps})\) shall be determined at the condition analyzed. [ASHRAE 62.1:A1.1]

**404.3 Zone Ventilation Efficiency.** The zone ventilation efficiency \((Ev_z)\) shall be determined in accordance with Section 404.3.1 or Section 404.3.2. [ASHRAE 62.1:A1.2]

**404.3.1 Single Supply Systems.** For single supply systems, where all of the air supplied to each ventilation zone is a mixture of outdoor air and system-level recirculated air, zone ventilation efficiency \((Ev_z)\) shall be determined in accordance with Equation 404.3.1. Examples of single supply systems include constant-volume reheat, single-duct VAV, single-fan dual-duct, and multizone-systems.

\[
Ev_z = 1 + X_s - Z_{pz} \text{ (Equation 404.3.1)}
\]

The average outdoor air fraction for the system \((X_s)\) shall be determined in accordance with Equation 404.2, and the primary outdoor air fraction for the zone \((Z_{pz})\) shall be determined in accordance with Equation 404.3.1. [ASHRAE 62.1:A1.2.1]

\[
Z_{pz} = \frac{V_{oz}}{V_{pz}} \text{ (Equation 404.3.1)}
\]

For VAV systems, \(V_{pz}\) is the lowest zone primary airflow value expected at the design condition analyzed.

**404.3.2 Secondary-Recirculation Systems.** For secondary-recirculation systems where the supply air or a portion thereof to each ventilation zone is recirculated air (air that has not been directly mixed with outdoor air) from other zones, zone ventilation efficiency \((Ev_z)\) shall be determined in accordance with Equation 404.3.2(1). Examples of secondary-recirculation systems include dual-fan dual-duct and fan-powered mixing-box systems, and systems that include transfer fans for conference rooms.

[Equation 404.3.2(1)]

\[
Ev_z = \frac{(F_a + X_s \cdot F_b - Z_{pz} \cdot E_p \cdot F_c)}{F_a} \text{ (Equation 404.3.2(2))}
\]

The system air fractions \(F_a, F_b, \text{ and } F_c\) shall be determined in accordance with Equation 404.3.2(2), Equation 404.3.2(3), and Equation 404.3.2(4), as applicable.

\[
F_a = E_p + (1 - E_p) \cdot E_r \text{ (Equation 404.3.2(2))}
\]

\[
F_b = E_p \text{ (Equation 404.3.2(3))}
\]

\[
F_c = 1 - (1 - E_z) \cdot (1 - E_r) \cdot (1 - E_p) \text{ (Equation 404.3.2(4))}
\]

The zone primary air fraction \((E_p)\) shall be determined in accordance with Equation 404.3.2(5). For single-zone and single-supply systems \(E_p\) shall equal to 1.0. The zone secondary recirculation fraction \((E_r)\) shall be determined by the designer based on system configuration. The zone air distribution effectiveness \((E_z)\) shall be determined in accordance with Section 403.2.2.

\[
F_a = E_p + (1 - E_p) \cdot E_r \text{ (Equation 404.3.2(2))}
\]

\[
F_b = E_p \text{ (Equation 404.3.2(3))}
\]

\[
F_c = 1 - (1 - E_z) \cdot (1 - E_r) \cdot (1 - E_p) \text{ (Equation 404.3.2(4))}
\]

\[
E_p = \frac{V_{pz}}{V_{dz}} \text{ (Equation 404.3.2(5))}
\]
Where:

\( A_z \) = Zone floor area: The net occupiable floor area of the ventilation zone, \( \text{ft}^2 (\text{m}^2) \).

\( D \) = Occupant diversity: The ratio of the system population to the sum of the zone populations.

\( E_p \) = Primary air fraction: The fraction of primary air in the discharge air to the ventilation zone.

\( E_r \) = Secondary recirculation fraction: In systems with secondary recirculation of return air, the fraction of secondary recirculated air to the zone that is representative of average system return air rather than air directly recirculated from the zone.

\( E_v \) = System ventilation efficiency: the efficiency with which the system distributes air from the outdoor air intake to the breathing zone in the ventilation-critical zone, which requires the largest fraction of outdoor air in the primary airstream.

\( E_{vz} \) = Zone ventilation efficiency: The efficiency with which the system distributes air from the outdoor air intake to the breathing zone in any particular ventilation zone.

\( E_z \) = Zone air distribution effectiveness: A measure of the effectiveness of supply air distribution to the breathing zone.

\( E_z \) is determined in accordance with Section 403.2.2.

\( F_a \) = Supply air fraction: The fraction of supply air to the ventilation zone from sources or air outside the zone.

\( F_b \) = Mixed air fraction: The fraction of supply air to the ventilation zone from fully mixed primary air.

\( F_c \) = Outdoor air fraction: The fraction of outdoor air to the ventilation zone from sources of air outside the zone.

\( P_s \) = System population: the simultaneous number of occupants in the area served by the ventilation system.

\( P_z \) = Zone population: see Section 403.2.1.

\( P_{pa} \) = People outdoor air rate: see Section 403.2.1.

\( V_{bz} \) = Breathing zone outdoor airflow: see Section 403.2.1.

\( V_{dz} \) = Zone discharge airflow: The expected discharge (supply) airflow to the zone that includes primary airflow and secondary recirculated airflow, CFM (m³/min).

\( V_{ot} \) = Outdoor air intake flow: see Section 403.3, Section 403.4, and Section 403.5.2.

\( V_{ou} \) = Uncorrected outdoor air intake: see Section 403.5.1.

\( V_{oz} \) = Zone outdoor airflow: see Section 403.2.3.

\( V_{ps} \) = System primary airflow: The total primary airflow supplied to all zones served by the system from the air-handling unit at which the outdoor air intake is located.

\( V_{pz} \) = Zone primary airflow: The zone primary airflow to the ventilation zone, including outdoor air and recirculated air.

\( X_s \) = Average outdoor air fraction: At the primary air handler, the fraction of outdoor air intake flow in the system primary airflow.

\( Z_{pz} \) = Primary outdoor air fraction: The outdoor air fraction required in the primary air supplied to the ventilation zone prior to the introduction of any secondary recirculation air. [ASHRAE 62.1:A3]

### TABLE 402.1
MINIMUM VENTILATION RATES IN BREATHING ZONE

<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY</th>
<th>PEOPLE OUTDOOR Air Rate ( R_p ) (CFM/person)</th>
<th>AREA OUTDOOR Air Rate ( R_a ) (CFM/ft²)</th>
<th>DEFAULT OCCUPANT DENSITY ( \text{^3} ) (people/1000 ft²)</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANIMAL FACILITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal exam room (veterinary office)</td>
<td>10</td>
<td>0.12</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Animal imaging (MRI/CT/PET)</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal operating rooms</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal postoperative recovery room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal preparation rooms</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal procedure room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal surgery scrub</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
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<td>Large-animal holding room</td>
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<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Necropsy</td>
<td>10</td>
<td>0.18</td>
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<tr>
<td>Small-animal-cage room (static cages)</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (ventilated cages)</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
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<td><strong>CORRECTIONAL FACILITIES</strong></td>
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<td>15</td>
<td>1</td>
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<td><strong>EDUCATIONAL FACILITIES</strong></td>
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</tr>
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<td>0.18</td>
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<td>7.5</td>
<td>0.06</td>
<td>150</td>
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<td>100</td>
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</tr>
<tr>
<td>Music/theater/dance</td>
<td>10</td>
<td>0.06</td>
<td>35</td>
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<td>Laundry rooms within dwelling units</td>
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<td>0.06</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Reception areas</td>
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<td>0.06</td>
<td>30</td>
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</tr>
<tr>
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<td>0.06</td>
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<td>Area (sq ft)</td>
<td>Height (ft)</td>
<td>Volume (cu ft)</td>
<td>Storey</td>
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<td>----------------------------------------------------------------------------</td>
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<td>----------------</td>
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<tr>
<td>Banks or bank lobbies&lt;sup&gt;h&lt;/sup&gt;</td>
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<td>0.06</td>
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<tr>
<td>Bank vaults/safe deposit&lt;sup&gt;h&lt;/sup&gt;</td>
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<tr>
<td>Computer (not printing)&lt;sup&gt;h&lt;/sup&gt;</td>
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<td>Freezer and refrigerated spaces (&lt;50°F)</td>
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<td>0.18</td>
<td>7</td>
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<td>0.18</td>
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<td>Shipping/receiving&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Occupiable storage rooms for dry materials</td>
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<td>1</td>
</tr>
<tr>
<td>Reception areas</td>
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<td>0.06</td>
<td>30</td>
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<td>Telephone/data entry</td>
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<td>Other dental treatment areas</td>
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<td>Courtrooms&lt;sup&gt;h&lt;/sup&gt;</td>
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<td>Legislative chambers&lt;sup&gt;h&lt;/sup&gt;</td>
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<td>0.06</td>
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<td>Libraries</td>
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<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Lobbies&lt;sup&gt;h&lt;/sup&gt;</td>
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<td>0.06</td>
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<tr>
<td>Item</td>
<td>Rate</td>
<td>Density</td>
<td>Area</td>
<td>Notes</td>
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<td>------</td>
<td>---------</td>
<td>------</td>
<td>--------------------------------------------</td>
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<tr>
<td>Places of religious worship(^h)</td>
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<td><strong>RESIDENTIAL</strong></td>
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<td>Common corridors(^h)</td>
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<td>4</td>
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<tr>
<td>Dwelling unit(^h)</td>
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<td>See foot note(^f)</td>
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<td>Sales (except as below)</td>
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<td>15</td>
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<td>Barber shop(^h)</td>
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<td>25</td>
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<td>Beauty and nail salons</td>
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<td>0.12</td>
<td>25</td>
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<td>Coin-operated laundries</td>
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<tr>
<td>Mall common areas(^h)</td>
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<td>0.06</td>
<td>40</td>
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<td>Pet shops (animal areas)</td>
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<td>0.18</td>
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<td>Supermarket(^h)</td>
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<td><strong>SPORTS AND ENTERTAINMENT</strong></td>
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<td>40</td>
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<tr>
<td>Disco/dance floors(^h)</td>
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<td>100</td>
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</tr>
<tr>
<td>Gambling casinos</td>
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<td>0.18</td>
<td>120</td>
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<tr>
<td>Game arcades</td>
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<td>0.18</td>
<td>20</td>
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<tr>
<td>Gym, sports arena (play area)(^h)</td>
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<td>7</td>
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<tr>
<td>Health club/aerobics room</td>
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<td>0.06</td>
<td>40</td>
<td>2</td>
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<tr>
<td>Health club/weight rooms</td>
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<td>0.06</td>
<td>10</td>
<td>2</td>
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<tr>
<td>Spectator areas(^h)</td>
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<td>0.06</td>
<td>150</td>
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<tr>
<td>Stages, studios(^d h)</td>
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<td>0.06</td>
<td>70</td>
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<tr>
<td>Swimming (pool &amp; and deck)(^c)</td>
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<td>0.48</td>
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<td><strong>TRANSIENT RESIDENTIAL</strong></td>
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<td>Common corridors</td>
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<td>0.06</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Dwelling unit</td>
<td>5</td>
<td>0.06</td>
<td>–</td>
<td>1</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.0283 m³/min, 1 square foot = 0.0929 m²

**Notes:**

1. This table applies to no-smoking areas. Rates for smoking-permitted spaces shall be determined using other methods.
2. Volumetric airflow rates are based on dry air density of 0.075 pounds of dry air per cubic foot (lbda/ft³) (1.201 kgda/m³) at a barometric pressure of 1 atm (101 kPa) and an air temperature of 70°F (21°C). Rates shall be permitted to be adjusted for actual density.
3. The default occupant density shall be used where actual occupant density is not known.
4. Where the occupancy category for a proposed space or zone is not listed, the requirements for the listed occupancy category that is most similar in terms of occupant density, activities, and building construction shall be used.

**ITEM-SPECIFIC NOTES FOR TABLE 402.1**

a. For high school and college libraries, the values shown for “Public Assembly Spaces – Libraries” shall be used.

b. Rate may not be sufficient where stored materials include those having potentially harmful emissions.

c. Rate does not allow for humidity control. “Deck area” refers to the area surrounding the pool that is capable of being wetted during pool use or when the pool is occupied. Deck area that is not expected to be wetted shall be designated as an occupancy category.

d. Rate does not include special exhaust for stage effects such as dry ice vapors and smoke.

e. Where combustion equipment is intended to be used on the playing surface or in the space, additional dilution ventilation, source control, or both shall be provided.

f. Default occupancy for dwelling units shall be two persons for studio and one-bedroom units, with one additional person for each additional bedroom.

g. Air from one residential dwelling shall not be recirculated or transferred to other spaces outside of that dwelling.

h. Ventilation air for this occupancy category shall be permitted to be reduced to zero where the space is in occupied-standby mode.
Outpatient facilities to which the rates apply are freestanding birth centers, urgent care centers, neighborhood clinics and physicians offices. Class 1 imaging facilities, outpatient psychiatric facilities, outpatient rehabilitation facilities, and outpatient dental facilities.

The requirements of this table provide for acceptable IAQ. The requirements of this table do not address the airborne transmission of airborne viruses, bacteria, and other infectious contagions.

These rates are intended only for outpatient dental clinics where the amount of nitrous oxide is limited. They are not intended for dental operatories in institutional buildings where nitrous oxide is piped.

### Table 403.7
**Minimum Exhaust Rates [ASHRAE 62.1: Table 6.5 6-2]**

<table>
<thead>
<tr>
<th>Occupancy Category</th>
<th>Exhaust Rate (CFM/unit)</th>
<th>Exhaust Rate (CFM/ft²)</th>
<th>Air Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Animal Facilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal imaging (MRI/CT/PET)</td>
<td></td>
<td>0.90</td>
<td>3</td>
</tr>
<tr>
<td>Animal operating rooms</td>
<td></td>
<td>3.00</td>
<td>3</td>
</tr>
<tr>
<td>Animal postoperative recovery room</td>
<td></td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Animal preparation rooms</td>
<td></td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Animal procedure room</td>
<td></td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Animal surgery scrub</td>
<td></td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Large-animal holding room</td>
<td></td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Necropsy</td>
<td></td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (static cages)</td>
<td></td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (ventilated cages)</td>
<td></td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Arenas²</td>
<td></td>
<td>0.50</td>
<td>1</td>
</tr>
<tr>
<td>Art classrooms</td>
<td></td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>Auto repair rooms¹</td>
<td></td>
<td>1.50</td>
<td>2</td>
</tr>
<tr>
<td>Barber shops</td>
<td></td>
<td>0.50</td>
<td>2</td>
</tr>
<tr>
<td>Beauty and nail salons</td>
<td></td>
<td>0.60</td>
<td>2</td>
</tr>
<tr>
<td>Cells with toilet</td>
<td></td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Copy, printing rooms</td>
<td></td>
<td>0.50</td>
<td>2</td>
</tr>
<tr>
<td>Darkrooms</td>
<td></td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Educational science laboratories</td>
<td></td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Janitor closets, trash rooms, recycling</td>
<td></td>
<td>1.00</td>
<td>3</td>
</tr>
<tr>
<td><strong>Kitchens — commercial</strong></td>
<td></td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>Kitchenettes</td>
<td></td>
<td>0.30</td>
<td>2</td>
</tr>
<tr>
<td><strong>Kitchens — commercial</strong></td>
<td></td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>Locker rooms for athletic, industrial, and health care facilities</td>
<td>– 0.50</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>All other Other locker rooms</td>
<td></td>
<td>0.25</td>
<td>2</td>
</tr>
<tr>
<td><strong>Shower rooms² 20/50</strong></td>
<td></td>
<td>20/50</td>
<td>2</td>
</tr>
<tr>
<td>Paint spray booths⁶</td>
<td></td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>Parking garages³</td>
<td></td>
<td>0.75</td>
<td>2</td>
</tr>
<tr>
<td>Pet shops (animal areas)</td>
<td></td>
<td>0.90</td>
<td>2</td>
</tr>
<tr>
<td>Refrigerating machinery rooms⁶</td>
<td></td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Residential – kitchens⁷</td>
<td></td>
<td>50/100</td>
<td>2</td>
</tr>
<tr>
<td>Soiled laundry storage rooms⁵</td>
<td></td>
<td>1.00</td>
<td>3</td>
</tr>
<tr>
<td>Storage rooms, chemical⁵</td>
<td></td>
<td>1.50</td>
<td>4</td>
</tr>
<tr>
<td>Toilets – private⁵ 25/50</td>
<td></td>
<td>25/50</td>
<td>2</td>
</tr>
</tbody>
</table>
For SI units: 1 cubic foot per minute = 0.0283 m³/min, 1 square foot = 0.0929 m²

Notes:
1. Stands where engines are run shall have exhaust systems that directly connect to the engine exhaust and prevent escape of fumes.
2. Where combustion equipment is intended to be used on the playing surface, additional dilution ventilation, source control, or both shall be provided.
3. Exhaust shall not be required where two or more sides comprise walls that are at least 50 percent open to the outside.
4. Rate is per water closet, urinal, or both. Provide the higher rate where periods of heavy use are expected to occur. The lower rate shall be permitted to be used otherwise.
5. Rate is for a toilet room intended to be occupied by one person at a time. For continuous system operation during normal hours of use, the lower rate shall be permitted to be used. Otherwise the higher rate shall be used.
6. See other applicable standards for exhaust rate.
7. For refrigeration machinery rooms, the exhaust rate shall comply with Chapter 11.
8. For unlisted occupancies for a proposed space not listed in the table, the requirements for the listed occupancy that is most similar in terms of occupant density and occupancy type shall be used.
9. Exhaust air that has been cleaned in accordance with the criteria to meet Class 1 criteria from Section 403.9 shall be permitted to be recirculated.
10. Rate is per shower head.

### TABLE 403.9
**AIRSTREAMS OR SOURCES DESCRIPTION AIR CLASS**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

### TABLE 403.2.2
**ZONE AIR DISTRIBUTION EFFECTIVENESS**

<table>
<thead>
<tr>
<th>AIR DISTRIBUTION CONFIGURATION</th>
<th>Ez</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-Mixed Air Distribution Systems</td>
<td></td>
</tr>
<tr>
<td>Ceiling supply of cool air</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air and floor return</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air 15°F or more above space temperature and ceiling return</td>
<td>0.8</td>
</tr>
<tr>
<td>Ceiling supply of warm air less than 15°F above space temperature and ceiling return provided that the supply air jet velocity is less than 150 feet per minute (fpm) supply air jet reaches to within 4.5 feet of the floor level and ceiling return</td>
<td>4.96-0.8</td>
</tr>
<tr>
<td>Floor supply of cool air and ceiling return provided that the vertical throw is more than 50 fpm at a height of 4.5 feet or more above the floor</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Ceiling supply of warm air less than 15°F above average space temperature where the supply air-jet velocity is equal to or greater than 150 feet per minute (fpm) within 4.5 feet of the floor and ceiling return.

Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification, or underfloor air distribution systems where the vertical throw is 50 fpm or less at a height of 4.5 feet above the floor.

Floor supply of warm air and floor return.

Floor supply of warm air and ceiling return.

Makeup supply drawn in on the opposite side of the room outlet located more than half the length of the space from the exhaust, return, or both.

Makeup supply drawn in near to the outlet located less than half the length of the space from the exhaust, return, or both locations.

**Stratified Air Distribution Systems (Section 403.2.2.1)**

Floor supply of cool air where the vertical throw is greater than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than or equal to 18 feet above the floor.

Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than 18 feet above the floor.

Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height greater than 18 feet above the floor.

**Personalized Ventilation Systems (Section 403.2.2.2)**

Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of cool air and ceiling return.

Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of warm air and ceiling return.

Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with nonaspirating floor supply devices and ceiling return.

Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with aspirating floor supply devices and ceiling return.

Notes:
1 “Cool air” is air cooler than space temperature.
2 “Warm air” is air warmer than space temperature.
3 “Ceiling supply” includes any point above the breathing zone.
4 “Floor supply” includes any point below the breathing zone.
5 As an alternative to using the above values, Ez shall be permitted to be regarded as equal to air change effectiveness determined in accordance with ASHRAE 129 for air distribution configurations except unidirectional flow.
6 For lower velocity supply air, Ez = 0.8

**TABLE 402.2.6.1(1)**
MINIMUM OPENABLE AREAS: SINGLE OPENINGS

<table>
<thead>
<tr>
<th>( V_{bz}/A_z ) = ([L/s]/m^2])</th>
<th>( V_{bz}/A_z ) = ([cfm/ft^2])</th>
<th>TOTAL OPENABLE AREAS IN ZONE AS A PERCENTAGE OF ( A_z )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( HS/WS = 0.1 )</td>
</tr>
<tr>
<td>1.0</td>
<td>0.2</td>
<td>4.0</td>
</tr>
<tr>
<td>2.0</td>
<td>0.4</td>
<td>6.9</td>
</tr>
<tr>
<td>3.0</td>
<td>0.6</td>
<td>9.5</td>
</tr>
<tr>
<td>4.0</td>
<td>0.8</td>
<td>12.0</td>
</tr>
<tr>
<td>5.5</td>
<td>1.1</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Where:

\( V_{bz} \) = breathing zone outdoor airflow, per Table 402.1,

\( A_z \) = zone floor area, the net occupiable floor area of the ventilation zone.

For SI units: °C = (°F-32)/1.8, 1 foot per minute = 0.005 m/s, 1 foot = 304.8 mm.
* Volumetric airflow rates used to estimate required operable area are based on the following:
  • Dry-air density of 0.075 lbda/ft³ (1.2 kgda/m³) at a barometric pressure of 1 atm (101.3 kPa) and an air temperature of 70°F (21°C)
  • Temperature difference between indoors and outdoors of 1.8°F (1°C)
  • Gravity constant of 32.2 ft/s² (9.81 m/s²)
  • Window discharge coefficient of 0.6

### TABLE 402.2.6.1(2)
 MINIMUM OPENABLE AREAS: TWO VERTICALLY SPACED OPENINGS

<table>
<thead>
<tr>
<th>Vbz/Az = (L/s/m²)</th>
<th>Vbz/Az = (cfm/ft²)</th>
<th>TOTAL OPENABLE AREAS IN ZONE AS A PERCENTAGE OF Az</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hvs = 8.2 ft (2.5 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>As/AI = 0.5</td>
</tr>
<tr>
<td>1.0</td>
<td>0.2</td>
<td>2.0</td>
</tr>
<tr>
<td>2.0</td>
<td>0.4</td>
<td>4.0</td>
</tr>
<tr>
<td>3.0</td>
<td>0.6</td>
<td>6.0</td>
</tr>
<tr>
<td>4.0</td>
<td>0.8</td>
<td>8.0</td>
</tr>
<tr>
<td>5.5</td>
<td>1.1</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Where:
- \( V_{bz} \) = breathing zone outdoor airflow, per Table 402.1.
- \( A_z \) = zone floor area, the net occupiable floor area of the ventilation zone.
- \( H_{vs} \) = vertical separation between the center of the top and bottom openings’ free operable area; in case of multiple horizontally spaced pairs of openings, use shortest distance encountered.
- \( A_s \) = openable area of smallest opening (top or bottom); in case of multiple horizontally spaced pairs of top-and-bottom openings, use aggregated areas.
- \( A_l \) = openable area of largest opening (top or bottom); in case of multiple horizontally spaced pairs of top-and-bottom openings, use aggregated areas.

**203.0 – A –**

**Air, Class 1.** Air with low contaminant concentration, low sensory-irritation intensity, and inoffensive odor. [ASHRAE 62.1:5.16.1 5.18.1]

**Air, Class 2.** Air with moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors. Class 2 air also includes air that is not necessarily harmful or objectionable, but that is inappropriate for transfer or recirculation to spaces used for different purposes. [ASHRAE 62.1:5.16.1 5.18.1]

**Air, Class 3.** Air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. [ASHRAE 62.1:5.16.1 5.18.1]

**Air, Class 4.** Air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases, at concentrations high enough to be considered as harmful. [ASHRAE 62.1:5.16.1 5.18.1]

### TABLE 1701.1
 REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)
Note: The AHRI and ASHRAE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 4 is being revised to the latest edition of ASHRAE 62.1-2019, addendum p as published on February 11, 2020.
Proposals

Item #: 089

UMC 2024  Section: 401.1, Table 1701.1, Table 1701.2

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

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. 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 or ASHRAE 62.2.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 62.2-2019</td>
<td>Ventilation and Acceptable Indoor Air Quality in Residential Buildings</td>
<td>Ventilation</td>
<td>401.1</td>
</tr>
</tbody>
</table>

Note: ASHRAE 62.2 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 62.2-2019</td>
<td>Ventilation and Acceptable Indoor Air Quality in Residential Buildings</td>
<td>Ventilation</td>
</tr>
</tbody>
</table>

SUBSTANTIATION:
The requirements for ventilation air rate for dwelling units in residential occupancies can either be in accordance with Section 405.0 of the UMC or ASHRAE 62.2, “Ventilation and Acceptable Indoor Air Quality in Residential Buildings,” as the ASHRAE standard contains provisions for dwelling units in residential occupancies similar to the UMC. This change clarifies the intent of Section 401.1.
Proposals

Item #: 090
UMC 2024 Section: 401.2, Table 1701.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

401.0 General.
401.1 Applicability. (remaining text unchanged)

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

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ANSI USPSHTC 1-2021</td>
<td>Uniform Swimming Pool, Spa and Hot Tub Code</td>
<td>Swimming Pools, Spas, Hot Tubs</td>
<td>401.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO/ANSI USPSHTC 1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Chapter 4 (Ventilation) addresses ventilation for several types of spaces, however, swimming pool ventilation is specifically addressed in the Uniform Swimming Pool, Spa and Hot Tub Code (USPSHTC). Therefore, a section is being added to the beginning of Chapter 4 to reference the USPSHTC, which is an ANSI standard, to provide installation requirements.
Proposals

Item #: 091
UMC 2024  Section: Table 402.1

SUBMITTER: Andrew Klein
A S Klein Engineering, PLLC
Rep. Self Storage Association

RECOMMENDATION:
Revise text

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

<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY(^{4})</th>
<th>PEOPLE OUTDOOR Air Rate (R_p) (CFM/person)</th>
<th>AREA OUTDOOR Air Rate (R_a) (CFM/ft(^2))</th>
<th>DEFAULT OCCUPANT DENSITY(^{3}) (people/1000 ft(^2))</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouses(^{b, i})</td>
<td>10</td>
<td>0.06</td>
<td>–</td>
<td>2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

For SI units: 1 cubic foot per minute = 0.0283 m\(^3\)/min, 1 square foot = 0.0929 m\(^2\)

**Notes:**
1 This table applies to no-smoking areas. Rates for smoking-permitted spaces shall be determined using other methods.
2 Volumetric airflow rates are based on dry air density of 0.075 pounds of dry air per cubic foot (lbda/ft\(^3\)) (1.201 kgda/m\(^3\)) at a barometric pressure of 1 atm (101 kPa) and an air temperature of 70°F (21°C). Rates shall be permitted to be adjusted for actual density.
3 The default occupant density shall be used where actual occupant density is not known.
4 Where the occupancy category for a proposed space or zone is not listed, the requirements for the listed occupancy category that is most similar in terms of occupant density, activities, and building construction shall be used.

**ITEM-SPECIFIC NOTES FOR TABLE 402.1**

a For high school and college libraries, the values shown for “Public Assembly Spaces – Libraries” shall be used.
b Rate may not be sufficient where stored materials include those having potentially harmful emissions.
c Rate does not allow for humidity control. “Deck area” refers to the area surrounding the pool that is capable of being wetted during pool use or when the pool is occupied. Deck area that is not expected to be wetted shall be designated as an occupancy category.
d Rate does not include special exhaust for stage effects such as dry ice vapors and smoke.
e Where combustion equipment is intended to be used on the playing surface or in the space, additional dilution ventilation, source control, or both shall be provided.
f Default occupancy for dwelling units shall be two persons for studio and one-bedroom units, with one additional person for each additional bedroom.
g Air from one residential dwelling shall not be recirculated or transferred to other spaces outside of that dwelling.
h Ventilation air for this occupancy category shall be permitted to be reduced to zero where the space is in occupied-standby mode.
i The occupiable floor area in warehouses does not include the floor area of self-storage units, floor areas under rack storage, or designated palletized storage floor areas.
This proposal clarifies the application of Section 402.1, regarding required minimum outdoor ventilation airflow rates, in storage occupancies. The code is clear that storage rooms do not require ventilation, however, the code language is inconsistently applied when there are storage areas that are not separated from other areas by a solid partition. This code change intends to clarify that fixed storage areas that cannot change without a permit are no different in their fresh air requirements than a closed off storage room. Examples of such floor areas may include those dedicated to high-piled rack storage, self-storage facility units that are not fully partitioned off from interior corridors, and other floor areas that are designated solely for storage. By not considering the volume taken up by storage and the thermal mass it provides in helping with temperature regulation, HVAC equipment is oversized, increasing energy use and limiting the effectiveness of humidity control that properly-sized systems provide. By adding this footnote, the minimum outdoor airflow rates for occupiable space in storage occupancies can be properly calculated and consistently enforced.
Proposals

Item #: 092

UMC 2024  Section: 402.1.2, Table 1701.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Revise text

402.0 Ventilation Air.
402.1 Occupiable Spaces.
402.1.2 Ventilation in Health Care Facilities. Mechanical ventilation for health care facilities shall be designed and installed in accordance with this code, and ASHRAE 170, and NFPA 99.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 99-2021</td>
<td>Health Care Facilities Code</td>
<td>Miscellaneous</td>
<td>402.1.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: NFPA 99 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
It is often difficult to get to the bottom of code-related issues in health care. One root problem is that there is a lot of overlap in the subjects governed by different codes. These codes are continually being updated, but by different individuals with varying interests, and on different update cycles. When it comes to health care facilities, in addition to keeping up-to-date with ASHRAE 170, it is important to understand the latest changes to NFPA 99 (Health Care Facilities Code).

Criteria for both ASHRAE 170 and NFPA 99 focuses on HVAC requirements for medical environments. Ventilation criteria addressed in ASHRAE 170 includes the need for an emergency power supply for continual ventilation, parameters for temperature and humidity ranges, air filtration, and air dispersal/removal locations. HVAC requirements designated by NFPA 99 mostly deal with the necessity to exhaust air from anesthetizing areas continually, while ASHRAE 170 addresses building pressure, air filtration, and infection control. Imaging rooms that house anesthetic gases must also meet the same stringent air change rate requirements as operating rooms.

Building pressure directly affects temperature, humidity, and airflow. HVAC systems must be designed and implemented in such a way as to ensure compliance with both NFPA 99 and ASHRAE 170 requirements. This requires deep level thought during the earliest design stages to arrive at viable solutions.

The design of medical spaces and facilities can offer many design challenges for both HVAC designers and facility owners. Ideally, health care facilities will exceed minimum requirements as laid out by NFPA 99, ASHRAE 170, and associated codes and manuals. By complying with both NFPA 99 and ASHRAE 170 requirements, HVAC system designers, engineers, installers, and maintenance personnel will support the integrity of such systems to maintain ongoing compliance.
Proposals

Item #: 093

UMC 2024  Section: 402.1.3 - 402.1.3.1

SUBMITTER: Mark Lessans
        Johnson Controls

RECOMMENDATION:
Add new text

402.0 Ventilation Air.
402.1 Occupiable Spaces. (remaining text unchanged)

402.1.3 Demand Control Ventilation (DCV). Each occupiable space shall be equipped with a carbon dioxide sensor in accordance with the requirements in Section 402.1.3.1 and Section 402.1.3.3. Mechanical equipment serving each zone(s) shall be equipped with controls in accordance with the requirements in Section 402.1.3.2.

402.1.3.1 Carbon Dioxide Sensor Performance Specifications. Carbon dioxide sensors installed in accordance with Section 402.1.3 shall comply with the following carbon dioxide measurement specifications as certified by the equipment manufacturer:
(1) Range lower bound less than or equal to 400 parts per million.
(2) Range upper bound greater than or equal to 2000 parts per million.
(3) Accuracy within ±75 parts per million at a reading of 1000 parts per million.
(4) Output resolution of 5 parts per million or less.

402.1.3.2 Mechanical System Controls. Controls installed in accordance with Section 402.1.3 shall comply with the following:
(1) Receive data from the carbon dioxide sensor in the occupiable zone(s) at least once per 5 minutes.
(2) Be calibrated to provide pre-established outdoor airflow rates, or be equipped with the necessary instrumentation to measure outdoor airflow.
(3) Be capable of adjusting the outdoor airflow in response to an adjustable outdoor airflow setpoint.
(4) Increase the amount of outdoor air provided to each occupiable zone until the carbon dioxide level in each occupiable zone falls below a maximum threshold as defined by the user.

402.1.3.3 Ventilation Rate Alarming. When carbon dioxide levels are above a maximum level as defined by the user, sensors installed in accordance with Section 402.1.3 shall alert the occupants with a visual and audible indication in the zone or through a building monitoring system.

402.1.3.3.1 Default Carbon Dioxide Threshold Level. The threshold level for carbon dioxide measurement above which triggers an alert in accordance with Section 402.1.3.3 shall be set to 1100 parts per million by default.

SUBSTANTIATION:
Several recently published studies (see [1] and [2] below) have demonstrated that a large portion of indoor occupied spaces do not meet minimum requirements for ventilation as set in ASHRAE Standard 62.1, and have documented the impacts on occupant health, comfort, and productivity. Additionally, providing adequate ventilation is the most effective first step in mitigating the transmission of viruses carried by airborne particulates, an issue that has been highlighted during the COVID-19 pandemic.

This proposal seeks to ensure building occupants have access to adequate ventilation by bringing Demand Control Ventilation (DCV) to each occupiable zone and managing carbon dioxide levels – the best proxy we have for determining inadequate ventilation and/or above-normal occupancy. The proposal requires that every occupiable zone have a basic CO2 sensor, that the CO2 sensor communicate with the building mechanical system, and that the mechanical system be capable of adjusting airflow rates to keep CO2 levels (and therefore ventilation adequacy) within acceptable levels. It also requires that the CO2 sensor notify either the occupants, or the building manager, when ventilation is inadequate. This can be especially helpful first step in helping building occupants...
understand when indoor may be at unhealthy levels and take mitigating action.

If successfully deployed, this proposal would go a long way toward maintaining adequate ventilation, as well as assist in saving energy by preventing over-ventilation of spaces.

Proposals

Item #: 094

UMC 2024  Section: 402.3, 402.3.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

402.0 Ventilation Air.

402.3 Mechanical Ventilation. Where natural ventilation is not permitted by this section or the building code, mechanical ventilation systems shall be designed, constructed, and installed to provide a method of supply air and either return air or exhaust air, or both, as required. 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.

402.3.1 Air Balancing. Air balancing shall be performed on mechanical ventilation systems in accordance with Section 314.0 to meet the ventilation airflow rates of this chapter.

(below shown for reference only)

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

SUBSTANTIATION:
An added reference for air balancing in Chapter 4 (Ventilation Air) is recommended to assist in enforcing the air balancing requirements found in Chapter 3 (General Regulations). The reference is a simple change that improves the code. Additionally, in a mechanical ventilation system, supply air is required, and either return air or exhaust air depending on the requirements for the space.
Proposals

Item #: 095
UMC 2024  Section: 402.3.1 - 402.3.1.2

SUBMITTER: Mark Lessans
Johnson Controls

RECOMMENDATION:
Add new text

402.0 Ventilation Air.

402.3 Mechanical Ventilation. (remaining text unchanged)

402.3.1 Clean Air Delivery Capability. Each mechanical system shall comply with the requirements in Section 402.3.1.1. Each occupiable space shall comply with the requirements in Section 402.3.1.2. Exception: Occupiable spaces where 100 percent of the supply air meets High-Efficiency Particulate Air (HEPA) filtration.

402.3.1.1 Airflow for Increased Filtration. Mechanical systems shall be sized to accommodate a design airflow at a total static pressure drop which assumes the utilization of a supply air filter with a Minimum Efficiency Reporting Value (MERV) of not less than 13.

402.3.1.2 Zonal Filtration or Disinfection Capability. Each occupiable space shall have 120-volt receptacles which provide at least 0.2 watts per square foot of occupiable space above the requirements of NFPA 70 to support supplemental air cleaning devices. Exception: Rooms with less than 500 square feet (46.45 m\(^3\)) of occupiable space shall not be required to comply with Section 402.3.1.2.

Note: NFPA 70 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This proposal seeks to “ready” buildings for retrofits and other changes if indoor clean air delivery needs to be increased – such as in response to mitigating an airborne contaminant – per ASHRAE and CDC guidance on reopening buildings during the COVID-19 pandemic. If the mechanical system is not designed with a MERV 13 filter, it would at least be sized to accommodate the use of one later on without having to redesign or replace the system. This is important, as MERV 13 filters are often at the balance point between filtration effectiveness and energy efficiency. However, these filters are thicker and have a larger airflow resistance when compared to conventional filters, and often existing systems cannot accommodate them. This proposal also requires that occupiable spaces be equipped with the electrical infrastructure needed to increase clean air delivery at the zonal level, such as using a HEPA room air cleaning machine.

Taken together, these requirements will result in a modest increase in construction costs, but this cost pales in comparison to the burden of adding them post-construction.
Proposals

Item #: 096
UMC 2024  Section: 402.4, 402.4.1, 502.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

402.0 Ventilation Air.

402.4 Outdoor Air Intake Protection. Required outdoor air intakes shall be covered with a corrosion-resistant screen or louver having not less than ¼ of an inch (6.4 mm) openings, and shall have not more than ½ 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.

502.0 Termination.

502.1 Exhaust Opening Protection. Exhaust openings terminating to the outdoors shall be covered with a corrosion-resistant screen or louver having not less than 1/4 of an inch (6.4 mm) openings, and shall have not more than 1/2 of an inch (12.7 mm) openings.

Exception: Clothes dryers.

SUBSTANTIATION:
This code change clarifies that either a screen or louver shall be used to cover exhaust openings to the outdoors. Additionally, the language in Section 402.4 (Outdoor Air Intake Protection) is being revised to correlate with Section 502.1 (Exhaust Opening Protection). Simple clean up.
Proposals

Item #: 097

UMC 2024  Section: 403.10

SUBMITTER: Christopher Ruch
National Energy Management Institute Committee (NEMIC)

RECOMMENDATION:
Add new text

403.0 Ventilation Rates.

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

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

(below shown for reference only)

E 802.1 Commissioning Requirements. HVAC commissioning shall be included in the design and construction processes of the project to verify that the HVAC systems and components meet the owner’s project requirements and in accordance with this appendix. Commissioning shall be performed in accordance with this appendix by personnel trained and certified in commissioning by a nationally recognized organization. Commissioning requirements shall include the following:

1. Owner’s project requirements
2. Basis of design
3. Commissioning measures shown in the construction documents
4. Commissioning plan
5. Functional performance
6. Testing
7. Post construction documentation and training
8. Commissioning report

HVAC systems and components covered by this appendix as well as process equipment and controls, and renewable energy systems shall be included in the scope of the commissioning requirements.

SUBSTANTIATION:
Concerns over airborne transmission of pathogens and the benefits of proper ventilation have highlighted the need for verified adequate ventilation. Inadequate ventilation is a recognized and documented concern (See Supporting Material: CEC-500-2020-049). If the ventilation system is not tested, adjusted, and balanced by a skilled, trained, and certified technician the public has little assurance that the ventilation system conforms to design intent. The listed organizations have significant certification programs which ensure the certified technician, and associated contractors, have the knowledgebase and skillset to accurately perform the Air Balance. (See Supporting Material: TAB-Technical-Report-051220) Section E 802.1 (Commissioning Requirements) of the Uniform Mechanical Code set a precedent for similar requirements where an accurate verification of design intent is required.

[Supporting documentation provided in KAVI for TC review]
Proposals

Item #: 098
UMC 2024  Section: 403.7.2, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

403.0 Ventilation Rates.

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

403.7.1 Parking Garages. Exhaust rate for parking garages shall be in accordance with Table 403.7. Exhaust rate shall not be required for enclosed parking garages having a floor area of 1000 square feet (92.9 m²) or less and used for the storage of 5 or less vehicles.

403.7.2 Enclosed Parking Garages. Mechanical ventilation systems for enclosed parking garages shall operate continuously.

Exceptions:
(1) Mechanical ventilation systems shall be permitted to operate intermittently where the system is designed to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices.
(2) Approved automatic carbon monoxide sensing devices, and nitrogen dioxide detectors shall be permitted to modulate the ventilation system to not exceed a maximum average of 50 parts per million of carbon monoxide, or 1 part per million nitrogen dioxide during an eight-hour period with a concentration of not more than 200 parts per million for carbon monoxide, or 5 parts per million nitrogen dioxide, for a period not exceeding 15 minutes. Automatic sensing devices installed in modulated parking garage ventilation systems shall be approved in accordance with Section 301.2. Such sensing devices shall be listed and labeled in accordance with UL 2075 and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 2075-2013</td>
<td>Gas and Vapor Detectors and Sensors (with revisions through December 21, 2017)</td>
<td>Detectors, sensors</td>
<td>403.7.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 2075 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
UL 2075 is being added to this section as the standard provides requirements that apply to gas and vapor detectors and sensors.
403.7 Exhaust Ventilation.

403.7.3 Storage Rooms, Chemical. Mechanical exhaust ventilation for chemical storage rooms containing hazardous substances, including but not limited to, chlorine, chloramines, and chlorine dioxide shall be in accordance with Section 403.7.3.1 through Section 403.7.3.3.

403.7.3.1 Exhaust Inlet Locations. Inlets to exhaust ducts shall be within 1 foot (305 mm) of the lowest point of the room for chemicals that are heavier than air and shall be within 1 foot (305 mm) of the highest point for chemicals that are lighter than air.

403.7.3.2 Discharge. The discharge of the exhaust air shall be to the outdoors.

403.7.3.3 Power to Exhaust Fans. Mechanical exhaust air fans shall be supplied with emergency backup power.

502.0 Exhaust Termination and Inlet Requirements.

502.3 Exhaust Inlet Locations. The inlet to an exhaust system shall be located in the area of heaviest concentration of contaminants and in accordance with Section 502.3.1 through Section 502.3.3.

502.3.1 Fuel-Dispensing Areas. The bottom of an air inlet or exhaust opening in fuel-dispensing areas shall be located not more than 18 inches (457 mm) above the floor.

502.3.2 Refrigeration Machinery Rooms. Inlet locations for refrigeration machinery rooms shall be in accordance with Section 1106.2.4.

502.3.3 Storage Rooms, Chemical. Inlet locations for chemical storage rooms shall be in accordance with Section 403.7.3.

(below shown for reference only)

1106.2.4 Ventilation. Mechanical ventilation referred to in Section 1106.2.3 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 1106.2.5.

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.

SUBSTANTIATION:
A new section for chemical storage rooms is being added to Chapter 4 (Ventilation Air) as the code is currently lacking in ventilation requirements for chemical storage rooms. Section 502.0 is also being revised with exhaust inlet location requirements.
405.0 Indoor Air Quality for Residential Occupancies.

405.3 Bathroom Exhaust. A mechanical exhaust directly to the outdoors shall be provided in each room containing a bathtub, shower, or tub/shower combination. The fan shall run intermittently (on demand) or continuously. A readily accessible manual control designed to be operated as needed or an automatic control shall be provided for intermittent operations.

405.3.1 Exhaust Rate. The exhaust rate shall be not less than 50 ft³/min (0.02 m³/s) for intermittent operation and 25 ft³/min (0.009 m³/s) for continuous operation.

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

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

405.4.1 Exhaust Rate. For intermittent-controlled operations, the exhaust rate shall be not less than 100 ft³/min (0.047 m³/s) for range hoods or 300 ft³/min (0.141 m³/s) for mechanical exhaust fans including downdraft appliances. For continuous operated ventilation, the exhaust rate shall be not less than 5 air changes per hour based on kitchen volume for enclosed kitchens 50 ft³/min (0.02 m³/s).

(below shown for reference only)

TABLE 403.7
MINIMUM EXHAUST RATES
[ASHRAE 62.1: TABLE 6.5]

<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY(^8)</th>
<th>EXHAUST RATE (CFM/unit)</th>
<th>EXHAUST RATE (CFM/ft(^2))</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential – kitchens(^7)</td>
<td>50/100</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Toilets – private(^5,(^9)</td>
<td>25/50</td>
<td>–</td>
<td>2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

516.0 Recirculating Systems.

516.1 General Requirements. Recirculating systems containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:

(1) The clearance requirements of Section 507.4 through Section 507.4.3.3.
(2) A hood complying with the requirements of Section 508.0.
(3) Grease removal devices complying with Section 509.0.
(4) The air movement requirements of Section 511.2.1 and Section 511.2.2.
(5) Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.
(6) Fire-extinguishing equipment complying with the requirements of Section 513.0.
Exception: Fire-extinguishing equipment in accordance with Section 513.1 and Section 513.5.
(7) The use and maintenance requirements of Section 514.0.
(8) The minimum safety requirements of Section 515.0.
(9) All the requirements of Section 516.0. [NFPA 96:13.1]

SUBSTANTIATION:
The code currently allows recirculation systems to be used for kitchen exhaust in Section 516.0 (Recirculating Systems). This change adds an exception to Section 405.4 to clarify that a mechanical exhaust system that discharges directly to the outdoors is not required where a recirculation system in accordance with Section 516.0 is used.

Additionally, there are conflicting exhaust rates for residential kitchens and bathrooms between Table 403.7 and Sections 405.3.1 and 405.4.1. These sections need to be updated to correspond with Table 403.7 to remove the conflicting exhaust rates.
Proposals

Item #: 101
UMC 2024 Section: 406.0, 406.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

406.0 Minimizing Transmission of Diseases and Viruses from Airborne Particles.
406.1 Ultraviolet Light (Lamp) Air Sterilization or Purification Systems. UV-C germicidal lamp systems installed in ductwork shall be listed and labeled in accordance with UL 1995 or UL 60335-2-40, and shall be installed in accordance with the manufacturer’s installation instructions. Germicidal equipment and systems installed in rooms or spaces shall be listed and labeled in accordance with UL 8802 and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 8802-2020</td>
<td>Outline of Investigation for Germicidal Systems</td>
<td>Air purification</td>
<td>406.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1995 and UL 60335-2-40 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

Note: UL 8802 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The need for requirements for air sterilization or purification systems to follow before, during, and after a pandemic has become increasingly apparent. The proposed code change provides requirements for UV light air sterilization or purification systems that can be applied to a building’s mechanical system to minimize transmission of diseases and viruses from airborne particles during a pandemic. UL 8802 has been specifically developed to address the associated risks and hazards for installation within rooms or spaces. Following manufacturer’s installation instructions are critical.
Proposals

Item #: 102

UMC 2024 Section: 406.0 - 406.2

SUBMITTER: Jay Egg
Egg Geothermal

RECOMMENDATION:
Add new text

406.0 Engineering Infection Controls.
406.1 General. The provisions of this section establish a means of reducing and minimizing transmission of diseases and viruses from airborne particles associated with building mechanical systems.

406.2 Heating, Ventilating, and Air-Conditioning Systems. The following engineering infection controls shall be accomplished for the heating, ventilation, and air-conditioning systems and equipment:
(1) Increase ventilation and exhaust rates to greater than the rates found in this chapter.
(2) Maintain continuous operated ventilation to increase air exchanges in the conditioned space to not less than 6 air changes per hour (ACH).
(3) Verify ventilation systems operation and acceptable indoor air quality meets criteria for the current occupancy level for each space.
(4) Disable demand-controlled ventilation (DCV) a minimum of 6 air changes per hour (ACH) and controlled by CO2 concentration controls where available.
(5) Open outdoor air dampers beyond minimum settings to reduce air recirculation - open enough to confirm at least 6 air changes per hour (ACH).
(6) Increase central air filtration to Minimum Efficiency Rating Value (MERV) of 13 or better.
(7) Inspect air filters to ensure they are within service life and appropriately installed.
(8) Install portable high-efficiency particulate air (HEPA) fan/filtration systems in higher risk areas.
(9) Install ultraviolet germicidal irradiation (UVGI) systems.

SUBSTANTIATION:
Protective ventilation practices can reduce the airborne concentration of viral particles, which reduces the overall viral dose to occupants. The proposed section is a list of ventilation practices based on CDC recommendations that can help reduce the concentration of virus particles in the air. While the list is intended to be universally applicable across indoor environments, applying them to different building types, occupancies, and activities under environmental and seasonal changes can be challenging. The specific combination of tools chosen for use at any point in time can change. It will be up to the building owner/operator to identify which tools are appropriate for each building throughout the year.

(4) and (5) According to both the W.H.O and the CDC as quoted in an article by Shelly Miller at the University of Colorado, Boulder.

(6) and (7) Trying to fit the more effective filters into old racks causes gaps and leaks that enable unfiltered air to recirculate.

(9) Although the science is sound, there are some health related concerns if the occupants are exposed to high-energy light, known as UV germicidal irradiation. In the 207- to 222-nm range has been demonstrated to be effective at inactivating airborne aerosolized viruses, while not causing harm to in vivo rodent and in vitro 3-D human skin models. More tests are being done.
507.2.6 Used in Other Applications. Cooking equipment used in fixed, mobile, or temporary concessions, such as trucks, buses, trailers, pavilions, tents, or any form of roofed enclosure, shall comply with this chapter. ([NFPA 96:4.4.9 1.1.3])

507.4.4 Factory Built. Factory-built grease duct enclosures shall be protected with a through-penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an "F" and a "T" rating equal to the fire resistance rating of the assembly being penetrated from the point at which the duct penetrates a ceiling, wall, or floor to the outlet terminal. ([NFPA 96:4.3.3-4.3.4])

507.4.4.1 Listing. The factory-built grease duct protection system shall be listed in accordance with UL 2221. ([NFPA 96:4.3.3-4.3.4.1])

507.4.4.2 Single Wall. Listed single wall factory-built grease ducts shall be permitted to be enclosed with field-applied grease duct enclosure material where the material and the assembly of duct and material are listed for that application and installed in accordance with the grease duct manufacturer’s listing and their installation instructions. ([NFPA 96:4.3.3.2 4.3.4.2])

507.4.4.3 Installation. The factory-built grease duct protection system shall be installed in accordance with the manufacturer's instructions and the listing requirements. ([NFPA 96:4.3.3.3 4.3.4.3])

507.4.5 Field Applied. Field-applied grease duct enclosures shall be protected with a through penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an "F" and a "T" rating equal to the fire resistance rating of the assembly being penetrated. The surface of the field fabricated grease duct shall be continuously covered on all sides from the point at which the duct enclosure penetrates a ceiling, wall, or floor to the outlet terminal. The field-applied grease duct shall be listed in accordance with ASTM E2336 and installed in accordance with the manufacturer’s instructions and the listing requirements. ([NFPA 96:4.3.3-4.3.4.2])

507.4.6 Both Field-Applied and Factory Built. Field-applied grease duct enclosures and factory-built grease duct enclosures shall demonstrate that they provide mechanical and structural integrity, resiliency, and stability where when subjected to expected building environmental conditions, duct movement under general operating conditions, and duct movement due to fire conditions. ([NFPA 96:4.3.4 4.3.5])

507.4.6.2 Specification. The specifications of material, gauge, and construction of the duct used in the testing and listing of field-applied grease duct enclosures and factory-built grease duct enclosures shall be included as minimum requirements in their listing and installation documentation. ([NFPA 96:4.3.5 4.3.6])

507.4.6.3 Clearance Options. The following clearance options for which field-applied grease duct enclosures and factory-built grease duct enclosures have been successfully evaluated shall be clearly identified in their listing and installation documentation and on their labels:

(1) Open combustible construction clearance at manufacturer’s requested dimensions.
(2) Closed combustible construction clearance at manufacturer’s requested dimensions, with or without specified ventilation.
(3) Rated shaft clearance at manufacturer’s requested dimensions, with or without specified ventilation. ([NFPA 96:4.3.6 4.3.7])

507.5 Drawings. For cooking operations in buildings, aA drawing(s) of the exhaust system installation along with copies of operating instructions for subassemblies and components used in the exhaust system, including electrical schematics, shall be kept on the premises and made available on request to the Authority Having Jurisdiction and
508.2 Listed Type I Hood Assemblies. Listed hood assemblies shall be installed in accordance with the terms of their listing and the manufacturer’s instructions. Listed hood assemblies shall be tested in accordance with UL 710, CAN/ULC-S646 for Canada, or equivalent. [NFPA 96: 5.4.1, 5.4.2]

508.2.1 Listed Ultraviolet Hoods. Listed ultraviolet hoods shall be installed and maintained in accordance with the terms of their listing and the manufacturer’s instructions. Duct systems connected to ultraviolet hoods shall comply with Section 510.0. Ultraviolet hoods shall be tested and listed in accordance with UL 710 and UL 749G CAN/ULC-S646 for Canada. [NFPA 96: 5.5 – 5.5.2]

509.1 Grease Removal Devices. Listed grease filters or other listed grease removal devices intended for use with commercial cooking operations shall be provided. Listed grease filters and grease removal devices that are removable but not an integral component of a specific listed exhaust hood shall be listed in accordance with UL 1046 or CAN/ULC-S649 for Canada and shall be designated on the filter. [NFPA 96: 6.1.1, 6.1.2]

509.1.1 Grease Filters, Mesh-Type. Mesh filters shall not be used unless evaluated as an integral part of a listed exhaust hood or listed in conjunction with a primary filter in accordance with UL 1046 or CAN/ULC-S649 for Canada. [NFPA 96: 6.1.3]

510.1 Duct Installation. All ducts shall be installed with a minimum 2 percent slope of ¼ inch per linear foot on horizontal runs up to 75 feet (22 860 mm) and a minimum 8 percent slope of 1 inch per linear foot on horizontal runs greater than 75 feet (22 860 mm). Factory-built grease ducts shall be permitted to be installed at a lesser slope in accordance with the listing and the manufacturer’s instructions. All horizontal ducts shall be provided with access in accordance with Section 510.3.3.

Drains shall be provided at low points in horizontal ducts. Where provided, drains shall be continuously welded to the exhaust duct or in accordance with the terms of the listing and the manufacturer’s installation manual.

All ducts shall be installed without forming dips or traps. In manifold (common duct) systems, the lowest end of the main duct shall be connected flush on the bottom with the branch duct. [NFPA 96: 7.1.4 – 7.1.4.5, 7.1.5-7.1.5.5]

510.1.4 Accessibility. Openings required for accessibility shall comply with Section 510.3 through Section 510.3.2. [NFPA 96: 7.1.5, 7.1.6]

510.1.5 Sign. A sign stating the following shall be placed on all access panels: ACCESS PANEL – DO NOT OBSTRUCT [NFPA 96: 7.1.6, 7.1.7]

510.1.7 Type I Exhaust Duct Systems. Listed grease ducts shall be installed in accordance with the terms of their listing and the manufacturer’s instructions. [NFPA 96: 7.1.7 – 7.1.8]

510.3 Access for Cleaning and Inspection. Exhaust fans with ductwork connected to both sides shall have access for cleaning and inspection within 3 feet (914 mm) of each side of the fan. Wall-mounted exhaust fans shall have access for cleaning and inspection within 3 feet (914 mm) of the exhaust fan. [NFPA 96: 7.3.7, 7.3.8, 7.3.9]

510.4 Listed Grease Ducts. Listed grease ducts shall be installed in accordance with the terms of the listing and the manufacturer’s instructions. [NFPA 96: 7.4 – 7.1.8]

510.5 Factory-Built Grease Ducts. Factory-built grease ducts listed in accordance with UL 1978 or CAN/ULC-S662 for Canada shall be permitted to use materials in accordance with their listing. [NFPA 96: 7.5.1.2]

510.5.3 Installation. All seams, joints, penetrations, and duct-to-hood collar connections shall have a liquid-tight continuous external weld. [NFPA 96: 7.5.2.1]

Exceptions:
(1) Factory-built grease ducts listed in accordance with UL 1978 or CAN/ULC-S662 for Canada shall be permitted to incorporate nonwelded joint construction in accordance with their listings. [NFPA 96: 7.5.2.1.1]
(2) Duct-to-hood collar connections as shown in Figure 510.5.3 shall not require a liquidtight continuous external weld. [NFPA 96: 7.5.2.2]

510.5.3.2 Welded Duct Connection. Acceptable duct-to-duct connection shall be as follows:
(1) Telescoping joint, as shown in Figure 510.5.3.2(1).
(2) Bell-type joint, as shown in Figure 510.5.3.2(2).
(3) Flange with edge weld, as shown in Figure 510.5.3.2(3).
(4) Flange with filled lap joint weld, as shown in Figure 510.5.3.2(4). [NFPA 96: 7.5.5.1]

510.6 Exterior Installations. For cooking operations in buildings, the exterior portion of the ductwork shall be vertical wherever possible and shall be installed and supported on the exterior of a building. Bolts, screws, rivets, and other mechanical fasteners shall not penetrate duct walls. Clearance of ducts shall comply with Section 507.4 through Section 507.4.3.3. [NFPA 96: 7.6.1 – 7.6.3, 7.6.1, 7.6.3, 7.6.4]

510.6.1 Weather Protection. All ducts shall be protected on the exterior by paint or other suitable weather-protective
coating. Ducts constructed of stainless steel shall not be required to have additional paint or weather-protective coatings. Ductwork subject to corrosion shall have minimal contact with the building surface. [NFPA 96:7.6.4 — 7.6.6 7.6.5-7.6.7]

510.9.1 Rooftop Terminations. Rooftop terminations shall be arranged with or provided with the following:

1. A minimum of 10 feet (3048 mm) of horizontal clearance from the outlet to adjacent buildings, property lines, and air intakes.
2. A minimum of 5 feet (1524 mm) of horizontal clearance from the outlet (fan housing) to any combustible structure.
3. A vertical separation of 3 feet (914 mm) above any air intakes within 10 feet (3048 mm) of the exhaust outlet.
4. The ability to drain grease out of any traps or low points formed in the fan or duct near the termination of the system into a collection container that is noncombustible, closed, rainproof, and structurally sound for the service to which it is applied and that will not sustain combustion.
5. A grease collection device that is applied to exhaust systems that does not inhibit the performance of any fan.
6. Listed grease collection systems that are listed in accordance with UL 710A and meet the requirements of Section 510.9.1(4) and Section 510.9.1(5).
7. A listed grease duct complying with Section 507.4.7 or ductwork complying with Section 507.4.8.
8. A hinged upblast fan supplied with flexible weatherproof electrical cable and service hold-open retainer to permit inspection and cleaning that is listed for commercial cooking equipment with the following conditions:
   (a) Where the fan attaches to the ductwork, the ductwork is a minimum of 18 inches (457 mm) away from any roof surface, as shown in Figure 510.9.1.
   (b) The fan discharges a minimum of 40 inches (1016 mm) away from any roof surface, as shown in Figure 510.9.1.
9. Other approved fan, provided it meets all of the following criteria:
   (a) The fan meets the requirements of Section 510.9.1(3) and Section 511.1.3.
   (b) Its discharge or its extended duct discharge meets the requirements of Section 510.9.1(2). (See Section 511.1.3)
   (c) Exhaust fan discharge is directed up and away from the roof surface. [NFPA 96:7.8.2.1]

511.1.3.2 Within the Building. Fans installed within the building shall be in accordance with the following:

1. Located in an accessible area of adequate size to allow for service or removal. [NFPA 96:8.1.4.2]
2. Flexible connectors shall not be used. [NFPA 96:8.1.4.6]
3. Exhaust fans shall have a drain directed to a readily accessible and visible grease receptacle not to exceed 1 gallon (4 L). [NFPA 96:8.1.4.6 8.1.4.7]

511.1.3.3 Duct Systems. Where the duct system connected to the fan is in an enclosure, the space or room in which the exhaust fan is located shall have the same fire resistance rating as the enclosure. The fan shall be connected to the exhaust duct by flanges securely bolted as shown in Figure 511.1.2(1) through Figure 511.1.2(4) or by a system specifically listed for such use. [NFPA 96:8.1.4.3, 8.1.4.4 8.1.4.5]

511.2.3 Exhaust Fan Operation. A hood exhaust fan(s) shall continue to operate after the extinguishing system has been activated unless fan shutdown is required by a listed component of the ventilation system or by the design of the extinguishing system. The hood exhaust fan shall start upon actuation of the extinguishing system if the exhaust fan and all cooking equipment served by the fan have been shut down, unless fan shutdown is required by a listed component of the ventilation system or by the listing of the extinguishing system. The exhaust fan shall be provided with a means so that the fan is activated when any heat-producing cooking appliance under the hood is turned on. [NFPA 96:8.2.3.1 — 8.2.3.3]

513.2.5.4 Activation. Where a separate fire-extinguishing system is used for protection of cooking equipment only, a water-wash fire-extinguishing system listed for protection of the grease removal device, exhaust plenum, exhaust duct, or combination thereof shall be provided with instructions and appropriate means for electrical interface for simultaneous activation. [NFPA 96:10.2.8.5]

513.2.5.5 Water-Wash System. A water-wash system approved to be used for simultaneous protection of the grease removal device, hood exhaust plenum, exhaust duct, or combination thereof shall include instructions and appropriate electrical interface for simultaneous activation of the water-wash system from an automatic fire-extinguishing system, where the automatic fire-extinguishing system is used for cooking equipment protection only. [NFPA 96:10.2.8.6]

513.2.5.6 Exception. Where the automatic fire-extinguishing system in accordance with NFPA 17A provides protection for the hood and duct in a fixed baffle hood containing a water-wash system, the water-wash system shall be made inoperable or delayed for a minimum of 60 seconds upon operation of the automatic fire-extinguishing system. [NFPA 96:10.2.8.7]

513.4 Fuel and Electric Power Shutoff. Upon activation of any fire-extinguishing system for a cooking operation, all sources of fuel and electrical power that produce heat to all equipment requiring protection protected by that system shall automatically shut off. [NFPA 96:10.4.1]

513.4.2 Protection Not Required. Any gas appliance not requiring protection but located under the same ventilation...
513.4.3 Manual Reset. Shutoff devices shall require manual reset resetting prior to fuel or power being restored. [NFPA 96:10.4.4]

513.5 Manual Activation. All systems shall have both automatic and manual methods of actuation. At least one manual actuation device shall be located in a means of egress or at a location acceptable to the Authority Having Jurisdiction.

The manual actuation device shall clearly identify the hazard protected and be provided with instructions for its use. An automatic sprinkler system shall not require a method of manual actuation. [NFPA 96:10.5.1, 10.5.1.1, 10.5.1.2, 10.5.2]

513.6 System Annunciation. Upon activation of an automatic fire-extinguishing system, an audible alarm or visual indicator shall be provided to show that the system has activated. [NFPA 96:10.6.1]

513.6.1 Signaling. Where a fire alarm signaling system is serving the occupancy where the extinguishing system is located, the activation of the automatic fire-extinguishing system shall activate the fire alarm signaling system in accordance with the requirements of NFPA 72. [NFPA 96:10.6.2]

514.1 Operating Procedures. Exhaust systems shall be operated whenever cooking equipment is turned on. [NFPA 96:11.1.1]

514.1.1 Filters. Filter-equipped exhaust systems shall not be operated with filters removed. [NFPA 96:11.1.2]

514.1.2 Openings. Openings provided for replacing air exhausted through ventilating equipment shall not be restricted by covers, dampers, or any other means that would reduce the operating efficiency of the exhaust system. [NFPA 96:11.1.3]

514.1.3 Posting of Instructions. Instructions for manually operating the fire-extinguishing system shall be posted conspicuously in the kitchen and shall be reviewed with employees by the management. [NFPA 96:11.1.4.3]

514.1.4 Listing and Manufacturer’s Instructions. Listed exhaust hoods shall be operated in accordance with the terms of their listings and the manufacturer’s instructions. [NFPA 96:11.1.5]

514.1.5 Nonoperational. Cooking equipment shall not be operated while its fire-extinguishing system or exhaust system is nonoperational or impaired. [NFPA 96:11.1.6]

514.1.6 Secondary Control Equipment. Secondary filtration and pollution control equipment shall be operated in accordance with the terms of its listing and the manufacturer’s recommendations. [NFPA 96:11.1.7]

514.1.7 Inspection Frequency. Inspection and maintenance of “other equipment” as allowed in Section 512.3 shall be conducted by properly trained and qualified persons at a frequency determined by the manufacturer’s instructions or the equipment listing. [NFPA 96:11.1.8]

514.2 Inspection, Testing, and Maintenance. Maintenance of the fire-extinguishing systems and listed exhaust hoods containing a constant or fire-activated water system that is listed to extinguish a fire in the grease removal devices, hood exhaust plenums, and exhaust ducts shall be made by properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction at least every 6 months. [NFPA 96:11.2.1]

514.2.1 Requirements. All actuation and control components, including remote manual pull stations, mechanical and electrical devices, detectors, and actuators, shall be tested for proper operation during the inspection in accordance with the manufacturer’s procedures. The specific inspection and maintenance requirements of the extinguishing system shall be followed. [NFPA 96:11.2.2, 11.2.3]

514.2.2 Fusible Links and Sprinklers. Fusible links of the metal alloy type and automatic sprinklers of the metal alloy type shall be replaced at least semiannually. [NFPA 96:11.2.4]

514.2.3 Inspection Tag. The year of manufacture and the date of installation of the fusible links shall be marked on the system inspection tag. The tag shall be signed or initialed by the installer. Detection devices that are bulb-type automatic sprinklers and fusible links other than the metal alloy type shall be examined and cleaned or replaced annually. [NFPA 96:11.2.5, 11.2.6, 11.2.7]

514.2.4 Temperature-Sensing Elements. Fixed temperature-sensing elements other than the fusible metal alloy type shall be permitted to remain continuously in service, provided they are inspected and cleaned, or replaced if necessary in accordance with the manufacturer’s instructions, every 12 months or more frequently to ensure proper operation of the system. [NFPA 96:11.2.8, 11.2.9]

514.2.5 Certification. Where required, certificates of inspection and maintenance shall be forwarded to the Authority Having Jurisdiction. [NFPA 96:11.2.10]

514.3 Inspection for Grease Buildup. The entire exhaust system shall be inspected for grease buildup by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction and in accordance with Table 514.3. [NFPA 96:11.2.11]

514.4 Cleaning of Exhaust Systems. If, upon inspection, the exhaust system is found to be contaminated with deposits from grease-laden vapors, the contaminated portions of the exhaust system shall be cleaned by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction. [NFPA 96:11.2.12]

514.4.1 Measurement System. A measurement system of deposition shall be established to trigger a need to clean when the exhaust system is inspected at the frequencies in Table 514.3. [NFPA 96:11.2.13]

514.4.1.1 Combustible Contaminants. Hoods, grease removal devices, fans, ducts, and other appurtenances shall be cleaned to remove combustible contaminants to a minimum of 0.002 of an inch (50 µm). [NFPA 96:11.2.14]
514.4.1.2 Gauge Comb. A grease depth gauge comb as shown in Figure 514.4.1.2 shall be placed upon the surface to measure grease depth. [NFPA 96:§ 44.6.1.1.2 12.6.1.1.2]

FIGURE 514.4.1.2
[NFPA 96: FIGURE 44.6.1.1.2 12.6.1.1.2]

514.4.1.3 Cleaning Method. Where a measured depth of 0.078 of an inch (2000 µm) is observed, the surfaces shall be cleaned in accordance with Section 514.4. [NFPA 96:§ 44.6.1.4 12.6.1.1.3]

514.4.1.4 Removable Contaminants. Where a measured depth of 0.125 of an inch (3175 µm) is observed in a fan housing, the surfaces shall be cleaned in accordance with Section 514.4. [NFPA 96:§ 44.6.1.4 12.6.1.1.4]

514.4.2 Removal of Contaminants. Hoods, grease removal devices, fans, ducts, and other appurtenances shall be cleaned to remove combustible contaminants prior to surfaces becoming heavily contaminated with grease or oily sludge. [NFPA 96:§ 44.6.2 12.6.2]

514.4.3 Electrical Switches. At the start of the cleaning process, electrical switches that could be activated accidentally shall be locked out. [NFPA 96:§ 44.6.3 12.6.3]

514.4.4 Fire Suppression System. Components of the fire suppression system shall not be rendered inoperable during the cleaning process. [NFPA 96:§ 44.6.4 12.6.4]

514.4.5 Inoperable. Fire-extinguishing systems shall be permitted to be rendered inoperable during the cleaning process where serviced by properly trained and qualified persons. [NFPA 96:§ 44.6.5 12.6.5]

514.4.6 Solvents/Cleaning Aids. Flammable solvents or other flammable cleaning aids shall not be used. [NFPA 96:§ 44.6.6 12.6.6]

514.4.7 Cleaning Chemicals. Cleaning chemicals shall not be applied on fusible links or other detection devices of the automatic extinguishing system. [NFPA 96:§ 44.6.7 12.6.7]

514.4.8 Coating. After the exhaust system is cleaned, it shall not be coated with powder or other substance. [NFPA 96:§ 44.6.8 12.6.8]

514.4.9 Access Panels and Cover Plates. When cleaning procedures are completed, all access panels (doors) and cover plates shall be restored to their normal operational condition. [NFPA 96:§ 44.6.9 12.6.9]

514.4.10 Date of Inspection. When an access panel is removed, a service company label or tag preprinted with the name of the company and giving the date of inspection or cleaning shall be affixed near the affected access panels. [NFPA 96:§ 44.6.10 12.6.10]

514.4.11 Airflow. Dampers and diffusers shall be positioned for proper airflow. [NFPA 96:§ 44.6.11 12.6.11]

514.4.12 Operable State. When cleaning procedures are completed, all electrical switches and system components shall be returned to an operable state. [NFPA 96:§ 44.6.12 12.6.12]

514.4.13 Certification of Service. When an exhaust system is inspected or cleaned, a certificate showing the name of the servicing company, the name of the person performing the work, and the date of inspection or cleaning shall be maintained on the premises. [NFPA 96:§ 44.6.13 12.6.13]

514.4.14 Report Provided. After cleaning or inspection is completed, the exhaust cleaning company and the person performing the work at the location shall provide the owner of the system with a written report that also specifies areas that were inaccessible or not cleaned. [NFPA 96:§ 44.6.14 12.6.14]

514.4.15 Unclean Area. Where required, certificates of inspection and cleaning and reports of areas not cleaned shall be submitted to the Authority Having Jurisdiction. [NFPA 96:§ 44.6.15 12.6.15]

514.4.16 Metal Containers. Metal containers used to collect grease drippings shall be inspected or emptied at least weekly. [NFPA 96:§ 44.6.16 12.6.16]

514.5 Cooking Equipment Maintenance. Inspection and servicing of the cooking equipment shall be made at least annually by properly trained and qualified persons. [NFPA 96:§ 44.7.1 12.7.1]

514.5.1 Cleaning. Cooking equipment that collects grease below the surface, behind the equipment, or in cooking equipment flue gas exhaust, such as griddles, deep-fat fryers, or charbroilers, shall be inspected and, if found with grease accumulation, cleaned by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction. [NFPA 96:§ 44.7.2 12.7.2]

515.1 Cooking Equipment. Cooking equipment shall be approved based on one of the following criteria:

1. Listings by a testing laboratory.
2. Test data acceptable to the Authority Having Jurisdiction. [NFPA 96:§ 42.1.1 13.1.1]

515.1.1 Installation. All listed appliances shall be installed in accordance with the terms of their listings and the manufacturer's instructions. Solid fuel used for flavoring within a gas-operated appliance shall be in a solid fuel holder. [smoker box] that is listed with the equipment. [NFPA 96:§ 42.1.2 13.1.2.1, 13.1.2.1.1]

515.1.1.1 Re-evaluation. Cooking appliances requiring protection shall not be moved, modified, or rearranged without prior re-evaluation of the fire-extinguishing system by the system installer or servicing agent, unless otherwise allowed by the design of the fire-extinguishing system. A solid fuel holder shall not be added to an existing appliance until the fire-extinguishing system has been evaluated by the fire-extinguishing system service provider. [NFPA 96:§ 42.1.2.2 12.7.1.2.1]

515.1.2 Prior Location. The fire-extinguishing system shall not require re-evaluation where the cooking appliances
are moved for the purposes of maintenance and cleaning, provided the appliances are returned to approved design location prior to cooking operations, and any disconnected fire-extinguishing system nozzles attached to the appliances are reconnected in accordance with the manufacturer’s listed design manual. [NFPA 96: 42.1.2.3 13.1.2.3]

515.1.1.3 Minimum Space. All deep-fat fryers shall be installed with at least a 16 inch (406 mm) space between the fryer and surface flames from adjacent cooking equipment. [NFPA 96: 42.1.2.4 13.1.2.4]

515.1.1.4 Space Not Required. Where a steel or tempered glass baffle plate is installed at a minimum 8 inches (203 mm) in height between the fryer and surface flames of the adjacent appliance, the requirement for a 16 inch (406 mm) space shall not apply. [NFPA 96: 42.1.2.5 13.1.2.5]

515.1.1.5 Minimum Height. If the fryer and the surface flames are at different horizontal planes, the minimum height of 8 inches (203 mm) shall be measured from the higher of the two. [NFPA 96: 42.1.2.5.1 13.1.2.5.1]

515.2 Operating Controls. Deep-fat fryers shall be equipped with a separate high-limit control in addition to the adjustable operating control (thermostat) to shut off fuel or energy when the fat temperature reaches 475°F (246°C) at 1 inch (25.4 mm) below the surface. [NFPA 96: 42.2 13.2]

516.1 General Requirements. Recirculating systems containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:

(1) The clearance requirements of Section 507.4 through Section 507.4.3.3.
(2) A hood complying with the requirements of Section 508.0.
(3) Grease removal devices complying with Section 509.0.
(4) The air movement requirements of Section 511.2.1 and Section 511.2.2.
(5) Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.
(6) Fire-extinguishing equipment complying with the requirements of Section 513.0.

Exception: Fire-extinguishing equipment in accordance with Section 513.1 and Section 513.5.

(7) The use and maintenance requirements of Section 514.0.
(8) The minimum safety requirements of Section 515.0.
(9) All the requirements of Section 516.0. [NFPA 96: 43.4 14.1]

516.2 Design Restrictions. All recirculating systems shall comply with the requirements of Section 516.2.1 through Section 516.2.9. [NFPA 96: 43.2 14.2]

516.2.1 Gas/Electrically Fueled Cooking Appliances. Only gas-fueled or electrically fueled cooking appliances shall be used. Listed gas-fueled equipment designed for use with specific recirculating systems shall have the flue outlets connected in the intended manner. Gas-fueled appliances shall have a minimum 18 inches (457 mm) clearance from the flue outlet to the filter inlet in accordance with Section 509.2.2 through Section 509.2.2.3 and shall meet the installation requirements of this code, NFPA 54 or NFPA 58. (NFPA 96: 43.2.1 – 43.2.3 14.2.1–14.2.3)

516.2.2 Recirculation. Recirculating systems shall be listed with a testing laboratory in accordance with UL 710B or equivalent. [NFPA 96: 43.2.4 14.2.4]

516.2.3 Protection. Cooking appliances that require protection and that are under a recirculating hood shall be protected by either the integral fire protection system in accordance with UL 710B or a system in accordance with Section 513.0. [NFPA 96: 43.2.4.2 14.2.4.2]

516.2.4 Maximum Limits. A recirculating system shall not use cooking equipment that exceeds that recirculating system’s labeled maximum limits for that type of equipment, stated in maximum energy input, maximum cooking temperature, and maximum square area of cooking surface or cubic volume of cooking cavity. [NFPA 96: 43.2.6 14.2.6]

516.2.5 Label. The listing label shall show the type(s) of cooking equipment tested and the maximum limits specified in Section 516.2.4. [NFPA 96: 43.2.7 14.2.7]

516.2.6 Fire Damper. A fire-actuated damper shall be installed at the exhaust outlet of the system. [NFPA 96: 43.2.8 14.2.8] The actuation device for the fire damper shall have a maximum temperature rating of 375°F (191°C). [NFPA 96: 43.2.10 14.2.10]

516.2.8 Power Supply. The power supply of any electrostatic precipitator (ESP) shall be of the “cold spark,” ferroresonant type in which the voltage falls off as the current draw of a short increases. [NFPA 96: 43.2.4.11 14.2.11]

516.2.9 Listing Evaluation. Listing evaluation shall include the following:

(1) Capture and containment of vapors at published and labeled airflows.
(2) Grease discharge at the exhaust outlet of the system not to exceed an average of 2.9 E-09 (oz/in³) (5.0 E-06 kg/m³) of exhausted air sampled from that equipment at maximum amount of product that is capable of being processed over a continuous 8 hour test with the system operating at its minimum listed airflow.
(3) Listing and labeling of clearance to combustibles from all sides, top, and bottom.
(4) Electrical connection in the field in accordance with NFPA 70.
(5) Interlocks on all removable components that lie in the path of airflow within the unit to ensure that they are in place during operation of the cooking appliance. (NFPA 96: 43.2.4.2 14.2.12)

516.3 Interlocks. The recirculating system shall be provided with interlocks of all critical components and operations as indicated in Section 516.3.1 through Section 516.3.3.1 such that, if any of these interlocks are interrupted, the cooking appliance will not be able to operate. [NFPA 96: 43.3.4 14.3.1]

516.3.1 Airflow Sections. All closure panels encompassing airflow sections shall have interlocks to ensure that the panels are in place and fully sealed. [NFPA 96: 43.3.2 14.3.2]
516.3.2 Filter Component. Each filter component (grease and odor) shall have an interlock to prove the component is in place. [NFPA 96:14.3.3 14.3.3]

516.3.3 ESP Interlocks. Each ESP shall have a sensor to prove its performance is as designed, with no interruption of the power to exceed 2 minutes. [NFPA 96:14.3.4.1 14.3.4.1]

516.3.3.1 Manual Reset. The sensor shall be a manual reset device or circuit. [NFPA 96:14.3.4.2 14.3.4.2]

516.3.4 Airflow Switch or Transducer. An airflow switch or transducer shall be provided after the last filter component to ensure that a minimum airflow is maintained. The airflow switch or transducer shall open the interlock circuit when the airflow falls 25 percent below the system's normal operating flow or 10 percent below its listed minimum rating, whichever is lower. The airflow switch or transducer shall be a manual reset device or circuit. [NFPA 96:14.3.5.1 14.3.5.1 14.3.5.3 14.3.5.1 14.3.5.3]

516.4 Location and Application Restrictions. The location of recirculating systems shall be approved by the Authority Having Jurisdiction. Items to be reviewed in the fire risk assessment shall include, but not be limited to, life safety, combustibility of surroundings, proximity to air vents, and total fuel load. [NFPA 96:14.4.1 14.4.2 14.4.1 14.4.2]

516.5 Additional Fire Safety Requirements. In addition to the appliance nozzle(s), a recirculating system shall be listed with the appropriate fire protection for grease filters, grease filtration, odor filtration units, and ductwork, where applicable. [NFPA 96:14.5.1 14.5.1]

516.5.1 Installation Downstream. In addition to any other fire-extinguishing system activation device, there shall be a fire-extinguishing system activation device installed downstream of any ESP. [NFPA 96:14.5.2 14.5.2]

516.5.2 Locations. The requirements of Section 513.6 shall also apply to recirculating system locations. [NFPA 96:14.5.3 14.5.3]

516.6 Use and Maintenance. Automatic or manual covers on cooking appliances, especially fryers, shall not interfere with the application of the fire suppression system. [NFPA 96:14.6.1 14.6.1]

516.6.1 Manufacturer’s Instructions. All filters shall be cleaned or replaced in accordance with the manufacturer’s instructions. [NFPA 96:14.6.2 14.6.2]

516.6.2 Cleaning Schedule. All ESPs shall be cleaned a minimum of once per week and according to the manufacturer’s cleaning instructions. [NFPA 96:14.6.3 14.6.3]

516.6.3 Hood Plenum and Blower Section Cleaning Schedule. The entire hood plenum and the blower section shall be cleaned a minimum of once every 3 months. [NFPA 96:14.6.4 14.6.4]

516.6.4 Inspection of Safety Interlocks. Inspection and testing of the total operation and all safety interlocks in accordance with the manufacturer’s instructions shall be performed by qualified service personnel a minimum of once every 6 months or more frequently if required. [NFPA 96:14.6.5 14.6.5]

516.6.5 Inspection. Fire-extinguishing equipment shall be inspected in accordance with Section 514.2. [NFPA 96:14.6.6 14.6.6]

516.6.6 Maintenance Log. A signed and dated log of maintenance as performed in accordance with Section 516.6.3 and Section 516.6.4 shall be available on the premises for use by the Authority Having Jurisdiction. [NFPA 96:14.6.7 14.6.7]

517.1 Venting Application. Venting requirements of solid-fuel cooking operations shall be determined in accordance with Section 517.1.1 through Section 517.1.6. [NFPA 96:15.1 15.1]

517.1.2 System Compliance. Where the solid-fuel cooking equipment has a self-contained top, is the appliance to be vented in an isolated space (except for a single water heater with its own separate vent), has a separate makeup air system, and is provided with supply and return air (not supplied or returned from other spaces), the system shall comply with Section 517.4 and Section 517.6. [NFPA 96:15.1.2 15.1.2]

517.1.3 Makeup Air System. Where the solid-fuel cooking equipment is located in a space with other vented equipment, all vented equipment shall have an exhaust system interlocked with a makeup air system for the space per Section 517.6. [NFPA 96:15.1.3 15.1.3]

517.1.4 Natural Draft Ventilation Systems. Natural draft ventilation systems and power-exhausted ventilation systems shall comply with Section 517.3, Section 517.4, and Section 517.6. [NFPA 96:15.1.5 15.1.5]

517.1.5 Opening Requirements. Where a solid-fuel cooking appliance allows effluent to escape from the appliance opening, this opening shall be covered by a hood and an exhaust system that meets the requirements of Section 517.3, Section 517.4, and Section 517.6. [NFPA 96:15.1.6 15.1.6]

517.1.6 Spark Arresters. Solid-fuel cooking operations shall have spark arresters to minimize the passage of airborne sparks and embers into plenums and ducts. Where the solid-fuel cooking operation is not located under a hood, a spark arrester shall be provided to minimize the passage of sparks and embers into flues and chimneys. [NFPA 96:15.1.7 15.1.7 15.1.8]

517.2 Location of Appliances. For cooking operations in buildings, every appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. [NFPA 96:15.2.1 15.2.1]

517.2.1 Prohibited Location. Solid-fuel cooking appliances shall not be installed in confined spaces. [NFPA 96:15.2.2 15.2.2]

Exception: Solid-fuel cooking appliances listed for installation in confined spaces such as alcoves shall be installed in accordance with the terms of the listing and the manufacturer’s instructions. [NFPA 96:15.2.3 15.2.3]

517.2.2 Flammable Vapors. Solid-fuel cooking appliances shall not be installed in any location where gasoline or any
other flammable vapors or gases are present. [NFPA 96:44.2.4 15.2.4]

517.3 Hoods for Solid-Fuel Cooking. Hoods shall be sized and located in a manner capable of capturing and containing all the effluent discharging from the appliances. The hood and its exhaust system shall comply with the requirements of Section 508.0 through Section 513.0. [NFPA 96:44.3.1, 14.3.2-15.3.1, 15.3.2]

517.3.1 Separation. Except as permitted in Section 517.3.1.1, exhaust systems serving solid-fuel cooking equipment in buildings, including gas or electrically operated equipment, shall be separate from all other exhaust systems. [NFPA 96:44.3.3-15.3.3]

Exception: Cooking equipment not requiring automatic fire-extinguishing equipment (per Section 513.0) shall be permitted to be installed under a common hood with solid-fuel cooking equipment that is served by a duct system separate from all other exhaust systems. [NFPA 96:44.3.5-15.3.5]

517.3.1.1 Equipment with Solid Fuel for Flavoring. Gas-operated equipment utilizing solid fuel for flavoring that meets all the following conditions shall not be required to have a separate exhaust system:

1. The solid fuel holder (smoker box) shall be listed with the gas-operated equipment.
2. The solid fuel holder shall be located underneath the gas burners.
3. Spark arresters conforming with Section 517.1.6 shall be provided.
4. The maximum quantity of solid fuel consumed shall not exceed 1 pound (0.45 kg) per hour per 100 000 Btu/h (29 kW) of gas burner capacity.
5. The gas-operated equipment shall be protected by a fire suppression system listed for the equipment, including the solid fuel holder.
6. Gas-operated equipment with integral solid fuel holder(s) intended for flavoring, such as radiant charbroiler(s), shall comply simultaneously with the requirements of UL 300 that address the gas radiant charbroiler(s) and mesquite wood charbroiler(s).
7. A fire suppression system nozzle(s) shall be installed to protect the solid fuel holder.
8. The fire suppression system shall be designed and installed to protect the entire cooking operation.
9. Each solid fuel holder shall be limited to a size of 150 cubic inches (2.5 L), with no dimension to exceed 20 inches (508 mm).
10. A maximum of one solid fuel holder for each 100 000 Btu/h (29 kW), or portion thereof, of burner capacity shall be permitted.
11. Solid fuel shall be immersed in water for a continuous period of at least 24 hours immediately prior to being placed in the cooking equipment.
12. The inspection frequency shall be the same as for solid fuel cooking operations in Table 514.3. [NFPA 96:44.3.4 15.3.4]

517.4 Exhaust Systems for Solid-Fuel Cooking. Where a hood is not required, in buildings where the duct system is three stories or less in height, a duct complying with Section 510.0 shall be provided. [NFPA 96:44.4 15.4]

517.4.1 Hood. If a hood is used in buildings where the duct system is three stories or less in height, the duct system shall comply with Section 510.0. [NFPA 96:44.4.1 15.4.1]

517.4.2 Building Exceeding Four Stories. A listed or approved grease duct system that is four stories in height or greater shall be provided for solid-fuel cooking exhaust systems. [NFPA 96:44.4.2 15.4.2]

517.4.3 Prohibited. Wall terminations of solid-fuel exhaust systems shall be prohibited. [NFPA 96:44.4.4 15.4.4]

517.5 Grease Removal Devices for Solid-Fuel Cooking. Grease removal devices shall be constructed of steel or stainless steel or be approved for solid-fuel cooking. [NFPA 96:44.5.1 15.5.1]

517.5.1 Spark Arrester Devices. If airborne sparks and embers can be generated by the solid fuel cooking operation, spark arrester devices shall be used prior to using the grease removal device, to minimize the entrance of these sparks and embers into the grease removal device and into the hood and the duct system. [NFPA 96:44.5.2 15.5.2]

517.5.2 Filters. Filters shall be a minimum of 4 feet (1219 mm) above the appliance cooking surface. [NFPA 96:44.5.3 15.5.3]

517.6 Air Movement for Solid-Fuel Cooking. Exhaust system requirements shall comply with Section 511.0 for hooded operation or shall be installed in accordance with the manufacturer’s recommendations for unhooded applications. [NFPA 96:44.6.1 15.6.1]

517.6.1 Replacement Air. A replacement or makeup air system shall be provided to ensure a positive supply of replacement air at all times during cooking operations. [NFPA 96:44.6.2 15.6.2]

517.6.2 Operation. Makeup air systems serving solid-fuel cooking operations shall be interlocked with the exhaust air system and powered, if necessary, to prevent the space from attaining a negative pressure while the solid-fuel appliance is in operation. [NFPA 96:44.6.3 15.6.3]

517.7 Fire-Extinguishing Equipment for Solid-Fuel Cooking. Solid-fuel cooking appliances that produce grease-laden vapors shall be protected by listed fire-extinguishing equipment. Exception: Where acceptable to the Authority Having Jurisdiction, solid-fuel cooking appliances constructed of solid masonry or reinforced Portland or refractory cement concrete and vented in accordance with NFPA 211 shall not require fixed automatic fire-extinguishing equipment. [NFPA 96:44.7.1, 44.7.2 15.7.1, 15.7.2]
517.7.1 Grease Removal Devices, Hoods, and Duct Systems. Listed fire-extinguishing equipment shall be provided for the protection of grease removal devices, hoods, and duct systems. [NFPA 96:14.7.3 15.7.3]

**Exception:** Where acceptable to the Authority Having Jurisdiction, solid-fuel cooking appliances constructed of solid masonry or reinforced Portland or refractory cement concrete and vented in accordance with NFPA 211 shall not require automatic fire-extinguishing equipment for the protection of grease removal devices, hoods, and duct systems. [NFPA 96:14.7.4 15.7.4]

517.7.2 Listed Fire-Extinguishing Equipment. Listed fire-extinguishing equipment for solid-fuel-burning cooking appliances, where required, shall comply with Section 513.0 and shall use water-based agents. [NFPA 96:14.7.5 15.7.5]

517.7.3 Rating and Design. Fire-extinguishing equipment shall be rated and designed to extinguish solid-fuel cooking fires. The fire-extinguishing equipment shall be of sufficient size to totally extinguish fire in the entire hazard area and prevent reignition of the fuel. [NFPA 96:14.7.6, 14.7.7 15.7.6, 15.7.7]

517.7.4 Listing/Class. All solid fuel appliances (whether under a hood or not) with fireboxes of 5 cubic feet (0.14 m³) volume or less shall have at least a listed 2-A rated water-spray fire extinguisher or a 1.6 gallon (6.1 L) wet chemical fire extinguisher listed for Class K fires in accordance with NFPA 10 with a maximum travel distance of 20 feet (6096 mm) to the appliance. [NFPA 96:14.7.8 15.7.8]

517.7.5 Fixed-Water Pipe System. Solid fuel appliances with fireboxes exceeding 5 cubic feet (0.14 m³) shall be provided with a fixed-water pipe system with a hose in the kitchen capable of reaching the firebox. The hose shall be equipped with an adjustable nozzle capable of producing a fine to medium spray or mist. The nozzle shall be of the type that cannot produce a straight stream. The system shall have a minimum operating pressure of 40 psi (276 kPa) and shall provide a minimum of 5 gallons per minute (gpm) (0.3 L/s). [NFPA 96:14.7.9.1 – 15.7.9.2]

517.7.6 Fuel Storage. All fuel storage areas for cooking operations in buildings shall be provided with a sprinkler system meeting the requirements of NFPA 13 except as permitted in accordance with the following:

1. Where acceptable to the Authority Having Jurisdiction, fuel storage areas shall be permitted to be protected with a fixed water pipe system with a hose capable of reaching all parts of the area.
2. In lieu of the sprinkler system outlined in Section 517.6, a listed 2-A rated water spray fire extinguisher or a 1.6 gallon (6.1 L) wet chemical fire extinguisher listed for Class K fires with a maximum travel distance of 20 feet (6096 mm) to the solid fuel piles shall be permitted to be used for a solid fuel pile, provided that the fuel pile does not exceed 5 cubic feet (0.14 m³) volume. [NFPA 96:14.9.2.8 – 15.9.2.8.3]

517.7.7 Auxiliary Fuel. In addition to the requirements of Section 517.7.4 through Section 517.8.3, where any solid-fuel cooking appliance is also served by any portion of a fire-extinguishing system complying with Section 513.0, such auxiliary fuel shall be shut off on actuation of the fire-extinguishing system. [NFPA 96:14.7.11 15.7.11]

517.8 Other Safety Requirements. Metal-fabricated solid-fuel cooking appliances shall be listed for the application where produced in practical quantities or shall be approved by the Authority Having Jurisdiction. Where listed, metal-fabricated solid fuel cooking appliances shall be installed in accordance with the terms of their listings and with the applicable requirements of this chapter. [NFPA 96:14.9.4.1, 14.9.4.2, 15.9.4.1, 15.9.4.2]

517.8.1 Site-Built Solid Fuel Cooking Appliances. Site-built solid-fuel cooking appliances shall be submitted for approval to the Authority Having Jurisdiction before being considered for installation. All units submitted to the Authority Having Jurisdiction shall be installed, operated, and maintained in accordance with the approved terms of the manufacturer’s instructions and any additional requirements set forth by the Authority Having Jurisdiction. [NFPA 96:14.9.4.3.1 – 15.9.4.3.2]

517.8.2 Additional Devices. Except for the spark arresters required in Section 517.1.6, there shall be no additional devices of any type in any portion of the appliance, flue pipe, and chimney of a natural draft solid-fuel operation. [NFPA 96:14.9.4.4 15.9.4.4]

517.8.3 Prohibited. No solid fuel cooking device of any type shall be permitted for deep fat frying involving more than 1 quart (qt) (1 L) of liquid shortening, nor shall any solid fuel cooking device be permitted within 3 feet (914 mm) of any deep fat frying unit. [NFPA 96:14.9.4.5 15.9.4.5]

518.1 General. Downdraft appliance ventilation system containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:

1. The clearance requirements of Section 507.4 through Section 507.4.3.3.
2. The primary collection means designed for collecting cooking vapors and residues complying with the requirements of Section 508.0.
3. Grease removal devices complying with Section 509.0.
4. Special-purpose filters as listed in accordance with UL 1046 or CAN/ULC-S649 for Canada.
5. Exhaust ducts complying with Section 510.0.
6. The air movement requirements of Section 511.2.1 and Section 511.2.2.
7. Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.
8. Fire-extinguishing equipment complying with the requirements of Section 513.0, and as specified in Section 518.3.
9. The use and maintenance requirements of Section 514.0.
10. The minimum safety requirements of Section 515.0. [NFPA 96:45.1.4 16.1.1]
518.2 Ventilation System. The downdraft appliance ventilation system shall be capable of capturing and containing all the effluent discharge from the appliance(s) it is serving. [NFPA 96: 15.1.2, 16.1.2]

518.3 Fire-Extinguishing Equipment. For fire-extinguishing equipment on downdraft appliance ventilation systems, the following shall apply:
(1) Cooking surface, duct, and plenum protection shall be provided.
(2) At least one fusible link or heat detector shall be installed within each exhaust duct opening in accordance with the manufacturer’s listing.
(3) A fusible link or heat detector shall be provided for each protected cooking appliance located in the plenum area of that appliance or in accordance with the extinguishing system manufacturer’s listing.
(4) A manual activation device shall be provided as part of each appliance at a height acceptable to the Authority Having Jurisdiction.
(5) Portable fire extinguishers shall be provided in accordance with Section 513.10 through Section 513.11. [NFPA 96: 15.2, 16.2]

518.3.1 Integral Fire-Extinguishing System. A listed downdraft appliance ventilation system employing an integral fire-extinguishing system including detection systems that has been evaluated for grease and smoke capture, fire extinguishing, and detection shall be considered as complying with Section 518.3. [NFPA 96: 15.2.1, 16.2.1]

518.3.2 Interlocks. The downdraft appliance ventilation system shall be provided with interlocks such that the cooking fuel supply will not be activated unless the exhaust and supply air systems have been activated. [NFPA 96: 15.2.2, 16.2.2]

518.4 Airflow Switch or Transducer. An airflow switch or transducer shall be provided after the last filter component to ensure that a minimum airflow is maintained. [NFPA 96: 15.3.1, 16.3.1]

518.4.1 Interlocks. The airflow switch or transducer shall open the interlock circuit when the airflow falls 25 percent below the system’s normal operating flow or less than 10 percent its listed minimum rating, whichever is lower. [NFPA 96: 15.3.2, 16.3.2]

518.4.2 Manual Reset. The airflow switch or transducer shall be a manual reset device or circuit. [NFPA 96: 15.3.3, 16.3.3]

518.5 Surface Materials. Any surface located directly above the cooking appliance shall be of noncombustible or limited-combustible materials. [NFPA 96: 15.4, 16.4]

### TABLE 1701.1
**REFERENCED STANDARDS**

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(portions of table not shown remain unchanged)

**Note:** The NFPA and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 5 is being revised to the latest edition of NFPA 96-2021.

[Digital View for UL Standards: https://www.shopulstandards.com/Catalog.aspx]
PROPOSALS

Item #: 104

UMC 2024  Section: Chapter 5

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

504.4.1 Provisions for Makeup Air. Makeup air shall be provided in accordance with the following:
(1) Makeup air shall be provided for Type 1 clothes dryers in accordance with the manufacturer’s installation instructions. Where a closet is designed for the installation of a clothes dryer, an opening of not less than 100 square inches (0.065 m²) for makeup air shall be provided in the door or by other approved means.
(2) Provision for makeup air shall be provided for Type 2 clothes dryers, with a minimum free area of 1 square inch (0.0006 m²) for each 1000 British thermal units per hour (Btu/h) (0.293 kW) total input rating of the dryer(s) installed.

504.4.3.1 Exhaust Ducts for Type 2 Clothes Dryers. Exhaust ducts for Type 2 clothes dryers shall comply with the following:
(1) Exhaust ducts for Type 2 clothes dryers shall comply with Section 504.4. [NFPA 54:10.4.5.1 10.4.6.1]
(2) Exhaust ducts for Type 2 clothes dryers shall be constructed of sheet metal or other noncombustible material. Such ducts shall be equivalent in strength and corrosion resistance to ducts made of galvanized sheet steel not less than 0.0195 of an inch (0.4953 mm) thick. [NFPA 54:10.4.5.2 10.4.6.2]
(3) Type 2 clothes dryers shall be equipped or installed with lint-controlling means. [NFPA 54:10.4.5.3 10.4.6.3]
(4) Exhaust ducts for unlisted Type 2 clothes dryers shall be installed with a minimum clearance of 6 inches (152 mm) from adjacent combustible material. Where exhaust ducts for Type 2 clothes dryers are installed with reduced clearances, the adjacent combustible material shall be protected in accordance with Table 303.10.1. [NFPA 54:10.4.5.4 10.4.6.4]
(5) Where ducts pass through walls, floors, or partitions, the space around the duct shall be sealed with noncombustible material. [NFPA 54:10.4.5.610.4.6.4]

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 5 is being revised to the latest edition of NFPA 54-2021.
Proposals

Item #: 105

UMC 2024  Section: 502.2.1

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

502.0 Termination.

502.2 Termination of Exhaust Ducts. Exhaust ducts shall terminate in accordance with Section 502.2.1 through Section 502.2.3.

502.2.1 Environmental Air Ducts. Environmental air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, 10 feet (3048 mm) from a forced air inlet, 10 feet (3048 mm) above a public walkway, and 3 feet (914 mm) from openings into the building. The discharge of environmental exhaust ducts shall not be directed onto a public walkway.

Exception: Whole house fans shall be permitted to discharge into the attic space of an individual dwelling unit.

SUBSTANTIATION:
An exception is being added to Section 502.2.1 as exhaust ducts typically must terminate to the outdoors, however, systems such as whole house fans are designed to exhaust into the attic space.
Proposals

Item #: 106

UMC 2024  Section: 502.2.3

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

502.0 Termination.

502.2 Termination of Exhaust Ducts.

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

(below shown for reference only)

510.9 Termination of Type I Hood Exhaust System. The exhaust system shall terminate as follows:
(1) Outside the building with a fan or duct.
(2) Through the roof or to the roof from outside, as in Section 510.9.1, or through a wall, as in Section 510.9.2. [NFPA 96:7.8.1]

519.5 Termination of Type II Hood Exhaust System. The exhaust system shall terminate as follows:
(1) Rooftop terminations shall terminate not less than 10 feet (3048 mm) from a property line, and the exhaust flow shall be directed away from the roof surface of the roof, not less than 40 inches (1016 mm).
(2) Horizontal terminations shall terminate not less than 10 feet (3048 mm) from adjacent buildings, property lines, operable openings, and from grade level.
(3) The discharge outlet shall not be directed onto a public walkway.

SUBSTANTIATION:
This code change clarifies that Section 510.9 applies to Type I exhaust terminations and Section 519.5 applies to Type II exhaust terminations. The code change improves the code by adding reference to the system each section applies to.
Proposals

Item #: 107
UMC 2024  Section: 503.2.1, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

503.0 Motors, Fans, and Filters.

503.2 Fans. Parts of fans in contact with explosive or flammable vapors, fumes, or dusts shall be of nonferrous or nonsparking materials, or their casing shall be lined or constructed of such material. Where the size and hardness of materials passing through a fan are capable of producing a spark, both the fan, and the casing shall be of nonsparking materials. Where fans are required to be spark-resistant, their bearings shall not be within the airstream, and parts of the fan shall be grounded. Fans in systems handling materials that are likely to clog the blades, and fans in buffing or woodworking exhaust systems, shall be of the radial-blade or tube-axial type.

Equipment used to exhaust explosive or flammable vapors, fumes, or dusts shall bear an identification plate stating the ventilation rate for which the system was designed.

Fans located in systems conveying corrosives shall be of materials that are resistant to the corrosive or shall be coated with corrosion-resistant materials.

503.2.1 Testing. Fans providing exhaust or outdoor air shall be tested in accordance with ANSI/AMCA 210/ASHRAE 51. Induced flow fans shall be tested in accordance with AMCA 260.

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(portions of table not shown remain unchanged)

Note: ANSI/AMCA 210/ASHRAE 51 and AMCA 260 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Testing requirements are being added for exhaust fans to clarify that such fans must be tested to AMCA 210/ASHRAE 51. This will assist the code official in approving such systems. To be assured that fan performance is factual for exhaust applications utilizing induced flow fans, be sure to specify fans and fan systems that have certified performance ratings. The ratings are based on testing in accordance with AMCA 210/ASHRAE 51 for standard fans and AMCA 260 for induced flow fans. AMCA certified ratings ensure that the product performs as tested and documented by the manufacturer. Caution must be taken when using performance data that is not verified by an independent third party.
504.0 Environmental Air Ducts.

504.1 General. Where not specified in this chapter, exhaust ducts shall be constructed and installed in accordance with Chapter 6 and shall be airtight as approved by the Authority Having Jurisdiction. Environmental air ducts that have an alternate function as a part of an approved smoke-control system in accordance with Section 504.7 do not require design as Class 1 product-conveying ducts.

Exceptions:
(1) Ductless range hoods where installed in accordance with the manufacturer’s installation instructions.
(2) Condensing clothes dryers where installed in accordance with the manufacturer’s installation instructions.

504.7 Smoke Control Systems. Smoke control systems shall be designed in accordance with NFPA 92 and installed where required by the building code. Pressurized stairways, elevator shafts, and vestibules shall comply with this section and the building code. All components of the smoke control system shall be clearly identified and marked in field. Components include, but are not limited to, fire alarm initiating devices, junction boxes, panels, modules, relays, dampers, doors sensors and air movement sensors.

504.7.1 Fire Detection Systems. Fire detection systems providing control input or output signals to smoke control systems shall comply with the building code and shall be equipped with a control unit listed and labeled in accordance with UL 864. Activation of the smoke control system is required immediately upon detection.

221.0 – S –
Smoke Control System. A system that includes all methods for controlling smoke movement, intended to provide a means of egress for the evacuation or relocation of occupants.

TABLE 1701.1
REFERENCED STANDARDS

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Note: NFPA 92 and UL 864 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
A smoke control system is a combination of fans, dampers, warning devices, and other equipment that work together to perform the containment function for any smoke event at any location in a building. Those who work in
the health care industry may be familiar with contamination control; smoke control systems are similar; however, such systems have additional applications. The term “smoke control” includes both the containment of smoke in a designated zone as well as the management of smoke within a large-volume space and adjacent connected spaces. The containment method is a smoke control method that uses mechanical equipment to produce pressure differences across smoke barriers. The management method is a smoke control method that utilizes natural or mechanical systems to maintain a tenable environment in the means of egress from a large-volume space or to control and reduce the migration of smoke between the fire area and communicating spaces.

Once it has been established that a smoke control system is required by the building code, the first step is to consult NFPA 92 and determine whether the system should be based on the smoke-containment concept or the smoke-management concept. NFPA 92 is arranged around smoke containment and smoke management, providing approaches and criteria for the implementation of each.

Smoke management generally is used for large multistory spaces, such as atriums. Smoke containment, achieved using pressurization, is used for elevators, stairways, and zoned smoke systems. Additionally, a building may include smoke management as well as a smoke containment; the two methodologies are not mutually exclusive systems and both are often found in the same building. After the design methodology and smoke control objectives are identified, the design approach(es) should be selected. For smoke-containment systems, the design approach includes one or more of the following: stairwell pressurization, zoned smoke control, elevator pressurization, vestibule pressurization, and smoke refuge area pressurization.

NFPA 92 applies to the design, installation, acceptance testing, operation, and ongoing periodic testing of smoke control systems, and covers both containment and management systems, including stairwell pressurization systems and testing requirements. NFPA 92A and NFPA 92B were withdrawn and the requirements were incorporated into NFPA 92. As the industry standard, it is important for designers, installers, and code officials to be familiar with the document.
Proposals

Item #: 109

UMC 2024 Section: 504.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

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

(below shown for reference only)

207.0 – E –
Environmental Air Duct. Ducting used for conveying air at temperatures not exceeding 250°F (121°C) to or from occupied areas of any occupancy through other than heating or air-conditioning systems, such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust ducts, and domestic-type clothes dryer exhaust ducts.

502.2.1 Environmental Air Ducts. Environmental air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, 10 feet (3048 mm) from a forced air inlet, 10 feet (3048 mm) above a public walkway, and 3 feet (914 mm) from openings into the building. The discharge of environmental exhaust ducts shall not be directed onto a public walkway.

504.4.4 Common Exhaust. Where permitted by the clothes dryer manufacturer’s installation instructions, multiple clothes dryers shall be permitted to be installed with a common exhaust. The common exhaust duct shall be constructed of rigid metal and shall be installed in a fire-resistant rated enclosure in accordance with the building code. The duct material shall be of rigid metal with a thickness of not less than 0.020 of an inch (0.508 mm) (24 gauge). The duct enclosure shall be provided with a cleanout opening at the base of not less than 12 inches by 12 inches (305 mm by 305 mm). The exhaust fan shall be located downstream of branch connections and operated continuously and shall be monitored by an approved means.

SUBSTANTIATION:
The code change provides clarity to Section 504.2 regarding independent exhaust systems. The intention of the section is to prohibit combining of dissimilar exhaust systems. By mentioning “environmental air” the section is improved and clearly states which systems shall not be combined. Additionally, combined exhaust systems must only operate at negative pressure. Furthermore, clothes dryers shall not be combined with any other exhaust systems.
Proposals

Item #: 110  
UMC 2024  Section: 504.3

SUBMITTER: Randy Young  
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:  
Revise text

504.0 Environmental Air Ducts.

504.3 Domestic Range Hoods. Ducts used for domestic kitchen range or cooktop ventilation shall be of metal and shall have smooth interior surfaces. All kitchen exhaust ducts used in domestic range hoods shall be constructed of metal and shall have a smooth surface, fastened and sealed with duct mastic or metal tapes that meet the requirements of UL 181. Range hoods shall discharge to the outdoors through a single wall duct and shall not terminate in an attic or crawl space.

A physical verification of air volume, operation, and design intent shall be performed by a certified Testing, Adjusting, and Balancing (TAB) technician. The TAB technician shall be certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB).

Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
(2) Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
(3) PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
(4) The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.

Note: UL 181 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:  
There are currently no provisions to properly seal and test range hoods and ducts. This also clarifies that ducts shall terminate outside and be tested in accordance with the nationally recognized testing standards.
Proposals

Item #: 111
UMC 2024  Section: 504.4.2.1

SUBMITTER: Phil Pettit  
Control Air Conditioning Corporation  
Rep. Self

RECOMMENDATION:  
Revise text

504.0 Environmental Air Ducts.

504.4 Clothes Dryers. (remaining text unchanged)

504.4.2 Domestic Clothes Dryers. (remaining text unchanged)
504.4.2.1 Length Limitation. Unless otherwise permitted or required by the dryer manufacturer’s instructions and approved by the Authority Having Jurisdiction, domestic dryer moisture exhaust ducts shall not exceed a total combined horizontal and vertical length of 44 35 feet (4267 10 668 mm), including two 90 degree (1.57 rad) elbows. A length of 2 feet (610 mm) shall be deducted for each 90 degree (1.57 rad) elbow in excess of two. 

Exception: Where an exhaust duct power ventilator, in accordance with Section 504.4.2.3, is used, the maximum length of the dryer exhaust duct shall be permitted to be in accordance with the dryer exhaust duct power ventilator manufacturer's installation instructions.

SUBSTANTIATION:
The first sentence of Section 504.4.2.1 already requires that the total length of the exhaust duct must first be determined by the clothes dryer manufacturer's instructions. In the absence of manufacturer's instructions, the UMC states that the total combined length limitation shall not exceed 14 feet per Section 504.4.2.1. This requirement is overly stringent. This code change would allow up to 35 feet of total length of clothes dryer exhaust duct in the absence of manufacturer's instructions and when approved by the AHJ.
Proposals

Item #: 112
UMC 2024 Section: 504.4.2.2

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.4 Clothes Dryers. (remaining text unchanged)

504.4.2 Domestic Clothes Dryers. (remaining text unchanged)

504.4.2.2 Transition Ducts. Listed clothes dryer transition ducts not more than 6 8 feet (1829 2438 mm) in length shall be permitted to be used to connect the Type 1 dryer to the exhaust ducts. Transition ducts and flexible clothes dryer transition ducts shall not be concealed within construction, and shall be installed in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
The UMC currently limits the length of clothes dryer transition ducts to 6 feet per Section 504.4.2.2. This requirement is overly stringent. This change allows up to 8 feet total length in the absence of manufacturer’s instructions and when approved by the AHJ.
Proposals

Item #: 113

UMC 2024 Section: 504.3, Table 1701.1

SUBMITTER: John Taeker
UL LLC

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.3 Domestic **Range Cooking Exhaust Equipment.** Where installed, domestic cooking exhaust equipment shall comply with the following, as applicable:

1. The fan for overhead range hoods and downdraft exhaust equipment not integral with the cooking appliance shall be listed and labeled in accordance with UL 507.
2. Overhead range hoods and downdraft exhaust equipment with integral fans shall be listed and labeled in accordance with UL 507.
3. Domestic cooking appliances with integral downdraft exhaust equipment shall be listed and labeled in accordance with UL 858 or ANSI Z21.1/CSA 1.1.
4. Microwave ovens with integral exhaust for installation over the cooking surface shall be listed and labeled in accordance with UL 923.
5. Ducts used for domestic kitchen range or cooktop ventilation shall be of metal and shall have smooth interior surfaces.

**Exception:** Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:

1. The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
2. Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
3. PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
4. The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.

**TABLE 1701.1 REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 507-2017</td>
<td>Electric Fans</td>
<td>Fans</td>
<td>504.3</td>
</tr>
</tbody>
</table>

Note: The UL and CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
This change adds requirements for domestic cooking exhaust equipment, including fans, overhead range hoods, integral downdraft equipment, and microwave ovens with integral exhaust.

[Digital View for UL Standards: https://www.shopulstandards.com/Catalog.aspx]
Proposals

Item #: 114
UMC 2024  Section: 504.4.5

SUBMITTER:  Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.4 Clothes Dryers.

504.4.5 Duct Supports. Ducts shall be supported at intervals not to exceed 4 feet (1219 mm) and in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.

SUBSTANTIATION:
This code change adds duct support spacing requirements for clothes dryers at 4 foot intervals for clarity and ease of use of the code.
Proposals

Item #: 115
UMC 2024  Section: 504.4.6

SUBMITTER:  Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

504.0 Environmental Air Ducts.

504.4 Clothes Dryers.

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

SUBSTANTIATION:
The code change adds provisions for clothes dryer cleanouts for vertical risers. The lint that dryer exhaust carries with it creates lint buildup that other exhaust systems do not create. Therefore, clothes dryer risers need cleanouts to manage lint buildup in the dryer exhaust ducts.
Proposals

Item #: 116

UMC 2024  Section: 207.0, 210.0, 504.5

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

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

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

504.0 Environmental Air Ducts.

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

SUBSTANTIATION:
After investigating various ventilation options, many HVAC designers conclude that they want either a heat-recovery ventilator (HRV) or an energy-recovery ventilator (ERV). They often remain confused, however, about which of the two devices to choose. There is quite a bit of debate out there as to where ERVs should be used and where HRVs should be used. HRVs, like ERVs, are ventilation systems that transfer heat. Like an HRV, an ERV contains a heat exchanger that transfers heat from one air stream to another. Unlike an HRV, an ERV also moves moisture between the two air streams. The two systems need to be differentiated to avoid confusion and clarify that Section 504.5 applies to both systems.
Proposals

Item #: 117
UMC 2024  Section: 504.6

SUBMITTER: John R Hamilton
International Certification Board
Rep. DLS

RECOMMENDATION:
Delete text without substitution

504.0 Environmental Air Ducts.

504.6 Gypsum Wallboard Ducts. Bathroom and laundry room exhaust ducts shall be permitted to be of gypsum wallboard subject to the limitations of Section 602.4.2.

SUBSTANTIATION:
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum. Gypsum has many specific limitations to exposure to humidity and mold growth. Using gypsum for these high humidity ducts is not recommended by the National Gypsum Association; in fact they say not to use gypsum as an HVAC ducting system.
Proposals

Item #: 118
UMC 2024  Section: 203.0, 221.0, 505.12, Table 505.12, 603.11, 1701.1

SUBMITTER: Jane Malone
American Association of Radon Scientists and Technologists (AARST)

RECOMMENDATION:
Revise text

505.0 Product-Conveying Systems.

505.12 Subslab Exhaust Systems. Where soil gas mitigation is required, an active soil depressurization (ASD) system such as a subslab soil exhaust or depressurization system shall be installed in accordance with Table 505.12.

<table>
<thead>
<tr>
<th>TABLE 505.12</th>
<th>SOIL GAS MITIGATION STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLICATION</td>
<td>STANDARD</td>
</tr>
<tr>
<td>Residential</td>
<td>New Construction</td>
</tr>
<tr>
<td>Buildings</td>
<td>ASTM E2121, ANSI/AARST CCAH,</td>
</tr>
<tr>
<td></td>
<td>ANSI/AARST RRNC</td>
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<tr>
<td>Existing</td>
<td>ANSI/AARST SGM-SF</td>
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<tr>
<td>Buildings</td>
<td>New Construction</td>
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<tr>
<td></td>
<td>ANSI/AARST CC-1000</td>
</tr>
<tr>
<td>Multifamily</td>
<td>Existing Buildings</td>
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<td>Buildings</td>
<td>ANSI/AARST CC-1000</td>
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<tr>
<td>Nonresidential Buildings</td>
<td>New Construction</td>
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<td></td>
<td>ANSI/AARST CC-1000</td>
</tr>
<tr>
<td>Existing</td>
<td>ANSI/AARST RMS-LB</td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
</tr>
</tbody>
</table>

603.0 Installation of Ducts.

603.11 Underground Installation. Ducts installed underground shall be approved for the installation and shall have a slope of not less than 1/8 inch per foot (10.4 mm/m) back to the main riser. Ducts, plenums, and fittings shall be permitted to be constructed of concrete, clay, or ceramics where installed in the ground or in a concrete slab, provided the joints are sealed and duct is secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Metal ducts where installed in or under a concrete slab shall be encased in not less than 2 inches (51 mm) of concrete, secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Subslab soil exhaust ducts shall be in accordance with Section 505.12.

203.0 – A –
Active Soil Depressurization (ASD). A soil gas control system involving fan-powered soil depressurization, including but not limited to sub-slab depressurization and sub-membrane depressurization.

221.0 – S –
Subslab Depressurization. A soil gas mitigation technique designed to maintain lower air pressure under a floor slab than above it by use of an active soil depressurization (ASD) fan installed in the radon system piping that draws air from below the floor slab.
<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM E2121-2013</td>
<td>Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings</td>
<td>Miscellaneous</td>
<td>Table 505.12</td>
</tr>
<tr>
<td>ANSI/AARST SGM-SF-2017</td>
<td>Soil Gas Mitigation Standards for Existing Homes</td>
<td>Miscellaneous</td>
<td>Table 505.12</td>
</tr>
<tr>
<td>ANSI/AARST RMS-MF-2018</td>
<td>Radon Mitigation Standards for Multifamily Buildings</td>
<td>Miscellaneous</td>
<td>Table 505.12</td>
</tr>
<tr>
<td>ANSI/AARST RMS-LB-2018</td>
<td>Radon Mitigation Standards for Schools and Large Buildings</td>
<td>Miscellaneous</td>
<td>Table 505.12</td>
</tr>
<tr>
<td>ANSI/AARST RRNC-2020</td>
<td>Rough-In of Radon Control Components in New Construction Of 1 &amp; 2 Family Dwellings and Townhouses</td>
<td>Miscellaneous</td>
<td>Table 505.12</td>
</tr>
<tr>
<td>ANSI/AARST CCAH-2020</td>
<td>Reducing Radon in New Construction of One &amp; Two Family Dwellings and Townhouses</td>
<td>Miscellaneous</td>
<td>Table 505.12</td>
</tr>
<tr>
<td>ANSI/AARST CC-1000-2018</td>
<td>Soil Gas Control Systems in New Construction of Buildings</td>
<td>Miscellaneous</td>
<td>Table 505.12</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASTM and AARST standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The purpose of this proposed change is to add the relevant consensus standards for soil gas exhaust systems, which includes additional specifications for materials, grade/slope, termination, and identification in the existing language as well as other essential components of soil gas control. The standards included in this proposal have been vetted and approved by EPA, multiple regulatory states, and HUD.
505.0 Product-Conveying Systems.

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

SUBSTANTIATION:
Product conveying ducts are classified by the substances considered to be abrasive. Class 4 (highly abrasive material) is not defined and there are no substances indicated to be highly abrasive. The addition of the highly abrasive materials will assist the code official in classifying Class 4 product conveying ducts.
Item #: 120
UMC 2024  Section: 506.1

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION: 
Revise text

506.0 Product-Conveying Ducts.
506.1 Materials. Materials used in product-conveying duct systems shall be suitable for the intended use and shall be of rigid sheet metal.

Exceptions:
(1) Asbestos-cement, concrete, clay, or ceramic materials shall be permitted to be used where it is shown that these materials will be equivalent to metal ducts installed in accordance with this chapter.
(2) Ducts serving a Class 5 system shall be permitted to be constructed of approved nonmetallic material where the corrosive characteristics of the material being conveyed make a metal system unsuitable and where the mixture being conveyed is nonflammable.
    Approved nonmetallic material shall be either a listed product having a flame-spread index not exceeding 25 and a smoke-developed rating of 50 or less on both inside and outside surfaces without evidence of continued progressive combustion, or shall have a flame-spread index not exceeding 25 and shall be installed with an automatic fire-sprinkler protection system inside the duct.
(3) Ducts used in central vacuum cleaning systems within a dwelling unit shall be constructed of materials in accordance with ASTM F2158 or the applicable standards referenced in Chapter 17. Penetrations of fire walls or floor-ceiling or roof-ceiling assemblies shall be in accordance with the building code.
    Copper or ferrous pipes or conduits extending from within the separation between a garage and dwelling unit to the central vacuuming unit shall be permitted to be used.
    Aluminum ducts shall not be used in systems conveying flammable vapors, fumes, or explosive dusts, nor in Class 2, 3, or 4 systems. Galvanized steel and aluminum ducts shall not be used where the temperature of the material being conveyed exceeds 400°F (204°C).
    Metal ducts used in Class 5 systems that are not resistant to the corrosiveness of the product shall be protected with an approved corrosion-resistant material.

SUBSTANTIATION:
This code change clarifies that product conveying ducts shall be of “rigid sheet” metal as simply stating “metal” is vague and could be interpreted as metallic flexible or metal semi-rigid ducts.
Proposals

Item #: 121

UMC 2024  Section: 505.11.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

505.0 Product-Conveying Systems.

505.11 Hoods and Enclosures. (remaining text unchanged)

505.11.1 Fume Hoods. Where installed, fume hoods used for exhausting flammable vapors shall be listed and labeled in accordance with UL 1805.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 1805-2002</td>
<td>Laboratory Hoods and Cabinets (with revisions through June 2, 2006)</td>
<td>Hoods</td>
<td>505.11.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1805 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The applicable standard for fume hoods used for exhausting hazardous and flammable vapors is UL 1805, Standard for Laboratory Hoods and Cabinets.

[Digital View for UL Standards: https://www.shopulstandards.com/Catalog.aspx]
Proposals

Item #: 122
UMC 2024  Section: 506.6

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

506.0 Product-Conveying Ducts.

506.6 Explosion Venting. Ducts conveying explosive dusts shall have explosion vents, openings protected by anti-flashback swing valves, or rupture diaphragms. Openings to relieve explosive forces shall be located outside the building. Where relief devices cannot provide sufficient pressure relief, ductwork shall be designed to withstand an internal pressure of not less than 100 pounds-force per square inch (psi) (689 kPa).

Where a room or building contains a dust explosion hazard that is external to protected equipment, as defined in NFPA 654, such areas shall be provided with deflagration venting to a safe outside location.

Systems exhausting explosive mixtures shall be protected by an approved explosion relief or prevention system in accordance with NFPA 69.

Note: NFPA 69 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
NFPA 69, Explosion Prevention Systems, is being added as the industry standard for systems exhausting explosive mixtures.
Proposals

Item #: 123
UMC 2024 Section: 507.1, 507.2, 519.3, 519.3.1

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

507.0 General Requirements.
507.1 Type I Hood Exhaust Systems. Exhaust systems serving Type I hoods shall comply with Section 507.0 through Section 518.0. Exhaust systems serving Type II hoods shall comply with Section 519.0.
507.2 Type I Hood Exhaust System Requirements. (remaining text unchanged)

519.0 Type II Hood Exhaust System Requirements.

519.3 Type II Hood Exhaust System Net Airflow. The net airflow for Type II hoods shall be in accordance with Section 508.5.1.5 for light-duty cooking appliances. The net airflow for Type II hoods serving dishwashing appliances shall comply with Section 519.3.1.
519.3.1 Dishwashing Appliances. The net airflow for Type II hoods used for dishwashing equipment shall be not less than 200 cubic feet per minute (0.094 m$^3$/s) per linear foot (m) of hood length.

(below shown for reference only)

508.5.1.5 Light-Duty Cooking Appliances. The minimum net airflow for hoods used for cooking appliances such as gas and electric ovens (including standard, bake, roasting, revolving, retherm, convection, combination convection/steamer, rotisserie, countertop conveyorized baking/finishing, deck, and pastr), discrete element ranges (with or without oven), electric and gas steam-jacketed kettles less than 20 gallons (76 L), electric and gas pasta cookers, electric and gas compartment steamers (both pressure and atmospheric), electric and gas cheese melters, electric and gas tilting skillets (braising pans) electric and gas rotisseries, and electric and gas salamanders shall be in accordance with Table 508.5.1.5.

SUBSTANTIATION:
Section 507.1 is being revised to clarify that Type II hoods shall comply with Section 519.0. Furthermore, a new section is being added for Type II exhaust systems to specify the required net airflow for such systems.
Item #: 124
UMC 2024 Section: 508.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

508.0 Type I Hoods.  
508.1 Where Required. Type I hoods shall be installed at or above commercial-type deep-fat fryers, broilers, grills, hot-top ranges, ovens, barbecues, rotisseries, and similar equipment that emits comparable amounts of smoke or grease in a food-processing establishment. For the purpose of this section, a food-processing establishment shall include a building or portion thereof used for the processing of food, but shall not include a dwelling unit.

Exceptions:
(1) Cooking appliances that are listed and labeled in accordance with UL 710B for reduced emissions where the grease discharge does not exceed 2.9 E-09 ounces per cubic inch (oz/in$^3$) (5.0 E-06 kg/m$^3$) where operated with a total airflow of 500 cubic feet per minute (CFM) (0.236 m$^3$/s).
(2) Recirculating systems listed in accordance with UL 710B and installed in accordance with Section 516.0.
(3) Solid-fuel-fired ovens that are listed and labeled in accordance with UL 2162 and that are vented in accordance with the manufacturer's instructions with venting systems complying with UL 103 and UL 1978.
(4) Listed and labeled cooking appliances with integral downdraft systems that comply with Section 518.0.

(below shown for reference only)

518.0 Downdraft Appliances.  
518.1 General. Downdraft appliance ventilation system containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:
(1) The clearance requirements of Section 507.4 through Section 507.4.3.3.
(2) The primary collection means designed for collecting cooking vapors and residues complying with the requirements of Section 508.0.
(3) Grease removal devices complying with Section 509.0.
(4) Special-purpose filters as listed in accordance with UL 1046.
(5) Exhaust ducts complying with Section 510.0.
(6) The air movement requirements of Section 511.2.1 and Section 511.2.2.
(7) Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.
(8) Fire-extinguishing equipment complying with the requirements of Section 513.0, and as specified in Section 518.3.
(9) The use and maintenance requirements of Section 514.0.
(10) The minimum safety requirements of Section 515.0. [NFPA 96:15.1.1]

518.2 Ventilation System. The downdraft appliance ventilation system shall be capable of capturing and containing all the effluent discharge from the appliance(s) it is serving. [NFPA 96:15.1.2]

518.3 Fire-Extinguishing Equipment. For fire-extinguishing equipment on downdraft appliance ventilation systems, the following shall apply:
(1) Cooking surface, duct, and plenum protection shall be provided.
(2) At least one fusible link or heat detector shall be installed within each exhaust duct opening in accordance with the manufacturer's listing.
(3) A fusible link or heat detector shall be provided for each protected cooking appliance located in the plenum area of that appliance or in accordance with the extinguishing system manufacturer's listing.
(4) A manual activation device shall be provided as part of each appliance at a height acceptable to the Authority Having Jurisdiction.
Portable fire extinguishers shall be provided in accordance with Section 513.10 through Section 513.11. [NFPA 96:15.2]

518.3.1 Integral Fire-Extinguishing System. A listed downdraft appliance ventilation system employing an integral fire-extinguishing system including detection systems that has been evaluated for grease and smoke capture, fire extinguishing, and detection shall be considered as complying with Section 518.3. [NFPA 96:15.2.1]

518.3.2 Interlocks. The downdraft appliance ventilation system shall be provided with interlocks such that the cooking fuel supply will not be activated unless the exhaust and supply air systems have been activated. [NFPA 96:15.2.2]

518.4 Airflow Switch or Transducer. An airflow switch or transducer shall be provided after the last filter component to ensure that a minimum airflow is maintained. [NFPA 96:15.3.1]

518.4.1 Interlocks. The airflow switch or transducer shall open the interlock circuit when the airflow falls 25 percent below the system’s normal operating flow or less than 10 percent its listed minimum rating, whichever is lower. [NFPA 96:15.3.2]

518.4.2 Manual Reset. The airflow switch or transducer shall be a manual reset device or circuit. [NFPA 96:15.3.3]

518.5 Surface Materials. Any surface located directly above the cooking appliance shall be of noncombustible or limited-combustible materials. [NFPA 96:15.4]

Note: The UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The requirements for the reduced emissions testing for cooking appliances, as covered by Exception 1, have been incorporated into UL 197. NFPA 96 includes requirements for cooking appliances with integral downdraft exhaust systems which do not require a Type I hood above. Solid fuel fired ovens that are listed and labeled to UL 2162 that have been evaluated for connection with venting systems that comply with both UL 103 (chimneys) and UL 1978 (grease ducts) do not need to have a Type I hood above. The downdraft appliances covered in Section 518.0 of this code do not need a Type I hood above.
Proposals

Item #: 125

UMC 2024  Section: 508.1(1)

SUBMITTER: Maria Yepremian
County of Los Angeles Building and Safety

RECOMMENDATION:
Revise text

508.0 Type I Hoods.
508.1 Where Required. Type I hoods shall be installed at or above commercial-type deep-fat fryers, broilers, grills, hot-top ranges, ovens, barbecues, rotisseries, and similar equipment that emits comparable amounts of smoke or grease in a food processing establishment. For the purpose of this section, a food-processing establishment shall include a building or portion thereof used for the processing of food, but shall not include a dwelling unit.

Exceptions:
(1) A Type I hood shall not be required for a cooking appliance that is listed in accordance with UL 710B for reduced emissions where the grease discharge does not exceed 2.9 E-09 ounces per cubic inch (oz/in\(^3\)) (5.0 E-06 kg/m\(^3\)) where operated with a total airflow of 500 cubic feet per minute (cfm) (0.236 m\(^3\)/s).
(2) Recirculating systems listed in accordance with UL 710B and installed in accordance with Section 516.0.

SUBSTANTIATION:
Section 508.1 exception (1) is being revised as exception (1) is creating confusion during plan check and in the field for AHJs. Many in the field are interpreting this section as excepting hoods altogether. However, this section only exempts the use of Type I hoods, not the use of Type II hoods. Type II hoods shall be required when excessive heat and/or steam is being emitted. UL 710B only tests hoods to be exempt from grease applications but not for excessive heat or steam such as bread ovens. In addition, exception (1) does not have language specifying that the cooking appliance must be "listed" in accordance with UL 710B, which is causing issues for AHJs. The phrase "listed in accordance with" should be used in exception (1) the same way as exception (2).
Proposals

Item #: 126
UMC 2024 Section: 506.9, 508.4

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Revise text

508.0 Type I Hoods.

508.4 Supports. Hoods shall be secured in place to resist lateral loads by noncombustible supports. The supports shall be capable of supporting the expected weight of the hood and plus 800 pounds (362.9 kg).

506.0 Product-Conveying Ducts.

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

SUBSTANTIATION:
Lateral loads are live loads that are applied parallel to the ground; that is, they are horizontal forces acting on a structure and equipment. They are different to gravity loads, for example, which are vertical, downward forces. Significant lateral loads can be imposed on a structure during earth pressure, such as settlement, wind loads, water pressure, and earthquakes. Buildings, especially in areas of seismic activity, need to be carefully designed to ensure they do not fail if lateral loads should occur. Bracing can be used to resist lateral loads. The beams and columns of a braced frame structure carry vertical loads, while the bracing carries the lateral loads.

Additionally, ducts as well as exhaust equipment, such as rooftop exhaust fans, must be protected from damage.
Proposals

Item #: 127
UMC 2024 Section: 508.5.1.4

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION: Revise text

508.5 Hood Size. (remaining text unchanged)
508.5.1 Canopy Size and Location. (remaining text unchanged)

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

SUBSTANTIATION:
Inspectors have had difficulty classifying medium duty cooking appliances for Type I hood requirements. The code change adds language to assist the AHJ in requiring the correct Type I hood.
Proposals

Item #: 128

UMC 2024 Section: 510.1.8

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

510.0 Exhaust Duct Systems.
510.1 General. (remaining text unchanged)

510.1.8 Independent Grease Duct System. Single or combined Type I exhaust systems shall be independent of other exhaust systems.

SUBSTANTIATION:
It is industry standard that Type I hood duct systems are not to be combined unless they meet specific conditions. This code change addresses a requirement that is enforced in jurisdictions all over the country. Although independent exhaust ducts for environmental air exhaust systems are addressed in Section 504.2, those requirements are only applicable to environmental exhaust, which includes domestic kitchens, not commercial kitchens.
Proposals

Item #: 129
UMC 2024  Section: 510.6.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

510.0 Exhaust Duct Systems.

510.6 Exterior Installations. (remaining text unchanged)
510.6.1 Weather Protection. All ducts shall be protected on the exterior by paint or other suitable weather-protective coating. Duct constructed of stainless steel shall not be required to have additional paint or weather-protective coatings. Ductwork subject to corrosion shall not have minimal contact with the building surface. [NFPA 96:7.6.4 – 7.6.6]

Exception: Ducts constructed of stainless steel shall not be required to have additional paint or weather-protective coatings.

SUBSTANTIATION:
This change to Section 510.6.1 relocates a portion of the language into an exception for clarity and removes the term “minimal” as it is unenforceable language.
Proposals

Item #: 130

UMC 2024  Section: 510.9.1.1, 511.1.3.1

SUBMITTER: Maria Yepremian
County of Los Angeles Building and Safety

RECOMMENDATION:
Revise text

510.0 Exhaust Duct Systems.

510.9 Termination of Type I Hood Exhaust System. (remaining text unchanged)
510.9.1 Rooftop Terminations. (remaining text unchanged)
510.9.1.1 Listed Vibration Isolation Connectors. Listed vibration isolation connectors shall be permitted to be used on exterior roof locations where required for proper equipment vibration isolation:

(renumber remaining sections)

511.0 Air Movement.
511.1 Exhaust Fans for Commercial Cooking Operations. (remaining text unchanged)

511.1.3 Utility Set Exhaust Fans. (remaining text unchanged)
511.1.3.1 At the Rooftop. Fans installed at the rooftop termination point shall be in accordance with the following:
(1) Section 510.9.1 and Section 510.9.1.2.
(2) Vibration isolation Flexible connectors shall be permitted prohibited.
(3) A drain shall be directed to a readily accessible and visible grease receptacle not to exceed 1 gallon (4 L).

SUBSTANTIATION:
Section 510.9.1.1 (Listed Vibration Isolation Connectors) is being deleted as there currently is no listing for vibration isolation connectors applicable for grease duct applications. Section 510.9.1.1 is creating problems for the AHJ as there currently is no guidance in the UMC as to what the acceptable listing for such vibration isolation connector is. NFPA 96, which is the source document for the majority of provisions for commercial kitchen ventilation, prohibits the use of flexible connectors altogether per sections 8.1.3.3 and 8.1.4.5 of the 2017 edition. The UMC shall either provide the appropriate listing for flexible connectors or prohibit their use as they do in NFPA 96.
511.0 Air Movement.
511.1 Exhaust Fans for Commercial Cooking Operations. Exhaust fans shall be installed in accordance with Section 511.1.1 through Section 511.1.6. Exhaust fans shall comply be listed and labeled in accordance with UL 762 UL 705 and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 705-2017</td>
<td>Power Ventilators (with revisions through October 8, 2018)</td>
<td>Power Ventilators</td>
<td>504.4.2.3, 511.1</td>
</tr>
<tr>
<td>UL-762-2013</td>
<td>Power Roof Ventilators for Restaurant Exhaust Appliances</td>
<td>Ventilators</td>
<td>511.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 705 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
All the requirements in UL 762 have been moved into UL 705.
512.0 Auxiliary Equipment.

512.3 Other Equipment. Fume incinerators, thermal recovery units, air pollution control devices, or other devices shall be permitted to be installed in ducts or hoods or to be located in the path of travel of exhaust products where specifically listed for such use. [NFPA 96:9.3.1] Where installed, pollution control units shall be listed and labeled in accordance with UL 8782 and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 8782-2017</td>
<td>Outline of Investigation for Pollution Control Units for Commercial Cooking Operations</td>
<td>Miscellaneous</td>
<td>512.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 8782 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The appropriate standard for pollution control units is UL 8782, Pollution Control Units for Commercial Cooking. Section 512.3 (Other Equipment) is a proper location to include the standard for pollution control units.
Proposals

Item #: 133
UMC 2024  Section: 513.2.3, Table 1701.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Revise text

513.0 Fire-Extinguishing Equipment.

513.2 Types of Equipment. (remaining text unchanged)

513.2.3 Installation. Approved automatic fire-extinguishing systems shall be installed in accordance with the terms of their listing, the manufacturer’s installation instructions, and the following standards where applicable:
(1) A carbon dioxide extinguishing system in accordance with NFPA 12.
(2) An automatic water sprinkler system in accordance with NFPA 13.
(3) A dry chemical extinguishing system in accordance with NFPA 17.
(4) A wet chemical extinguishing system in accordance with NFPA 17A.
(6) A fixed aerosol extinguishing system in accordance with NFPA 2010.

TABLE 1701.1
REFERRED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
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<tbody>
<tr>
<td>NFPA 2001-2018</td>
<td>Clean Agent Fire Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3</td>
</tr>
<tr>
<td>NFPA 2010-2020</td>
<td>Fixed Aerosol Fire-Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3</td>
</tr>
</tbody>
</table>

Note: NFPA 2001 and NFPA 2010 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 513.2.3 is not complete with the applicable fire protection systems. The section is being completed with the additional applicable fire protection system standards as well as the application of each standard for easy reference.

Item (5) adds Clean Agent systems which utilize gases that are safe for humans and the environment. These systems are ideal for all occupied spaces. The clean agent is discharged as a gas. The gas is an electrically non-conductive and is designed to interrupt the combustion process to extinguish the fire but not damage sensitive equipment.

Item (6) adds Aerosol fire suppressant which is a potassium-based aerosol that suppresses fire by chemically interfering with the free radicals of flame. These systems are great for protecting small enclosures. The AHJ can approve the fire protection method(s) based on the needs of the system.
Proposals

Item #: 134
UMC 2024  Section: 519.7

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

519.0 Type II Hood Exhaust System Requirements.

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

SUBSTANTIATION:
Type II exhaust systems, like Type I systems, shall not be combined with dissimilar exhaust systems. Although independent exhaust ducts for environmental air exhaust systems are addressed in Section 504.2, these requirements are only applicable to environmental air. A section is needed for Type II exhaust ducts.
Proposals

Item #: 135

UMC 2024  Section: Chapter 6

SUBMITTER:  IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.13.2 Supply Air Ducts to Listed Furnaces. Supply air ducts connecting to listed central heating furnaces shall have the same minimum clearance to combustibles as required for the furnace supply plenum for a distance of not less than 3 feet (914 mm) from the supply plenum. Clearance shall not be required beyond the 3 feet (914 mm) distance. [NFPA 54:10.3.2.7 10.3.3.7]

603.13.3 Supply Air Ducts to Unlisted Furnaces. Supply air ducts connecting to unlisted central heating furnaces equipped with temperature limit controls with a maximum setting of 250°F (121°C) shall have a minimum clearance to combustibles of 6 inches (152 mm) for a distance of not less than 6 feet (1829 mm) from the furnace supply plenum. Clearance shall not be required beyond the 6 feet (1829 mm) distance. [NFPA 54:10.3.2.8 10.3.3.8]

603.13.4 Furnace Plenums and Air Ducts. A furnace plenum supplied as a part of the air-conditioning appliance shall be installed in accordance with the manufacturer’s instructions. Where a furnace plenum is not supplied with the appliance, any fabrication and installation instructions provided by the manufacturer shall be followed. The method of connecting supply and return ducts shall facilitate proper circulation of air. Where the air conditioner is installed within an enclosure, the installation shall comply with Section 604.4. [NFPA 54:40.2.5 10.2.6]

604.0 Furnace Plenums and Air Ducts Used in Fuel-Gas Appliances.
604.1 Furnace Plenums and Air Ducts. Furnace plenums and air ducts shall be installed in accordance with this Chapter, and NFPA 90A or NFPA 90B. [NFPA 54:40.3.7.7 10.3.8.1]
604.2 Supplied as a Part of Furnace. A furnace plenum supplied as a part of a furnace shall be installed in accordance with the manufacturer’s instructions. [NFPA 54:40.3.7.8.2]
604.3 Not Supplied with the Furnace. Where a furnace plenum is not supplied with the furnace, any fabrication and installation instructions provided by the manufacturer shall be followed. The method of connecting supply and return ducts shall facilitate proper circulation of air. [NFPA 54:40.3.7.9 10.3.8.3]
604.4 Return Air. Where a furnace is installed so supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. Return air shall not be taken from the mechanical room containing the furnace. [NFPA 54:40.3.7.10.3.8.4]

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 6 is being revised to the latest edition of NFPA 54-2021.
Proposals

Item #: 136
UMC 2024  Section: 601.1

SUBMITTER: David Dias  
         Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

601.1 Applicability. Ducts and plenums that are portions of a heating, cooling, ventilation, or exhaust system shall comply with the requirements of this chapter, and Chapter 5 for exhaust ducts, and Chapter 7 for combustion air ducts.

SUBSTANTIATION:
This code change clarifies that ducts shall comply with Chapters 5, 6, and 7, as applicable.
Proposals

Item #: 137
UMC 2024  Section: 602.1

SUBMITTER: Christopher Ruch
National Energy Management Institute Committee (NEMIC)

RECOMMENDATION:
Revise text

602.0 Material.
602.1 General. Materials used for duct systems shall comply with Section 602.2 through Section 602.6 as applicable. Concealed building spaces or independent construction within buildings shall be permitted to be used as ducts or plenums. Gypsum board shall not be used for positive pressure ducts.

Exception: In healthcare facilities, medical office buildings, and buildings used for medical purposes, concealed spaces shall not be permitted to be used as ducts or plenums.

SUBSTANTIATION:
Per UMC 2021 – Concealed Spaces. That portion(s) of a building behind walls, over suspended ceilings, in pipe chases, attics, and elsewhere whose size might normally range from 1 ¾ inch (44 mm) stud spaces to 8 foot (2438 mm) interstitial truss spaces and that might contain combustible materials such as building structural members, thermal, electrical insulation, or both, and ducting. Such spaces have sometimes been used as HVAC plenum chambers.

A building engineers' ability to reduce pathogen transmission in existing buildings are limited by the original design of the mechanical systems, the original installation achieving design intent, and proper maintenance by a skilled, trained, and certified technician. Two of the approaches that a building engineer has at their disposal to reduce pathogen transmission are pressure barriers and airflow distribution.

Open ceiling plenum returns limit a building engineers' capabilities to reduce pathogen transmission by removing fundamental aspects of pressure barrier and airflow distribution strategies. In addition, ceiling plenum returns add additional safety concerns to daily maintenance tasks, infiltration, source control, introduction of additional airborne particulates that may compromise indoor air quality, and reduced ability to disinfect.

The COVID-19 pandemic has highlighted the need for all healthcare facilities, Medical Office Buildings, buildings used for medical purposes, or any building has high chance to be commandeered during a pandemic to act as a medical facility to be available to meet the needs of unforeseen public health care emergencies and reduce airborne pathogen transmission at the Engineering Control level.
Proposals

Item #: 138
UMC 2024  Section: 602.1

SUBMITTER: John R Hamilton
International Certification Board
Rep. DLS

RECOMMENDATION:
Revise text

602.0 Material.
602.1 General. Materials used for duct systems shall comply with Section 602.2 through Section 602.6 as applicable. Concealed building spaces or independent construction within buildings shall be permitted to be used as ducts or plenums. Gypsum board shall not be used for positive pressure ducts. Exception: In healthcare facilities, concealed spaces shall not be permitted to be used as ducts or plenums.

SUBSTANTIATION:
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum.
Proposals

Item #: 139
UMC 2024  Section: 602.1

SUBMITTER: John R Hamilton  
International Certification Board  
Rep. DLS

RECOMMENDATION: 
Revise text

602.0 Material. 
602.1 General. Materials used for duct systems shall comply with Section 602.2 through Section 602.6 as applicable. Concealed building spaces or independent construction within buildings shall be permitted to be used as ducts or plenums. Gypsum board shall not be permitted to be used as ducts or plenums used for positive pressure ducts. 
Exception: In healthcare facilities, concealed spaces shall not be permitted to be used as ducts or plenums.

SUBSTANTIATION: 
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum.
Proposals

Item #: 140
UMC 2024  Section: 602.1.1

SUBMITTER: John R Hamilton
    International Certification Board
    Rep. DLS

RECOMMENDATION:
Add new text

602.0 Material.
602.1 General. (remaining text unchanged)
602.1.1 Duct Construction. All HVAC ducts and plenums conveying air shall be built to SMACNA standards recognized in the HVAC industry, ANSI, or organizational standards for construction and installation.

SUBSTANTIATION:
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum.
Proposals

Item #: 141
UMC 2024  Section: 602.2, 602.2.5, Table 1701.1

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
(1) through (4) (remaining text unchanged)
(5) Products listed and labeled for installation within plenums in accordance with Section 602.2.1 through Section 602.2.3 602.2.5.
(6) through (8) (remaining text unchanged)

602.2.5 Water Distribution Piping. Nonmetallic water distribution piping in plenums shall be listed and labeled for use in plenums. Piping shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15 and, a peak optical density not exceeding 0.5, where tested in accordance with UL 2846, or shall have a flame spread index not to exceed 25 and a smoke developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723.

TABLE 1701.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>UL 2846-2014</td>
<td>Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics (with revisions through December 20, 2016)</td>
<td>Surface Burning Test, Plastic Pipe</td>
<td>602.2.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM E84, UL 723, and UL 2846 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Adds new section for inclusion of UL 2846, Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics, as an alternative plenum test standard to ASTM E84 / UL 723. This is similar to other standards in the UMC which are product specific, such as; UL 1887 (602.2.2 Fire Sprinkler Piping) and UL 1820 (602.2.3 Pneumatic Tubing). The UL 2846 standard has been in the IMC since the 2014 version.
Proposals

Item #: 142

UMC 2024  Section: 602.2

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Revise text

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
(1) Return-air and outside-air ducts, plenums, or concealed spaces that serve a dwelling unit.
(2) Air filters in accordance with the requirements of Section 311.2.
(3) Water evaporation media in an evaporative cooler.
(4) Charcoal filters where protected with an approved fire suppression system.
(5) Products listed and labeled for installation within plenums in accordance with Section 602.2.1 through Section 602.2.3.
(6) Smoke detectors in accordance with the requirements of Section 609.0.
(7) Duct insulation, coverings, and linings and other supplementary materials installed in accordance with Section 605.0.
(8) Materials in a hazardous fabrication area including the areas above and below the fabrication area sharing a common air recirculation path with the fabrication area.

(below shown for reference only)

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 (ft\(^3\)/min) (0.9439 m\(^3\)/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 served by such equipment. Duct smoke detectors shall comply with UL 268A and shall be installed in accordance with the manufacturer’s installation instructions. Such devices shall be compatible with the operating velocities, pressures, temperatures, and humidities 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.

Exceptions:
(1) Where the space supplied by the air-moving equipment is served by a total coverage smoke-detection system in accordance with the fire code, interconnection to such system shall be permitted to be used to accomplish the required 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.

SUBSTANTIATION:
Early warning plays a key role in a facility’s ability to safely evacuate its residents during a fire emergency. As a result, a lot is riding on smoke detectors and the fire alarm system’s ability to operate and function properly. Smoke detectors are addressed in Section 609.0. A reference to Section 609.0 is being made in Section 602.2 as this provides ease of use for the end user and ensures that smoke detectors are installed correctly up-to-code.
Proposals

Item #: 143
UMC 2024  Section: 602.2

SUBMITTER: Michael Cudahy
Plastic Pipe & Fittings Association

RECOMMENDATION:
Revise text

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping Combustible materials installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
(1) through (8) (remain unchanged)

SUBSTANTIATION:
The language, being specific to only plastic piping suggests other combustible materials may not be required to be tested in accordance with or to all requirements of ASTM E84 or UL 723. The last sentence is redundant to the previous.
Proposals

Item #: 144

UMC 2024  Section: 602.2.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. (remaining text unchanged)

602.2.1 Electrical. Electrical wiring in plenums shall comply with NFPA 70. Electrical wires and cables and optical fiber cables exposed within the plenum shall be listed and labeled for use in plenums and shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15, and a peak optical density not exceeding 0.5, where tested in accordance with NFPA 262, or shall be installed in metal raceways or metal sheathed cable.

Combustible optical fiber and communication raceways exposed within a plenum shall be listed and labeled for use in plenums and shall have a flame spread distance not greater than 5 feet (1524 mm), an average optical density not greater than 0.15, and a peak optical density not exceeding 0.5, where tested in accordance with UL 2024. Only plenum-rated wires and cables shall be installed in plenum-rated raceways.

TABLE 1701.1
REFERENCED STANDARDS

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<thead>
<tr>
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<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 2024-2014</td>
<td>Cable Routing Assemblies and Communications Raceways (with revisions through August 5, 2015)</td>
<td>Miscellaneous</td>
<td>602.2.1</td>
</tr>
</tbody>
</table>

( порции таблицы не показаны, остаются неизменными)

Note: UL 2024 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This code change differentiates the requirements for electrical wiring and optical fiber cables in plenums from the requirements for optical fiber cable and communication raceways in plenums. The appropriate standard for the raceways is UL 2024, “Cable Routing Assemblies and Communications Raceways.”
Proposals

Item #: 145
UMC 2024  Section: 602.3

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

602.0 Material.

602.3 Tall Wood (Mass Timber) Buildings. Duct systems installed in Type IV-A, Type IV-B, or Type IV-C tall wood (mass timber) buildings shall comply with the following:

1. Be designed by a registered design professional in accordance with this code and the building code.
2. Duct systems shall have a flame-spread index and a smoke developed index in accordance with Section 602.2.
3. Smoke dampers, fire dampers, and ceiling dampers shall be in accordance with Section 606.0.
4. Be designed to accommodate expansion, contraction, and differential movement between parts of a mass timber building.

(renumber remaining sections)

(below shown for reference only)

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
1. Return-air and outside-air ducts, plenums, or concealed spaces that serve a dwelling unit.
2. Air filters in accordance with the requirements of Section 311.2.
4. Charcoal filters where protected with an approved fire suppression system.
5. Products listed and labeled for installation within plenums in accordance with Section 602.2.1 through Section 602.2.3.
6. Smoke detectors.
7. Duct insulation, coverings, and linings and other supplementary materials installed in accordance with Section 605.0.
8. Materials in a hazardous fabrication area including the areas above and below the fabrication area sharing a common air recirculation path with the fabrication area.

606.0 Smoke Dampers, Fire Dampers, and Ceiling Dampers.
606.1 Smoke Dampers. Smoke dampers shall comply with UL 555S, and shall be installed in accordance with the manufacturer’s installation instructions where required by the building code.
606.2 Fire Dampers. Fire dampers shall comply with UL 555, and shall be installed in accordance with the manufacturer’s installation instructions where required by the building code. Fire dampers shall have been tested for closure under airflow conditions and shall be labeled for both maximum airflow permitted and direction of flow. Where more than one damper is installed at a point in a single air path, the entire airflow shall be assumed to be passing through the smallest damper area.
Ductwork shall be connected to damper sleeves or assemblies in accordance with the fire damper manufacturer’s installation instructions.

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

606.4 Multiple Arrangements. Where size requires the use of multiple dampers, each damper shall be listed for use in multiple arrangements and installed in accordance with the manufacturer’s installation instructions.

606.5 Access and Identification. Fire and smoke dampers shall be provided with an approved means of access large enough to allow inspection and maintenance of the damper and its operating parts. The access shall not affect the integrity of the fire-resistance-rated assembly. The access openings shall not reduce the fire-resistance rating of the assembly.

Access shall not require the use of tools. Access doors in ducts shall be tight fitting and approved for the required duct construction. Access points shall be permanently identified on the exterior by a label with letters not less than 1/2 of an inch (12.7 mm) in height reading as one of the following:

1. Smoke Damper
2. Fire Damper
3. Fire/Smoke Damper

606.6 Freedom from Interference. Dampers shall be installed in a manner to ensure positive closing or opening as required by function. Interior liners or insulation shall be held back from portions of a damper, its sleeve, or adjoining duct that would interfere with the damper’s proper operation. Exterior materials shall be installed so as to not interfere with the operation or maintenance of external operating devices needed for the function of the damper.

606.7 Temperature Classification of Operating Elements. Fusible links, thermal sensors, and pneumatic or electric operators shall have a temperature rating or classification as in accordance with the building code.

SUBSTANTIATION:

The building codes include Type IV tall wood buildings (also known as mass timber construction) which are constructed with fire resistive ratings of either three or two hours. Proposed Section 602.3 provides information and direction for fire resistive ratings associated with mass timber construction.

There are no prescriptive requirements for allowance of expansion and contraction of mass timber buildings either during or after completion of construction. Current studies that are monitoring the moisture performance of mass timber building during construction utilize monitors, and there is indication that the mass timber expands during construction and contracts over time. The proposed Section 602.3 provides guidance for the mechanical system design within wood buildings constructed of Type IV-A, Type IV-B, or Type IV-C.

[Supporting documentation provided in KAVI for TC review]
Proposals

Item #: 146

UMC 2024  Section: 602.3.1, Table 602.3.1

SUBMITTER: Rudy B. Utulo, PE; Martin Espinosa
M & P Consulting Engineers, Inc.

RECOMMENDATION:
Add new text

602.0 Material.

602.3 Metallic. Ducts, plenums, or fittings of metal shall comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Flexible metallic ducts shall comply with UL 181.

602.3.1 Minimum Duct Thickness. Metallic ducts, plenums, or fittings shall have a thickness not less than that specified in Table 602.3.1 or in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

<table>
<thead>
<tr>
<th>DUCT DIAMETER</th>
<th>ALUMINUM B. &amp; S. GAUGE</th>
<th>STEEL-THICKNESS IN INCHES (STEEL-GALVANIZED SHEET GAUGE)</th>
<th>GIRTH JOINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW PRESSURE</td>
<td>LOW PRESSURE&lt;2&quot; WC</td>
<td>PRESSURE&lt;2&quot; &lt;10&quot; WC</td>
<td>MEDIUM &amp; HIGH PRESSURE</td>
</tr>
<tr>
<td></td>
<td>ROUND</td>
<td>ROUND</td>
<td>FLAT-OVAL</td>
</tr>
<tr>
<td>Up to 9</td>
<td>24</td>
<td>0.019 (26)</td>
<td>0.024 (24)</td>
</tr>
<tr>
<td>9 to 14</td>
<td>24</td>
<td>0.019 (26)</td>
<td>0.024 (24)</td>
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<tr>
<td>14 to 23</td>
<td>22</td>
<td>0.024 (24)</td>
<td>0.030 (22)</td>
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<tr>
<td>23 to 37</td>
<td>20</td>
<td>0.030 (22)</td>
<td>0.036 (20)</td>
</tr>
<tr>
<td>37 to 51</td>
<td>18</td>
<td>0.036 (20)</td>
<td>0.047 (18)</td>
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<tr>
<td>51 to 61</td>
<td>16</td>
<td>0.047 (18)</td>
<td>0.058 (16)</td>
</tr>
<tr>
<td>61 to 84</td>
<td>14</td>
<td>0.058 (16)</td>
<td>0.070 (14)</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 inch water gauge = 0.249 kPa
(1) For low pressure system any of the following joints are acceptable: butt slip, roll slip, snap slip, plenum lock and companion flange.
(2) Acceptable longitudinal seams for low-pressure systems: acme (grooved), snap lock, standing and spiral.
Note: The SMACNA standard was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The minimum duct sheet metal thickness table was removed from the 2009 UMC. This proposal adds the minimum sheet metal thickness for ducts that are commonly used in the industry.
Proposals

Item #: 147
UMC 2024 Section: 602.4, 602.4.4, Table 1701.1, Table 1701.2

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

602.0 Material.

602.4 Nonmetallic Ducts. Nonmetallic ducts shall comply with Section 602.4.1, Section 602.4.2, Section 602.4.3 or Section 602.4.4 through Section 602.4.5.

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

602.4.5 Other Materials. Flexible and rigid ducts, plenums, or fittings for use in heating, ventilation, and air conditioning systems of other nonmetallic materials listed and labeled to UL 181 shall be permitted.

Exception: Plastic ducts shall comply with Section 603.5.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMACNA-2003</td>
<td>Fibrous Glass Duct Construction Standards, Seventh Edition</td>
<td>Fiberglass Ducts</td>
<td>602.4.4</td>
</tr>
<tr>
<td>NAIMA-2002</td>
<td>Fibrous Glass Duct Construction Standards, Fifth Edition</td>
<td>Fiberglass Ducts</td>
<td>602.4.4</td>
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(portions of table not shown remain unchanged)

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Note: The SMACNA and NAIMA standards were not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A section for fibrous glass duct is being added to Chapter 6 as the UMC is currently silent on provisions for fibrous glass duct. There are two industry standards used for fibrous glass duct: SMACNA Fibrous Glass Duct Construction...
Standards and NAIMA Fibrous Glass Duct Construction Standards. The standards provide the performance characteristics for fibrous glass board as well as specifications for closures and illustrations of how to construct the full range of fittings. Also covered are details for connections to equipment and air terminals, hanger schedules, reinforcement requirements, fabrication of rectangular duct and fittings, closures of seams and joints, channel and tie rod reinforcements, and hangers and supports.
Proposals

Item #: 148

UMC 2024  Section: 602.4.4, 602.4.5, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

602.0 Material.

602.4 Nonmetallic Ducts. Nonmetallic ducts shall comply with Section 602.4.1, Section 602.4.2, Section 602.4.3 or Section 602.4.4 through Section 602.4.5.

602.4.4 Plastic Ducts. Plastic air ducts and fittings shall comply with ASTM D1784 and ASTM D2412 and shall be constructed of polyvinyl chloride (PVC). Plastic air ducts and fittings shall only be utilized in underground installations in accordance with Section 603.5 and Section 603.11. The maximum design temperature for systems utilizing plastic air duct and fittings shall be 150°F (66°C).

602.4.4 602.4.5 Other Materials. Flexible and rigid ducts, plenums, or fittings for use in heating, ventilation, and air conditioning systems of other nonmetallic materials listed and labeled to UL 181 shall be permitted.

Exception: Plastic ducts shall comply with Section 603.5.

(below shown for reference only)

603.0 Installation of Ducts.

603.5 Plastic Ducts. Plastic air ducts and fittings shall be permitted where installed underground and listed for such use.

603.11 Underground Installation. Ducts installed underground shall be approved for the installation and shall have a slope of not less than 1/8 inch per foot (10.4 mm/m) back to the main riser. Ducts, plenums, and fittings shall be permitted to be constructed of concrete, clay, or ceramics where installed in the ground or in a concrete slab, provided the joints are sealed and duct is secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Metal ducts where installed in or under a concrete slab shall be encased in not less than 2 inches (51 mm) of concrete, secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
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<tr>
<td>ASTM D1784-2020</td>
<td>Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds</td>
<td>Plastic ducts</td>
<td>602.4.4</td>
</tr>
<tr>
<td>ASTM D2412-2021</td>
<td>Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading</td>
<td>Plastic ducts</td>
<td>602.4.4</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM D 1784 and ASTM D 2412 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
Plastic air ducts and fittings are commonly used in underground applications. ASTM D1784 and ASTM D2412 are the appropriate standards for the testing of plastic ducts for tensile strength, modulus of elasticity, flexural yield strength, impact strength, deflection temperatures, flammability, and chemical resistance. Plastic duct fittings are manufactured with either high density polyethylene (HDPE) or polyvinyl chloride (PVC). Since plastic duct and fitting systems are installed below grade, they are not directly exposed to a fire within the building. Therefore, the fire characteristics of the duct and fittings would not be applicable to underground duct systems.
Proposals

Item #: 149
UMC 2024  Section: 602.6

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

602.0 Material.

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

SUBSTANTIATION:
As stated in this code change, the added sentence clarifies that corridors shall not serve as supply, return, exhaust,
relief, or ventilation air ducts except where permitted by the building code.
Proposals

Item #: 150

UMC 2024  Section: 603.1.1

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

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

SUBSTANTIATION:
Leaky ducts are a symptomatic problem within the industry. By requiring all ducts to be sealed to Seal Class A per the requirements of SMACNA HVAC Duct Construction Standards will decrease the issue, making a more reliable outcome for the end users.
Proposals

Item #: 151

UMC 2024  Section: 603.10

SUBMITTER: Randy Young  
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:  
Revise text

603.0 Installation of Ducts.

603.10 Cross Contamination. Exhaust ducts that convey Class 4 air shall be negatively pressurized relative to ducts, plenums, or occupiable spaces through which the ducts pass. Exhaust ducts under positive pressure that convey Class 2 or Class 3 air shall not extend into or pass through ducts, plenums, or occupiable spaces other than the space from which the exhaust air is drawn.

Exception: Exhaust ducts conveying Class 2 air and exhaust ducts conveying air from residential kitchen hoods that are sealed in accordance with Seal Class A of the SMACNA HVAC Air Duct Leakage Test Manual. (ASHRAE 62.1:5.2.1, 5.2.2)

SUBSTANTIATION:  
Leaky ducts are a symptomatic problem within the industry, by requiring all ducts to be sealed to Seal Class A per the requirements of SMACNA HVAC Duct Construction Standards will decrease the issue making a more reliable outcome for the end users. This exception will not be needed if other proposals for 603.9 and 603.1.1 are approved.
Proposals

Item #: 152
UMC 2024  Section: 603.11

SUBMITTER: Phil Pettit
            Control Air Conditioning Corporation
            Rep. Self

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.11 Underground Installation. Ducts installed underground shall be approved for the installation and shall have a slope of not less than 1/8 inch per foot (10.4 mm/m) back to the main riser. Underground Ducts, plenums, and fittings shall be permitted to be constructed of approved concrete, clay, or ceramics, metal, or plastic where installed in the ground or in a concrete slab, provided the joints are sealed and duct is secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Metal ducts where installed in or under a concrete slab shall be encased in not less than 2 inches (51 mm) of concrete, secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.

(below shown for reference only)

603.0 Installation of Ducts.

603.5 Plastic Ducts. Plastic air ducts and fittings shall be permitted where installed underground and listed for such use.

SUBSTANTIATION:
Plastic ducts are permitted to be installed underground per Section 603.5 (Plastic Ducts). Metal ducts are also allowed to be installed underground per the last sentence of Section 603.11 (Underground Installation). Therefore, metal and plastic need to be added to Section 603.11 to make it clear that these materials are permitted to be installed underground as long as they meet the requirements of this section and other applicable sections of the UMC.
Proposals

Item #: 153
UMC 2024 Section: 203.0, 602.4.3, 603.12

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION: Revise text

603.0 Installation of Ducts.

603.12 Fabric Air Dispersion Systems. Where installed, fabric air dispersion systems shall be completely in exposed locations in duct systems under positive pressure, and not pass through or penetrate fire-resistant-rated construction. Fabric air dispersion systems shall be listed and labeled in accordance with UL 2518.

Exception: Installation of under-floor air dispersion systems shall be permitted where listed and labeled for such use.

602.4.3 Fabric Air Dispersion Systems. Fabric air dispersion systems shall be listed and labeled in accordance with UL 2518.

203.0 – A –
Fabric Air Dispersion Systems. Materials such as fabrics or textiles intended for use in air handling systems in exposed locations operating under positive pressure. Also known as fabric duct, air socks, textile ventilation, or textile air dispersion systems.

SUBSTANTIATION:
Air dispersion systems that are listed and labeled for under-floor installation are used in the industry and allowed by jurisdictions. Under-floor air dispersion systems are designed to distribute and disperse air to perimeter and high-heat load locations in Under Floor Air Distribution (UFAD) Systems. Fabric duct for underfloor air dispersion is an ideal alternative to conventional metal ducting for more efficient cooling. Efficient and effective cooling is necessary to create a comfortable indoor environment. Fabric underfloor air dispersion systems are a unique method for delivering conditioned air in buildings or spaces. Ideal for high rise buildings, offices, hospitals, hotels, schools, airports, and other commercial buildings.

Fabric duct for underfloor cooling are based on displacement ventilation principles, requiring that the air stratifies from the floor to the ceiling, where it is either exhausted or recycled back into the conditioned space. Under-floor air dispersion systems reduce heat loss (temperature gain) or thermal decay over extended distances and to perimeter zones. Additionally, porous fabrics eliminate the risk of condensation to the ductwork.

This change clarifies that air dispersion systems are not always installed in completely exposed locations when they are under-floor systems. UL 2518 uses the term "fabric air dispersion system" throughout the standard. Additionally, the code change removes a requirement from the definition of “Air Dispersion Systems” to be installed “in exposed locations.” Section 603.12 already requires air dispersion systems to be installed “in exposed locations.”
Proposals

Item #: 154
UMC 2024  Section: 603.2, 608.9, 608.11

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.2 Under Floor or Crawl Space. Air ducts installed under a floor in a crawl space be installed in accordance with the following:
(1) Shall not prevent access to an area of the crawl space.
(2) Where it is required to move under ducts for access to areas of the crawl space, a vertical clearance of not less than 18 inches (457 mm) shall be provided.
(3) Diffusers, registers, or grilles shall not be installed in floors of toilet rooms, bathrooms, or high-humidity areas.

608.0 Use of Under-Floor Space as Supply Plenum for Dwelling Units.

608.9 Floor Registers. Floor registers shall be designed for easy removal in order to give access for cleaning the receptacles. Where installed, floor registers shall be located not less than 4 inches (102 mm) from the finished wall. Diffusers, registers, or grilles shall not be installed in floors of toilet rooms, bathrooms, or high-humidity areas.

608.11 Wall Registers. Each wall register shall be connected to the air chamber by a register box or boot. Diffusers, registers, or grilles in walls of toilet rooms, bathrooms, or high-humidity areas shall be installed not less than 6 inches (152 mm) above the finished floor.

SUBSTANTIATION:
There are currently no code requirements for floor registers installed in bathrooms, or high-humidity areas, such as laundry areas and kitchens. Although it is a poor design choice, there is no code language that I know of. Water (or other substances) from these areas can and will make it into the duct system, causing mold growth, rust, odors, and other issues. For example, a floor register located near a shower is subject to water entering the duct system; a floor register located near a toilet is subject to bodily fluids such as vomit or urine making it into the duct system, which can occur with children, elderly, infirm, or pets. This code requirement should be located in both the under floor duct installation section as well as the section for floor registers. An additional requirement for wall registers is being added to address the same issue.
Proposals

Item #: 155

UMC 2024  Section: 603.3.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.
603.1 General. (remaining text unchanged)

603.3.1 603.1.6 Earthquake Seismic Loads. Ducts located in structures that are installed in areas classified as seismic design category C, D, E, or F categories shall be restrained to resist displacement due to earthquake motion in accordance with the building code.

SUBSTANTIATION:
This proposal change removes the specific seismic design categories and addresses potential duct displacement, leaving the responsibility to the installer or designer. The section is also being relocated to apply to ducts in general rather than only metal ducts.
603.0 Installation of Ducts.

603.4 Flexible Air Ducts. (remaining text unchanged)

603.4.1 Length Limitation. Flexible air ducts shall be not more than 5 feet (1524 mm) in length and shall not be used in lieu of rigid elbows or fittings. Flexible air ducts shall be permitted to be used as an elbow at a terminal device.

Exceptions:

1. Residential occupancies.
2. Length limitations for flexible air ducts used as transition ducts for clothes dryers shall be in accordance with Section 504.4.2.2.

(below shown for reference only)

504.4.2.2 Transition Ducts. Listed clothes dryer transition ducts not more than 6 feet (1829 mm) in length shall be permitted to be used to connect the Type 1 dryer to the exhaust ducts. Transition ducts and flexible clothes dryer transition ducts shall not be concealed within construction, and shall be installed in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
Although clothes dryer transition ducts are flexible air ducts, they are not intended to be grouped in with the flexible air duct requirements of Section 603.4.1. There has been confusion in the field and with code officials as to whether semi-rigid ducts are limited to the 5-foot length limit in UMC Section 603.4.1. Therefore, an exception is needed to clarify that the length limitation in Section 603.4.1 does not apply to flexible clothes dryer transition ducts; such requirements are found in Section 504.4.2.2 (Transition Ducts).
603.5 Plastic Ducts. Plastic air ducts and fittings shall be permitted where installed underground in accordance with Section 603.11 and listed for such use.

(below shown for reference only)

603.11 Underground Installation. Ducts installed underground shall be approved for the installation and shall have a slope of not less than 1/8 inch per foot (10.4 mm/m) back to the main riser. Ducts, plenums, and fittings shall be permitted to be constructed of concrete, clay, or ceramics where installed in the ground or in a concrete slab, provided the joints are sealed and duct is secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Metal ducts where installed in or under a concrete slab shall be encased in not less than 2 inches (51 mm) of concrete, secured in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.

SUBSTANTIATION:
Plastic ducts are only permitted to be installed underground as stated in Section 603.5 (Plastic Ducts). The installation of underground ducts is addressed in Section 603.11 (Underground Installation). A reference in Section 603.5 would make it clear that plastic ducts must be installed underground per Section 603.11.
Proposals

Item #: 158
UMC 2024 Section: 603.6.1

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Add new text

603.0 Installation of Ducts.

603.6 Protection of Ducts. Ducts installed in locations where they are exposed to mechanical damage by vehicles or from other causes shall be protected by approved barriers. 

603.6.1 Weather Protection. Ducts installed on the exterior of the building shall be protected against the elements in accordance with Section 510.6.1.

(below shown for reference only)

510.6.1 Weather Protection. All ducts shall be protected on the exterior by paint or other suitable weather-protective coating. Ducts constructed of stainless steel shall not be required to have additional paint or weather-protective coatings. Ductwork subject to corrosion shall have minimal contact with the building surface. [NFPA 96:7.6.4 – 7.6.6]

SUBSTANTIATION:
Chapter 6 (Duct Systems) provides most of the duct requirements found in the UMC, however, there are some additional requirements from other chapters that apply to ducts in Chapter 6. For example, Section 510.6.1 applies to all ducts, not only exhaust ducts. Therefore, a reference to Section 510.6.1 would strengthen the code regarding weather protection of ducts installed on the exterior of buildings.
Proposals

Item #: 159
UMC 2024  Section: 603.9

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts. Joints and seams for duct systems shall comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Joints of duct systems shall be made substantially airtight by means of tapes, mastics, gasketing, or other means. All ducts shall be sealed to Seal Class A. Crimp joints for round ducts shall have a contact lap of not less than 11/2 inches (38 mm) and shall be mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint, or an equivalent fastening method.

SUBSTANTIATION:
Leaky ducts are a symptomatic problem within the industry. By requiring all ducts to be sealed to Seal Class A per the requirements of SMACNA HVAC Duct Construction Standards will decrease the issue, making a more reliable outcome for the end users.
603.0 Installation of Ducts.

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

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
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<td>SMACNA 002-2004</td>
<td>SMACNA Rectangular Industrial Duct Construction Standards</td>
<td>Ducts</td>
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<td>SMACNA 005-2013</td>
<td>SMACNA Round Industrial Duct Construction Standards</td>
<td>Ducts</td>
<td>603.9</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** The SMACNA standards do not meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

The “SMACNA HVAC Duct Construction Standards – Metal and Flexible” standard covers general ducts joints and seams; however industrial rectangular and round ducts can also have joints and seams in accordance with the SMACNA Industrial Standards. The SMACNA Industrial Standards are being added to the end of Section 603.9 (Joints and Seams of Ducts).

The SMACNA Round Industrial Duct Construction standard covers joints and seams for round industrial duct and provides a standardized, engineered basis for design and construction of industrial ducts of Classes 1 to 5 air. The standard includes a spiral duct chapter for Classes 1 and 2 air that covers design pressures ranging from 30 in. wg negative to 50 in. wg positive, plus carbon and galvanized steel tables and tables for stainless steel and aluminum, tables for duct sizes up to 96 in. diameter, and Duct Class 5 for systems handling corrosives and spiral lockseam pipe.

The SMACNA Rectangular Industrial Duct Construction standard covers joints and seams for rectangular industrial
duct and provides tables for stainless steels and aluminum, plus materials, welding practices, and a guide specification. It covers the simple, low or moderate temperature and pressure (or vacuum) indoor systems as well as the more complex outdoor systems that operate at moderate to high temperature and pressure (or vacuum), and are subject to higher and more complex external loading.
Proposals

Item #: 161
UMC 2024 Section: 603.9.2

SUBMITTER: Christopher Ruch
National Energy Management Institute Committee (NEMIC)

RECOMMENDATION:
Revises text

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts. (remaining text unchanged)

603.9.2 Duct Leakage Tests. Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual. Duct leakage tests shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB). Representative sections totaling not less than 10 percent of the total installed duct area shall be tested. Where the tested 10 percent fail to comply with the requirements of this section, then 40 percent of the total installed duct area shall be tested. Where the tested 40 percent fail to comply with the requirements of this section, then 100 percent of the total installed duct area shall be tested. Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork. The permitted duct leakage shall be not more than the following:

(remaining text unchanged)

SUBSTANTIATION:
Duct Air Leakage Testing should be limited to a certified Testing, Adjusting, and Balancing Technician (AABC, NEBB, or TABB). To provide accurate testing results, certified technicians must complete extensive training in the proper use of the SMACNA test methods, mechanical system understanding and the knowledge of the principles of air flow and pressure measurements. The listed certification organizations have proven methods for quality control. (See Supporting Material: TAB-Technical-Report-051220)

Section E 802.1, Commissioning Requirements, of the Uniform Mechanical Code set a precedent for similar requirements where an accurate verification of design intent is required.
Proposals

Item #: 162

UMC 2024 Section: 603.9.2, Table 1701.1, Table 1701.2

SUBMITTER: Mitch Pinsker
Affiliated Engineers Inc
Rep. ASHRAE Golden Gate Chapter Chair of Government Affairs Committee and Code Review Committee

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts.

603.9.2 Duct Leakage Tests. Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual and Table 603.9.2. Duct Locations in Table 603.9.2 shall be as defined in ASHRAE 90.1. Test A shall include testing of representative sections totaling not less than 40% of the total installed duct area for the designated Duct Application, Duct Location, and Pressure Class in Table 603.9.2 shall be tested. Where the tested 10% of Test A duct sections fail to comply with the leakage requirements of this section, then 40% of the total installed duct area in Table 603.9.2 shall be tested. Where the tested 40% of Test B duct sections fail to comply with the requirements of this section, then 100% of the total duct area in Table 603.9.2 shall be tested. Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork. The permitted duct leakage shall be not more than the following:

\[ L_{\text{max}} = C_L P \times 0.65 \] (Equation 603.9.2)

Where:

- \( L_{\text{max}} \) = maximum permitted leakage, \((\text{ft}^3/\text{min})/100\) square feet \([0.0001 \text{ (m}^3/\text{s})/\text{m}^2]\) duct surface area.
- \( C_L \) = six, duct leakage class, \((\text{ft}^3/\text{min})/100\) square feet \([0.0001 \text{ (m}^3/\text{s})/\text{m}^2]\) duct surface area at 1 inch water column (0.2 kPa).
- \( P \) = test pressure, which shall be equal to the design duct pressure class rating, inch water column (kPa).

Exception: Transfer air duct operating at less than 1 inch of water column (0.25 kPa). Testing is not required where the total duct surface area for a Duct Application, Duct Location, and Pressure Class row in Table 603.9.2 is less than 500 \(\text{ft}^2\) (46.45 \(\text{m}^2\)).

<table>
<thead>
<tr>
<th>TABLE 603.9.2</th>
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<tbody>
<tr>
<td>DUCT LEAKAGE TEST REQUIREMENTS</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>DUCT APPLICATION</th>
<th>DUCT LOCATION</th>
<th>PRESSURE CLASS</th>
<th>TEST A PERCENTAGE</th>
<th>TEST B PERCENTAGE</th>
<th>TEST C PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Outdoors</td>
<td>All</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Supply Return</td>
<td>Unconditioned spaces</td>
<td>=3 inch (0.75 kPa)</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 to 2 inch (0.25 to 0.5 kPa)</td>
<td>10</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;1 inch (0.25 kPa)</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Supply</td>
<td>Indirectly</td>
<td>=3 inch</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Exhaust conditioned spaces (including return air plenums)</td>
<td>(0.75 kPa)</td>
<td>2 inch (0.5 kPa)</td>
<td>&lt;2 inch (0.5 kPa)</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>-------------</td>
<td>------------------</td>
<td>-------------------</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>All Conditioned spaces</td>
<td>All</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>All Underground</td>
<td>All</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
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</table>

**TABLE 1701.1**
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

**TABLE 1701.2**
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

**Note:** ASHRAE/IES 90.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**Substantiation:**
Section 603.9.2 currently requires leakage testing of all ductwork regardless of location, application (e.g. supply vs. return vs. exhaust), and operating static pressure. This is at times onerous, e.g. simply installing a small tenant improvement with a handful of diffusers and small area of ductwork would require expensive testing. On the other hand, this section requires testing of only a small amount of ductwork outside of the building and high pressure ducts, yet leaks from these ducts have the largest impact on energy use. ASHRAE 90.1 requires testing of all exterior ductwork starting with 25% sampling as proposed here. The other testing requirements proposed in Table 603.9.2 are the same stringency as the current requirement for higher pressure classes. They are less stringent than the current requirement for lower pressure classes but still more stringent ASHRAE 90.1 which only requires testing of ductwork 3 inch pressure class and higher. Testing scope is broader for applications where leakage results in thermal heating and cooling impacts (e.g. supply air and return air ducts) as well as fan energy impacts.

An Exception is added for small projects with less than 500 square feet of duct area. This equates to a negligible 30 CFM of leakage for 1 inch pressure class.

Members of the Golden Gate ASHRAE chapter have submitted this recommendation to the ASHRAE 90.1 committee.
605.1.2 Duct Coverings and Linings. Insulation applied to the surface of ducts, including duct coverings, linings, tapes, and adhesives, located in buildings shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. Air duct coverings and linings shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250 F (121 C). Coverings shall not penetrate a fire-resistance-rate assembly. The duct coverings and linings shall be listed and labeled.

SUBSTANTIATION:
The proposed change will unify the listed and labeled requirements in the Uniform Mechanical Code and International Mechanical Code, Section 602.2.1.
605.0 Insulation of Ducts.
605.1 General. (remaining text unchanged)
605.1.2 Duct Coverings and Linings. Insulation applied to the surface of ducts, including duct coverings, linings, tapes, and adhesives, located in buildings shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. Air duct coverings and linings shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250°F (121°C). Coverings shall not penetrate a fire-resistance-rated assembly.

Exception: Polyurethane foam insulation shall be in accordance with Section 605.1.3.

605.1.3 Polyurethane Foam Insulation. Polyurethane foam insulation that is spray applied to the exterior of metallic ducts in attics and crawl spaces shall be tested in accordance with IAPMO/ANSI ES1000 and shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 450, where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. The foam plastic insulation shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250°F (121°C) nor shall such foam insulation be applied to flexible air ducts.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ANSI ES1000-2020</td>
<td>Spray Applied Polyurethane Foam</td>
<td>Miscellaneous</td>
<td>605.1.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM C411, ASTM E84, ASTM E2231, IAPMO/ANSI ES1000, and UL 723 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section for polyurethane foam insulation is being added to Chapter 6 under Insulation of Ducts as foam insulation requires a smoke-developed index not to exceed 450.
Proposals

Item #: 165

UMC 2024 Section: 605.2, Table 1701.1, Table 1701.2

SUBmitter: Keith Blazer
Self

RECOMMENDATION:
Add new text

605.0 Insulation of Ducts.

605.2 Duct Lining in Health Care Facilities. Duct lining materials shall not be installed within ducts, terminal boxes, sound traps, or other in-duct systems serving areas such as operating rooms, delivery rooms, post anesthesia care units, cystoscopy, cardiac catheterization labs, nurseries, intensive care units, newborn intensive care units, and airborne infection isolation rooms. Duct lining materials shall not be installed within ducts which are downstream of 99.97 percent High-Efficiency Particulate Air (HEPA) filters or filters with a Minimum Efficiency Rating Value (MERV) of 17.

Exception: Terminal filters with 90 percent average efficiency in accordance with ASHRAE 52.2 or a Minimum Efficiency Rating Value (MERV) of 14 installed downstream of the duct lining.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>ASHRAE 52.2-2017</td>
<td>Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size</td>
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<table>
<thead>
<tr>
<th>TABLE 1701.2</th>
<th>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOCUMENT NUMBER</td>
<td>DOCUMENT TITLE</td>
</tr>
<tr>
<td>ASHRAE 52.2-2012</td>
<td>General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASHRAE 52.2 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Health care facilities can benefit from the use of duct liner as a sound attenuator, although its use in these environments has been largely restricted due to duct liners having been generally associated with fiberglass, which can trap dirt and moisture and potentially support mold growth. Fiberglass degrades over time and may infiltrate the air stream, clogging filters. Elastomeric foam may be a solution as these problems do not apply to elastomeric foam, which is fiber-free with near zero moisture permeability. Still, it has been prohibited along with all other duct liners in certain critical care areas of hospitals. Previous guidelines prohibited the use of duct liner in any duct serving operating rooms, delivery rooms, LDR rooms, nurseries, protective environmental rooms, and critical care units. Now the use of duct liner is limited more by its location within the duct rather than the space the duct is serving. This gives engineers other options for sound attenuation in health care facilities.
Item #: 166

UMC 2024 Section: 606.10

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

606.0 Smoke Dampers, Fire Dampers, and Ceiling Dampers.

606.10 Where Required. Fire dampers, smoke dampers, combination fire/smoke dampers, ceiling radiation dampers, and corridor dampers shall be installed where required by the building code at locations including, but not limited to, the following:
(1) Fire walls
(2) Fire barriers
(3) Horizontal barriers
(4) Fire partitions
(5) Fire-rated corridors and smoke barriers
(6) Shaft enclosures
(7) Exterior walls
(8) Smoke partitions

SUBSTANTIATION:
The code currently sends the end user to the building code for where dampers are required. This code change assists the end user by listing where dampers are required without conflicting with the building code.
Proposals

Item #: 167
UMC 2024  Section: 606.3, Table 1701.1

SUBMITTER:  Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

606.0 Smoke Dampers, Fire Dampers, and Ceiling Dampers.

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

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCED STANDARDS</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>STANDARD NUMBER</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>UL 263-2011</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: ASTM E119 and UL 263 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 606.3 is being modified to clarify that ceiling radiation dampers shall either comply with UL 555C or shall be tested as part of a fire-resistance-rated floor-ceiling or roof-ceiling assembly in accordance with ASTM E119 or UL 263.
Proposals

Item #: 168
UMC 2024  Section: 206.0, 606.4, 606.5

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Add new text

606.0 Smoke Dampers, Fire Dampers, and Ceiling Dampers.
606.1 Smoke Dampers. Smoke dampers shall comply with UL 555S, and shall be installed in accordance with the manufacturer’s installation instructions where required by the building code.
606.2 Fire Dampers. Fire dampers shall comply with UL 555, and shall be installed in accordance with the manufacturer’s installation instructions where required by the building code. Fire dampers shall have been tested for closure under airflow conditions and shall be labeled for both maximum airflow permitted and direction of flow. Where more than one damper is installed at a point in a single air path, the entire airflow shall be assumed to be passing through the smallest damper area. Ductwork shall be connected to damper sleeves or assemblies in accordance with the fire damper manufacturer’s installation instructions.

606.4 Combination Fire/Smoke Dampers. Combination fire/smoke dampers shall comply with UL 555 and UL 555S and the requirements in Section 606.1 and Section 606.2.
606.5 Corridor Dampers. Corridor dampers shall comply with the requirements of combination fire/smoke dampers in Section 606.4.
(renumber remaining sections)

206.0    – D –
Damper. A valve or plate for controlling draft or the flow of gases, including air. [NFPA 211:3.3.52]

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

Note: UL 555 and UL 555S meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Sections for combination fire/smoke dampers and corridor dampers are being added to Chapter 6 for clarity on the requirements for such dampers. A definition for “corridor damper” is also being added.
Proposals

Item #: 169

UMC 2024  Section: 606.6, Table 1701.1, Table 1701.2

SUBMITTER: Keith Blazer  
Self

RECOMMENDATION:
Add new text

606.0 Smoke Dampers, Fire Dampers, and Ceiling Dampers.

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

(renumber remaining sections)

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>NFPA 80-2019</td>
<td>Fire Doors and Other Opening Protectives</td>
</tr>
<tr>
<td>NFPA 105-2019</td>
<td>Smoke Door Assemblies and Other Opening Protectives</td>
</tr>
</tbody>
</table>

Note: The NFPA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Regular testing and inspection of dampers is required to determine if a damper will function when needed to resist the spread of fire. The requirements of NFPA 80 or NFPA 105 shall apply for testing and inspections. Per these NFPA standards, the first inspection involves the function test or operational test, which must be completed after the damper is installed. Each damper must then be tested and inspected one year after installation. After the one-year inspection, fire dampers must be tested and inspected every four years for non-hospitals; every six years for hospitals.

NFPA 80 regulates the installation and maintenance of assemblies and devices used to protect openings in walls, floors, and ceilings against the spread of fire and smoke within, into, or out of buildings.

NFPA 105 prescribes the minimum requirements for smoke door assemblies and smoke dampers that are used to restrict the flow of smoke though openings to provide safety to life and protection of property.
Proposals

Item #: 170
UMC 2024  Section: 607.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Revise text

607.0 Ventilating Ceilings.
607.1 General. Perforated ceilings shall be permitted to be used for air supply within the limitations of this section. Exit corridors, where required to be of fire-resistant construction by the building code, shall not have ventilating ceilings. Ventilating ceilings shall not be permitted in health care facilities.

SUBSTANTIATION:
A ventilating ceiling, sometimes called a perforated ceiling, creates a downward uniform flow similar to the downward unidirectional flow for clean rooms. In most cases, ventilating ceilings discharge conditioned air through the entire ceiling to form a downward uniform flow, except in the area occupied by light troffers. Unidirectional flow requires a 60 to 90 fpm (0.3 to 0.45 m/s) air velocity and ultraclean air in the working area, and ventilating ceilings usually have a mean air velocity of less than 15 fpm (0.075 m/s) of conditioned air. There is no mixing of supply and space air in unidirectional flow; whereas just below the perforated ceiling, supply air is mixed with the ambient air at a vertical distance of less than 1 ft (0.3 m) in downward uniform flow from the ventilating ceiling. Although beneficial in other applications, ventilating ceilings shall not be permitted in health care facilities.
Proposals

Item #: 171
UMC 2024 Section: 609.1.1, Table 1701.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Add new text

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 served by such equipment. Duct smoke detectors shall comply with UL 268A and shall be installed in accordance with the manufacturer’s installation instructions. Such devices shall be compatible with the operating velocities, pressures, temperatures, and humidities 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.

Exceptions:
(1) Where the space supplied by the air-moving equipment is served by a total coverage smoke-detection system in accordance with the fire code, interconnection to such system shall be permitted to be used to accomplish the required 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 Smoke Detector Installation. Smoke detectors shall be installed in accordance with NFPA 72. Access shall be provided to smoke detectors for inspection and maintenance.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 72-2019</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
<td>609.1.1</td>
</tr>
</tbody>
</table>

(Note: NFPA 72 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.)

SUBSTANTIATION:
Smoke detectors are addressed in Section 609.0. A new section is being created for the installation of smoke detectors. Early warning plays a key role in a facility’s ability to safely evacuate its residents during a fire emergency. As a result, a lot is riding on the fire alarm system’s ability to operate and function properly. NFPA 72, National Fire Alarm and Signaling Code, applies to both residential and commercial buildings and is the model standard used by electricians, architects, engineers, builders, and inspectors to determine what features and
equipment must be included in a fire alarm system.

The NFPA 72 standard covers the application, installation, location, performance, and inspection, testing, and maintenance of fire alarm and emergency communications systems, including Mass Notification Systems (MNS). The standard also includes testing requirements for Energy Storage Systems (ESS) and requirements for HVLS fans and air-sampling smoke detectors which are important for designers, installers, and AHJs.

NFPA 72 also addresses nuisance alarms in several ways. First, all smoke alarms are required to be “listed” by a nationally recognized testing lab. The applicable standard for testing of smoke alarms is UL 217, which has some limited requirements for resistance to nuisances. Second, NFPA 72 has requirements for technology and spacing aimed to limit nuisance alarms.

Standards are constantly changing to adapt to new building technologies and development patterns. NFPA 72 is adopted and incorporated into local building codes by virtually every community in the U.S. in one form or another through their residential, fire, and building codes.
Proposals

Item #: 172

UMC 2024 Section: 311.2, 610.0, 610.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

311.0 Heating or Cooling Air System.

311.2 Air Filters. Air filters shall be installed in a heating, cooling, or makeup air system and shall comply with Section 610.0. Media-type air filters shall comply with UL 900. Electrostatic and high efficiency particulate filters shall comply with Section 936.0.

Exceptions:
(1) Systems serving single guest rooms or dwelling units shall not require a listed filter.
(2) Air filters used in listed appliances and in accordance with the manufacturer’s instructions.

610.0 Air Filters.

610.1 General. Air filters shall be installed in heating and air conditioning systems in accordance with Section 311.2. Ducts shall be constructed to allow an even distribution of airflow through the entire air filter. Air filters shall be installed so that all return air, outdoor air, and makeup air is filtered upstream from any heat exchanger or coil. Liquid adhesive coatings used on filters shall have a flash point of not less than 325°F (163°C).

SUBSTANTIATION:
The air filter requirements in Section 311.2 do not address the full scope of air filters. This proposal adds improvements to the current provisions for air filters such as how duct construction (Chapter 6) is related to air filter performance and the requirement that air must be filtered upstream from heat exchangers or coils. As several studies have shown, the role of filtration in maintaining clean heat exchanger coils and overall performance must not be overlooked.
Proposals

Item #: 173
UMC 2024  Section: Chapter 7

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

701.0 General.

701.4.2 Known Air Infiltration Rate Method. Where the air infiltration rate of a structure is known, the minimum required volume shall be determined as follows [NFPA 54:9.3.2.2]:

(1) For appliances other than fan-assisted, calculate using the following Equation 701.4.2(1). [NFPA 54:9.3.2.2(1)]

\[
\text{Required Volume}_{\text{other}} \geq \frac{21 \text{ft}^3}{\text{ACH}} \left( \frac{I_{\text{other}}}{1000 \text{ Btu/hr}} \right)
\]

[Equation 701.4.2(1)]

(2) For fan-assisted appliances, calculate using the following Equation 701.4.2(2). [NFPA 54: 9.3.2.2(2)]

\[
\text{Required Volume}_{\text{fan}} \geq \frac{15 \text{ft}^3}{\text{ACH}} \left( \frac{I_{\text{fan}}}{1000 \text{ Btu/hr}} \right)
\]

[Equation 701.4.2(2)]

Where:

- \( I_{\text{other}} \) = All appliances other than fan-assisted input (Btu/h)
- \( I_{\text{fan}} \) = Fan-assisted appliance input (Btu/h)
- \( \text{ACH} \) = Air change per hour (percent of volume of space exchanged per hour, expressed as a decimal)

For SI units: 1 cubic foot = 0.0283 m\(^3\), 1000 British thermal units per hour = 0.293 Kw

(3) For purposes of these calculations, an infiltration rate greater than 0.60 ACH shall not be used in the equations in Section Equation 701.4.2(1) and Section Equation 701.4.2(2). [NFPA 54:9.3.2.2(3)]

701.8 Engineered Installations. Engineered combustion air installations shall provide an adequate supply of combustion, ventilation, and dilution air and shall be approved by the Authority Having Jurisdiction determined using engineering methods. [NFPA 54:9.3.5]

701.11 Combustion Air Ducts. Combustion air ducts shall comply with the following [NFPA 54:9.3.8]:

(1) Ducts shall be constructed of galvanized steel or a material having equivalent corrosion resistance, strength, and rigidity.

Exception: Within dwellings units, unobstructed stud and joist spaces shall not be prohibited from conveying combustion air, provided that not more than one fireblock is removed. [NFPA 54:9.3.8.1]

(2) Ducts shall terminate in an unobstructed space, allowing free movement of combustion air to the appliances. [NFPA 54:9.3.8.2]

(3) Ducts shall serve a single space. [NFPA 54:9.3.8.3]
(4) Ducts shall not serve both upper and lower combustion air openings where both such openings are used. The separation between ducts serving upper and lower combustion air openings shall be maintained to the source of combustion air. [NFPA 54:9.3.8.4]

(5) Ducts shall not be screened where terminating in an attic space. [NFPA 54:9.3.8.5]

(6) Combustion air intake openings located on the exterior of the building shall have the lowest side of the combustion air intake openings located at least 12 inches (305 mm) vertically from the adjoining finished ground level. [NFPA 54:9.3.8.6]

(7) Horizontal upper combustion air ducts shall not slope downward toward the source of combustion air. [NFPA 54:9.3.8.6]

(8) The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry, metal, or factory built chimney shall not be used to supply combustion air. **Exception:** Direct vent appliances designed for installation in a solid fuel-burning fireplace where installed in accordance with the manufacturer’s installation instructions. [NFPA 54:9.3.8.7]

(9) Combustion air intake openings located on the exterior of the building shall have the lowest side of the combustion air intake openings located at least 12 inches (305 mm) vertically from the adjoining finished ground level. [NFPA 54:9.3.8.8]

**SUBSTANTIATION:**
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 7 is being revised to the latest edition of NFPA 54-2021.
Proposals

**Item #: 174**

**UMC 2024  Section: Chapter 8**

**SUBMITTER:** IAPMO Staff - Update Extracts

**NFPA 54 Extract Update**

**RECOMMENDATION:**

Revise text

**801.0 General.**

**802.1.1 Installation.** Listed chimneys and vents shall be installed in accordance with this chapter and the manufacturer’s installation instructions. [NFPA 54:12.2.1]

**802.2.6 Direct Vent Appliances.** Listed direct vent appliances shall be installed in accordance with the manufacturer’s installation instructions and Section 802.8. [NFPA 54:12.3.5.1]

**802.2.6.1 Through-the-Wall Vent Terminations.** Through-the-wall vent terminations for listed direct vent appliances shall be in accordance with Section 802.8. [NFPA 54:12.3.5.2]

**802.2.7 Appliances with Integral Vents.** Appliances incorporating integral venting means shall be installed in accordance with the manufacturer’s installation instructions and Section 802.8 and Section 802.8.1. [NFPA 54:12.3.6]

**802.2.8 Incinerators, Commercial–Industrial.** Commercial industrial-type incinerators shall be vented in accordance with NFPA 82. [NFPA 54:12.3.7]

**802.3.3.5 Exit Terminals.** The exit terminals of mechanical draft systems shall be not less than 7 feet (2134 mm) above finished ground level where located adjacent to public walkways and shall be located as specified in Section 802.8 and Section 802.8.1. [NFPA 54:12.4.3.6]

**802.3.4 Ventilating Hoods and Exhaust Systems.** Where automatically operated appliances, other than food service commercial cooking appliances, are vented through a ventilating hood or exhaust system equipped with a damper or with a power means of exhaust, provisions shall be made to allow the flow of gas to the main burners only when the damper is open to a position to properly vent the appliance and when the power means of exhaust is in operation. [NFPA 54:12.4.4.1]

**802.5.1 Factory-Built Chimneys.** Factory-built chimneys shall be listed in accordance with UL 103, UL 959, or UL 2561. Factory-built chimneys shall be installed in accordance with the manufacturer’s installation instructions. Factory-built chimneys used to vent appliances that operate at positive vent pressure shall be listed for such application. [NFPA 54:12.6.1.1]

**802.5.4 Termination.** A chimney for residential-type or low-heat appliances shall extend at least 3 feet (914 mm) above the highest point where it passes through a roof of a building and at least 2 feet (610 mm) higher than any portion of any building within a horizontal distance of 10 feet (3048 mm). [NFPA 54:12.6.2.1] (See Figure 802.5.4)

**802.5.5 Size of Chimneys.** The effective area of a chimney venting system serving listed appliances with draft hoods, Category I appliances, and other appliances listed for use with Type B vents shall be in accordance with one of the following methods:

1. Those listed in Section 803.0.
2. For sizing an individual chimney venting system for a single appliance with a draft hood, the effective areas of the vent connector and chimney flue of a venting system serving a single appliance with draft hood shall be not less than the area of the appliance flue collar or draft hood outlet or greater than seven times the draft hood outlet area.
3. For sizing the effective area of the chimney flue of a chimney venting system serving two appliances with draft hoods, the effective area of the chimney flue shall be not less than the area of the larger draft hood outlet plus...
50 percent of the area of the smaller draft hood outlet or greater than seven times the smaller draft hood outlet area.

(4) Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods. [NFPA 54:12.6.3.1]

802.5.7.1 Standard. Chimneys shall be lined in accordance with NFPA 211.

Exception: Existing chimneys shall be permitted to have their use continued when an appliance is replaced by an appliance of similar type, input rating, and efficiency, where the chimney complies with Section 802.5.7 through Section 802.5.7.3 and the sizing of the chimney is in accordance with Section 802.5.6. [NFPA 54:12.6.4.2]

802.5.8.1 Gas and Liquid Fuel-Burning Appliances. Where one chimney serves gas appliances and liquid fuel-burning appliances, the appliances shall be connected through separate openings or connected through a single opening where joined by a suitable fitting located as close as practical to the chimney. Where two or more openings are provided into one chimney flue, they shall be at different levels. Where the gas appliance is automatically controlled, it shall be equipped with a safety shutoff device. [NFPA 54:12.6.5.2]

### TABLE 802.6.1

| ROOF PITCH |
|------------|-----------|
| SLOPE HEIGHT |

[portion of table not show remains unchanged]

802.6.2.1 Category I Appliances. The sizing of natural draft venting systems serving one or more listed appliances equipped with a draft hood or appliances listed for use with a Type B gas vent, installed in a single story of a building, shall be in accordance with one of the following:

(1) The provisions of Section 803.0.

(2) Vents serving fan-assisted combustion system appliances, or combinations of fan-assisted combustion system and draft hood-equipped appliances, shall be sized in accordance with Section 803.0 or other approved engineering methods.

(3) For sizing an individual gas vent for a single, draft hood-equipped appliance, the effective area of the vent connector and the gas vent shall be not less than the area of the appliance draft hood outlet or greater than seven times the draft hood outlet area.

(4) For sizing a gas vent connected to two appliances with draft hoods, the effective area of the vent shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet or greater than seven times the smaller draft hood outlet area.

(5) Other approved engineering practices. [NFPA 54:12.7.4.1]

802.6.2.3 Category II, Category III, and Category IV Appliances. The sizing of gas vents for Category II, Category III, and Category IV appliances shall be in accordance with the appliance manufacturer's instructions. The sizing of plastic pipe specified by the appliance manufacturer as a venting material for Category II, III, and IV appliances shall be in accordance with the appliance manufacturers' instructions. [NFPA 54:12.7.4.3]

802.6.2.4 Sizing. Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods. [NFPA 54:12.7.4.4]

802.6.3 Gas Vents Serving Appliances on More than One Floor. A single-wall metal pipe passes through a roof constructed of combustible material, a noncombustible, nonventilating thimble shall be used at the point of passage. The thimble shall extend at least 18 inches (457 mm) above and 6 inches (152 mm) below the roof with the annular space open at the bottom and closed only at the top. The thimble shall be sized in accordance with Section 802.7.3.4 802.7.3.5. [NFPA 54:12.8.4.5]

802.7.3.4 Combustible Exterior Wall. Single-wall metal pipe shall not pass through a combustible exterior wall unless guarded at the point of passage by a ventilated metal thimble not smaller than the following:

(1) For listed appliances with draft hoods and appliances listed for use with Type B gas vents, the thimble shall be a minimum of 4 inches (102 mm) larger in diameter than the metal pipe. Where there is a run of not less than 6 feet (1829 mm) of metal pipe in the opening between the draft hood outlet and the thimble, the thimble shall be a minimum of 2 inches (51 mm) larger in diameter than the metal pipe.

(2) For unlisted appliances having draft hoods, the thimble shall be a minimum of 6 inches (152 mm) larger in diameter than the metal pipe.

(3) For residential and low-heat appliances, the thimble shall be a minimum of 12 inches (305 mm) larger in diameter than the metal pipe.

802.7.3.5 Roof Thimble. Where a single-wall metal pipe passes through a roof constructed of combustible material, a noncombustible, nonventilating thimble shall be used at the point of passage. The thimble shall extend at least 18 inches (457 mm) above and 6 inches (152 mm) below the roof with the annular space open at the bottom and closed only at the top. The thimble shall be sized in accordance with Section 802.7.3.4 802.7.3.5. [NFPA 54:12.8.4.5]
802.7.4 Size of Single-Wall Metal Pipe. Single-wall metal piping shall comply with the following requirements:
(1) A venting system of a single-wall metal pipe shall be sized in accordance with one of the following methods and the appliance manufacturer's instructions:
(a) For a draft hood-equipped appliance, in accordance with Section 803.0.
(b) For a venting system for a single appliance with a draft hood, the areas of the connector and the pipe each shall not be less than the area of the appliance flue collar or draft hood outlet, whichever is smaller. The vent area shall not be greater than seven times the draft hood outlet area.
(c) Other approved engineering methods.
(2) Where a single-wall metal pipe is used and has a shape other than round, it shall have an equivalent effective area equal to the effective area of the round pipe for which it is substituted and the minimum internal dimension of the pipe shall be 2 inches (51 mm).
(3) The vent cap or a roof assembly shall have a venting capacity not less than that of the pipe to which it is attached. [NFPA 54:12.8.5]

802.8 Through-the-Wall Vent Termination. Through-the-wall vent termination shall be in accordance with Section 802.8.1 through Section 802.8.3.
A mechanical draft venting system shall terminate at least 3 feet (914 mm) above any forced air inlet located within 10 feet (3048 mm). (See Figure 802.8)

Exceptions:
(1) This provision shall not apply to the combustion air intake of a direct vent appliance.
(2) This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of listed outdoor appliances. [NFPA 54:12.9.1]

802.8.1 Mechanical Draft Venting System. A mechanical draft venting system of other than direct vent type shall terminate not less than 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window, or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 12 inches (305 mm) above finished ground level. [NFPA 54:12.9.2]

802.8.2 802.8.1 Direct Vent Appliance Clearance for Through-the-Wall Vent Termination. The clearances for through-the-wall direct vent and non-direct vent terminals shall be in accordance with Table 802.8.2 802.8.1 and Figure 802.8.1. The bottom of the vent terminal and the air intake shall be located not less than 12 inches (305 mm) above finished ground level.

Exception: The clearances in Table 802.8.1 shall not apply to the combustion air intake of a direct vent appliance. [NFPA 54:12.9.3 12.9.1]

### TABLE 802.8.2 802.8.1 THROUGH-THE-WALL DIRECT VENT TERMINATION CLEARANCES
[NFPA 54: TABLE 12.9.3 12.9.1]

<table>
<thead>
<tr>
<th>DIRECT VENT APPLIANCE INPUT RATING</th>
<th>THROUGH-THE-WALL VENT TERMINAL CLEARANCE FROM ANY AIR OPENING INTO A BUILDING (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 000 Btu/h and less</td>
<td>6</td>
</tr>
<tr>
<td>Greater than 10 000 Btu/h and not exceeding 50 000 Btu/h</td>
<td>9</td>
</tr>
<tr>
<td>Greater than 50 000 Btu/h and not exceeding 150 000 Btu/h</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 150 000 Btu/h</td>
<td>In accordance with the appliance manufacturer's instructions and in no case less than the clearances specified in Section 802.8.1.</td>
</tr>
</tbody>
</table>

### FIGURE CLEARANCE

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

For SI Units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW
802.8.3 Category I through Category IV and Noncategorized Appliances. Through-the-wall vents for Category II and Category IV appliances and noncategorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment. Where local experience indicates that condensate is a problem with Category I and Category III appliances, this provision shall also apply. Drains for condensate shall be installed in accordance with the appliance and the vent manufacturer’s installation instructions. [NFPA 54: 12.9.4]

802.8.4 802.8.2 Annular Spaces. Where vents, including those for direct vent appliances or combustion air intake pipes, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using approved materials to prevent entry of combustion products into the building. [NFPA 54: 12.9.5]

802.8.5 802.8.3 Vent Terminals. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building.

Exception: This shall not apply to vent terminals that are 2 feet (610 mm) or more above or 25 feet (7620 mm) or more...
802.9 Condensation Drain. Provision shall be made to collect and dispose of condensate from venting systems serving Category II and Category IV appliances and noncategorized condensing appliances in accordance with Section 802.8.3. [NFPA 54:12.10.1]

802.9.1 Local Experience Installation. Where local experience indicates that condensation is a problem, provision shall be made to drain off and dispose of condensate from venting systems serving Category I and Category III appliances in accordance with Section 802.8.3 Drains for condensate shall be installed in accordance with the appliance and vent manufacturers’ installation instructions. [NFPA 54:12.10.2]

802.10.1.4 Medium-Heat Appliances. Vent connectors for medium-heat appliances shall be constructed of factory-built, medium-heat chimney sections or steel of a thickness not less than that specified in Table 802.10.1.4 and shall comply with the following:

1. A steel vent connector for an appliance with a vent gas temperature in excess of 1000°F (538°C) measured at the entrance to the connector shall be lined with medium-duty fire brick or the equivalent.
2. The lining shall be at least 2½ inches (64 mm) thick for a vent connector having a diameter or greatest cross-sectional dimension of 18 inches (457 mm) or less.
3. The lining shall be at least 4½ inches (114 mm) thick laid on the 4½ inches (114 mm) bed for a vent connector having a diameter or greatest cross-sectional dimension greater than 18 inches (457 mm).
4. Factory-built chimney sections, if employed, shall be joined together in accordance with the chimney manufacturer’s instructions. [NFPA 54:12.11.2.5]

802.10.2 Size of Vent Connector. A vent connector for an appliance with a single draft hood or for a Category I fan-assisted combustion system appliance shall be sized and installed in accordance with Section 803.0 or other approved engineering methods. [NFPA 54:12.11.3.1]

802.10.2.1 Manifold. For a single appliance having more than one draft hood outlet or flue collar is installed, the manifold shall be constructed according to the instructions of the appliance manufacturer. Where there are no instructions, the manifold shall be designed and constructed in accordance with approved engineering methods. As an alternative method, the effective area of the manifold shall equal the combined area of the flue collars or draft hood outlets, and the vent connectors shall have a minimum 1 foot (305 mm) rise. [NFPA 54:12.11.3.2]

802.10.2.2 Size. Where two or more appliances are connected to a common vent or chimney, each vent connector shall be sized in accordance with Section 803.0 or other approved engineering methods. [NFPA 54:12.11.3.3]

802.10.2.3 Height. Where two or more appliances are vented through a common vent connector or vent manifold, the common vent connector or vent manifold shall be located at the highest level consistent with available headroom and clearance to combustible material and sized in accordance with Section 803.0 or other approved engineering methods. [NFPA 54:12.11.3.5]

As an alternative method applicable only where there are two draft hood-equipped appliances, the effective area of the common vent connector or vent manifold and all junction fittings shall be not less than the area of the larger vent connector plus 50 percent of the area of the smaller flue collar outlet. [NFPA 54:12.11.3.6]

802.10.6 Connector Junctions. Where vent connectors are joined together, the connection shall be made with a manufactured tee or wye fitting. [NFPA 54:12.11.7]

802.10.6 Slope. A vent connector shall be installed without any dips or sags and shall slope upward toward the vent or chimney at least 1/4 inch per foot (20.8 mm/m). Exception: Vent connectors attached to a mechanical draft system installed in accordance with appliance and the draft system manufacturers’ instructions. [NFPA 54:12.11.8]

802.10.7.1 Single Wall Connector. The maximum horizontal length of a single-wall connector shall be 75 percent of the height of the chimney or vent, except for engineered systems. [NFPA 54:12.11.9.1]

802.10.7.2 Type B Double Wall Connector. The maximum horizontal length of a Type B double-wall connector shall be 100 percent of the height of the chimney or vent, except for engineered systems. The maximum length of an individual connector for a chimney or vent system serving multiple appliances, from the appliance outlet to the junction with the common vent or another connector, shall be 100 percent of the height of the chimney or vent. [NFPA 54:12.11.9.2]

802.10.8 Support. A vent connector shall be supported for the design and weight of the material employed to maintain clearances and prevent physical damage and separation of joints. [NFPA 54:12.11.10]

802.10.9 Chimney Connection. Where entering a flue in a masonry or metal chimney, the vent connector shall be installed above the extreme bottom to avoid stoppage. [NFPA 54:12.11.11.1] Where a thimble or slip joint is used to facilitate removal of the connector, the connector shall be firmly attached to or inserted into the thimble or slip joint to prevent the connector from falling out. [NFPA 54:12.11.11.2] Means shall be employed to prevent the connector from entering so far as to restrict the space between its end and the opposite wall of the chimney flue. [NFPA 54: 12.11.10]
802.10.10 Inspection. The entire length of a vent connector shall be readily accessible for inspection, cleaning, and replacement. [NFPA 54:12.11.14 12.11.12]

802.10.11 Fireplaces. A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace flue opening is permanently sealed. [NFPA 54:12.11.13]

802.10.12.1 Medium-Heat Appliances. Vent connectors for medium-heat appliances shall not pass through walls or partitions constructed of combustible material. [NFPA 54:12.11.14.2]

802.12 Appliances Requiring Draft Hoods and Draft Controls. Vented appliances shall be installed with draft hoods. Exception: Dual oven-type combination ranges; incinerators; direct vent appliances; fan-assisted combustion system appliances; appliances requiring chimney draft for operation; single-firebox boilers equipped with conversion burners with inputs greater than 400 000 Btu/h (117 kW); appliances equipped with blast, power, or pressure burners that are not listed for use with draft hoods; and appliances designed for forced venting. [NFPA 54:12.13.1]

802.12.1 Installation. A draft hood supplied with or forming a part of a listed vented appliance shall be installed without alteration, exactly as furnished and specified by the appliance manufacturer. [NFPA 54:12.13.2] If a draft hood is not supplied by the appliance manufacturer where one is required, a draft hood shall be installed, be of a listed or approved type, and, in the absence of other instructions, be of the same size as the appliance flue collar. Where a draft hood is required with a conversion burner, it shall be of a listed or approved type. [NFPA 54:12.13.2.1] Where a draft hood of special design is needed or preferable, the installation shall be approved and in accordance with the recommendations of the appliance manufacturer. [NFPA 54:12.13.2.2]


802.14.1 Listing. Automatically operated vent dampers for oil-fired appliances shall comply with UL 17. The automatic damper control shall comply with UL 378.

802.14.2 Engineering Methods. Draft regulators and safety controls specifically listed for installation in venting systems and installed in accordance with the manufacturer’s installation instructions.

802.15 Obstructions. Devices that retard the flow of vent gases shall not be installed in a vent connector, chimney, or vent. The following shall not be considered as obstructions:

1. Draft regulators and safety controls specifically listed for installation in venting systems and installed in accordance with the manufacturer’s installation instructions.
2. Approved draft regulators and safety controls designed and installed in accordance with approved engineering methods.
3. Listed heat reclaimers and automatically operated vent dampers installed in accordance with the manufacturer’s installation instructions.
4. Vent dampers serving listed appliances installed in accordance with Section 803.1 or Section 803.2 or other approved engineering methods.
5. Approved economizers, heat reclaimers, and recuperators installed in venting systems of appliances not required to be equipped with draft hoods, provided the appliance manufacturer’s instructions cover the installation of such a device in the venting system and performance in accordance with Section 802.3 and Section 802.3.1 is obtained. [NFPA 54:12.16]

803.1.5 Multiple-Input Ratings Two-Stage/Modulating Appliances. For appliances with more than one input rate, the minimum vent capacity (FAN Min) determined from Table 803.1.2(1) through Table 803.2(9) shall be less than the lowest appliance input rating, and the maximum vent capacity (FAN Max/NAT Max) determined from the tables shall be greater than the highest appliance rating input. [NFPA 54:13.1.6]

803.1.6 Corrugated Chimney Liner Reduction. Listed corrugated metallic chimney liner systems installed in masonry chimneys shall be sized by using Table 803.1.2(1) or Table 803.1.2(2) for Type B vents, with the maximum capacity reduced by 20 percent (0.80 x maximum capacity) and the minimum capacity as shown in Table 803.1.2(1) or Table 803.1.2(2).

C corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with Section 803.1.2. The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one long radius 90 degree (1.57 rad) turn at the bottom of the liner. [NFPA 54:13.1.7]

803.1.8 Vertical Vent Upsizing Using the 7 x Times Rule. Where the vertical vent has a larger diameter than the vent connector, the vertical vent diameter shall be used to determine the minimum vent capacity, and the connector diameter shall be used to determine the maximum vent capacity. The flow area of the vertical vent shall not exceed seven times the flow area of the listed appliance categorized vent area, flue collar area, or draft hood outlet area unless designed in
accordance with approved engineering methods. [NFPA 54:13.1.9]

803.1.14 Single Run of Vent Multiple Vertical Vent Sizes. In a single run of vent or vent connector, more than one diameter and type shall be permitted to be used, provided that all the sizes and types are permitted by the tables. [NFPA 54:13.1.14]

803.1.17 Engineering Methods. For Where a vent height is lower than 6 feet (1829 mm) and or higher than shown in Table 803.1.2(1) through Table 803.2(9), an engineering methods shall be used to calculate the vent capacities. [NFPA 54:13.1.17]

803.2 Multiple-Appliance Vent Table 803.2(1) through Table 803.2(9) Obstructions and Vent Dampers. (remaining text unchanged) [NFPA 54:13.2.1]

803.2.12 Vent Height. For The available total height (H) for multiple appliances all located on one the same floor; available total height (H) shall be measured from the highest draft hood outlet or flue collar up to the level of the outlet of the common vent. [NFPA 54:13.2.13]

803.2.13 Multistory Vent Height Installations. For multistory installations, Where appliances are located on more than one floor, the available total height (H) for each segment of the system shall be the vertical distance between the highest draft hood outlet or flue collar entering that segment and the centerline of the next higher interconnection tee. [NFPA 54:13.2.14]

803.2.15 Vent-Type Multistory Type B Vents Required Installation. (remaining text unchanged) [NFPA 54:13.2.16]

803.2.16 Offsets in Multistory Vent Offsets and Capacity Installations. (remaining text unchanged) [NFPA 54:13.2.17]

803.2.17 Vertical Vent Size Limitation. Where two or more appliances are connected to a vertical vent or chimney, the flow area of the largest section of vertical vent or chimney shall not exceed seven times the smallest listed appliance categorized vent areas, flue collar area, or draft hood outlet area unless designed in accordance with approved engineering methods. [NFPA 54:13.2.18]

803.2.18 Multiple Input Ratings Two-Stage/Modulating Appliances. For appliances with more than one input rate, the minimum vent connector capacity (FAN Min) of appliances with more than one input rate shall be determined from the tables and shall be less than the lowest appliance input rating and the maximum vent connector capacity (FAN Max or NAT Max) shall be determined from the tables shall be greater than the highest appliance input rating. [NFPA 54:13.2.19]

803.2.22 Combination of Pipe Types and Multiple Vent and Connector Sizes. All combinations of pipe sizes, single-wall metal pipe, and double-wall metal pipe shall be allowed within any connector run(s) or within the common vent, provided ALL of the appropriate tables permit ALL of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent. Where single-wall and Type B double-wall metal pipes are used for vent connectors within the same venting system, the common vent shall be sized using Table 803.2(2) or Table 803.2(4) as appropriate. [NFPA 54:13.2.25]

803.2.26 Engineering Methods Sizing Vents Not Covered by Tables. For vent heights lower than 6 feet (1829 mm) and higher than shown in the tables, engineering methods shall be used to calculate vent capacities. [NFPA 54:13.2.29]

Note: UL 378 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 8 is being revised to the latest edition of NFPA 54-2021.
802.0 Venting of Appliances.

802.10.2 Size of Vent Connector. (remaining text unchanged)

802.10.12 Passage Through Ceilings, Floors, or Walls. A vent connector shall not pass through a ceiling, floor, or fire-resistance-rated wall. A single-wall metal pipe connector shall not pass through an interior wall.

Exception:
(1) Vent connectors made of listed Type B or Type L vent material and serving listed appliances with draft hoods and other appliances listed for use with Type B gas vents that pass through walls or partitions constructed of combustible material shall be installed with not less than the listed clearance to combustible material.
(2) Connectors shall be permitted to pass through ceilings, floors, or walls in accordance with Section 802.7.3.1 and Section 802.7.3.4.

(below shown for reference only)

802.7.3.1 Limitations. Single-wall metal pipe shall be used only for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air. A pipe passing through a roof shall extend without interruption through the roof flashing, roof jacket, or roof thimble. [NFPA 54:12.8.4.2]

802.7.3.4 Combustible Exterior Wall. Single-wall metal pipe shall not pass through a combustible exterior wall unless guarded at the point of passage by a ventilated metal thimble not smaller than the following:
(1) For listed appliances with draft hoods and appliances listed for use with Type B gas vents, the thimble shall be a minimum of 4 inches (102 mm) larger in diameter than the metal pipe. Where there is a run of not less than 6 feet (1829 mm) of metal pipe in the opening between the draft hood outlet and the thimble, the thimble shall be a minimum of 2 inches (51 mm) larger in diameter than the metal pipe.
(2) For unlisted appliances having draft hoods, the thimble shall be a minimum of 6 inches (152 mm) larger in diameter than the metal pipe.
(3) For residential and low-heat appliances, the thimble shall be a minimum of 12 inches (305 mm) larger in diameter than the metal pipe.

Exception: In lieu of thimble protection, all combustible material in the wall shall be removed a sufficient distance from the metal pipe to provide the specified clearance from such metal pipe to combustible material. Any material used to close up such opening shall be noncombustible. [NFPA 54:12.8.4.6]

SUBSTANTIATION:
The intent of the exception to Section 802.10.12 is further clarified by directing the end user to Section 802.7.3.1 and Section 802.7.3.4 which permit connectors to pass through ceilings, floors, or wall and are specified in the indicated sections. This change will clarify the intent of Section 802.10.12 and avoid any confusion between the sections.
Proposals

Item #: 176
UMC 2024 Section: 802.5.1.1, 1002.5, 1202.2, 1203.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

802.0 Venting of Appliances.

802.5 Masonry, Metal, and Factory-Built Chimneys. (remaining text unchanged)
802.5.1 Factory-Built Chimneys. (remaining text unchanged)
802.5.1.1 Decorative Shrouds. Decorative shrouds addressed in Section 802.5.4.3 shall be listed or and labeled in accordance with UL 103 for factory-built residential chimneys, UL 127 for factory-built fireplaces, or UL 1482 for solid-fuel room heaters.

1002.0 Standards.

1002.5 Dual Purpose Water Heaters. Water heaters utilized for combined space- and water-heating applications shall be listed or and labeled in accordance with the standards referenced in Table 1203.2, and shall be installed in accordance with the manufacturer’s installation instructions.

1202.0 Protection of Potable Water Supply.

1202.2 Chemical Injection. Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by a reduced-pressure principle backflow prevention assembly listed or and labeled in accordance with ASSE 1013. Such additive or chemical shall be compatible with system components.

1203.0 Capacity of Heat Source.

1203.2 Dual Purpose Water Heaters. Water heaters utilized for combined space-heating and water-heating applications shall be listed or and labeled in accordance with the standards referenced in Table 1203.2, and shall be installed in accordance with the manufacturer’s installation instructions. The total heating capacity of a dual purpose water heater shall be based on the sum of the potable hot water requirements and the space heating design requirements corrected for hot water first-hour draw recovery.

SUBSTANTIATION:
This proposal changes “listed or labeled” to “listed and labeled” to clarify the intention of the language.
Proposals

Item #: 177
UMC 2024  Section: 802.6.1.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

802.6 Gas Vents. (remaining text unchanged)
802.6.1 Gas Vent Termination. (remaining text unchanged)
802.6.1.1 Insulation Protection Shield. Where a vent passes through an insulated assembly, an approved metal shield constructed of steel having a thickness of not less than 26 gauge shall be installed between the vent and insulation. The shield shall extend not less than 2 inches (51 mm) above the insulation and be secured to the structure in accordance with the manufacturer's installation instructions.

SUBSTANTIATION:
The existing language does not contain guidance regarding the minimum gauge required for insulation shields passing through insulated areas such as attics. The proposed language will add the minimum shield thickness. The proposed 26 gauge minimum thickness is found in other manufacturer requirements.
Proposals

Item #: 178
UMC 2024  Section: 803.2.11

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

803.0 Sizing of Category I Venting Systems.

803.2 Multiple Appliance Vent Table 803.2(1) through Table 803.2(9). (remaining text unchanged)

803.2.11 Vent Connector Rise. The vent connector rise (R) for each appliance connector shall be measured from the draft hood outlet or flue collar to the centerline where the vent gas streams come together. [{NFPA 54:13.2.12}]

SUBSTANTIATION:
The language in Section 803.2.11 is being revised for clarity and ease of use.
Proposals

Item #: 179
UMC 2024  Section: Chapter 9, Table 1701.1

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

902.4 Type of Gas(es). The appliance shall be connected to the fuel gas for which it was designed. No attempt shall be made to convert the appliance from the gas specified on the rating plate for use with a different gas without consulting the installation instructions, the serving gas supplier, or the appliance manufacturer for complete instructions. Listed appliances shall not be converted unless permitted by and in accordance with the manufacturer's installation instructions. [NFPA 54:9.1.3]

902.8 Building Structural Members Appliance Support. Appliances and equipment shall be furnished either with load-distributing bases or with a sufficient number of supports to prevent damage to either the building structure or the appliance and the equipment. [NFPA 54:9.1.8.1]

902.11 Combination of Appliances and Equipment. Any combination of appliances, equipment, attachments, or devices used together in any manner shall comply with the standards that apply to the individual appliance and equipment. [NFPA 54:9.1.21 9.1.19]

902.14 Gas Appliance Pressure Regulators. Where the gas supply pressure is higher than that at which the appliance is designed to operate or varies beyond the design pressure limits of the appliance, a gas appliance pressure regulator listed in accordance with ANSI Z21.18/CSA 6.3 shall be installed. [NFPA 54:9.1.18 9.1.17]

902.15 Venting of Gas Appliance Pressure Regulators. Venting of gas appliance pressure regulators shall comply with the following requirements:
(1) Appliance pressure regulators requiring access to the atmosphere for successful operation shall be equipped with vent piping leading outdoors or, if the regulator vent is an integral part of the appliance, into the combustion chamber adjacent to a continuous pilot, unless constructed or equipped with a vent limiting means to limit the escape of gas from the vent opening in the event of diaphragm failure.
(2) Vent limiting means shall be employed on listed appliance pressure regulators only.
(3) In the case of vents leading outdoors, means shall be employed to prevent water from entering this piping and also to prevent blockage of vents by insects and foreign matter.
(4) Under no circumstances shall a regulator be vented to the appliance flue or exhaust system.
(5) In the case of vents entering the combustion chamber, the vent shall be located so the escaping gas is readily ignited by the pilot and the heat liberated thereby does not adversely affect the normal operation of the safety shutoff system. The terminus of the vent shall be securely held in a fixed position relative to the pilot. For manufactured gas, the need for a flame arrester in the vent piping shall be determined.
(6) A vent line(s) from an appliance pressure regulator and a bleed line(s) from a diaphragm-type valve shall not be connected to a common manifold terminating in a combustion chamber. Vent lines shall not terminate in positive-pressure-type combustion chambers. [NFPA 54:9.1.19]

902.16 Bleed Lines for Diaphragm-Type Valves. Bleed lines shall comply with the following requirements:
(1) Diaphragm-type valves shall be equipped to convey bleed gas to the outdoors or into the combustion chamber adjacent to a continuous pilot.
(2) In the case of bleed lines leading outdoors, means shall be employed to prevent water from entering this piping and
also to prevent blockage of vents by insects and foreign matter.

(3) Bleed lines shall not terminate in the appliance flue or exhaust system.

(4) In the case of bleed lines entering the combustion chamber, the bleed line shall be located so the bleed gas is readily ignited by the pilot and the heat liberated thereby does not adversely affect the normal operation of the safety shutoff system. The terminus of the bleed line shall be securely held in a fixed position relative to the pilot. For manufactured gas, the need for a flame arrester in the bleed line piping shall be determined.

(5) A bleed line(s) from a diaphragm-type valve and a vent line(s) from an appliance pressure regulator shall not be connected to a common manifold terminating in a combustion chamber. Bleed lines shall not terminate in positive-pressure-type combustion chambers. [NFPA 54:9.1.20 9.1.18]

903.0 Air-Conditioning Appliances.

903.2 Gas-Fired Air Conditioners and Heat Pumps. Gas-fired air conditioners shall comply with Section 903.2.1 through Section 903.2.6 903.2.7.

903.2.1 Application. Gas-fired air conditioners and heat pumps shall be listed in accordance with ANSI Z21.40.1/CSA 2.91 or ANSI Z21.40.2/CSA 2.92. [NFPA 54:10.2.1]

903.2.2 Connection of Gas Engine-Powered Air Conditioners. To protect against the effects of normal vibration in service, gas engines shall not be rigidly connected to the gas supply piping. [NFPA 54:10.2.2 10.2.3]

903.2.3 Clearances for Indoor Installation. The installation of air-conditioning appliances shall comply with the following requirements:

1) **Listed-air** appliance shall be installed with clearances in accordance with the terms of their listing and the manufacturer’s installation instructions. [NFPA 54: 10.2.4(1)]

2) Unlisted air conditioning appliances shall be installed with clearances from combustible material of not less than 18 inches (457 mm) above the appliance and at the sides, front, and rear and in accordance with the manufacturer’s installation instructions. [NFPA 54:10.2.3(2)]

3) **Listed and unlisted** air appliance shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 303.10.1 and such reduction is allowed by the manufacturer’s installation instructions. [NFPA 54:10.2.4(3)]

4) Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 inches (51 mm) or less. [NFPA 54:10.2.4(4)]

5) **Listed-air** appliance shall have the clearance from supply ducts within 3 feet (914 mm) of the furnace plenum be not less than that specified from the furnace plenum. No clearance is necessary beyond this distance. [NFPA 54:9.2.3(4) 10.2.4(3)]

903.2.4 Assembly and Installation. Air appliance shall be installed in accordance with the manufacturer’s installation instructions. Unless the appliance is listed for installation on a combustible surface, such as a floor or roof, or unless the surface is protected in an approved manner, it shall be installed on a surface of noncombustible construction with no combustible material against the underside thereof. [NFPA 54:10.2.4 10.2.5]

903.2.5 Refrigeration Coils. The installation of refrigeration coils shall be in accordance with Section 904.7 and Section 904.8. [NFPA 54:10.2.4 10.2.7]

903.2.6 Switches in Electrical Supply Line. Means for interrupting the electrical supply to the air-conditioning appliance and to its associated cooling tower (if supplied and installed in a location remote from the air conditioner) shall be provided within sight of and not over 50 feet (15 240 mm) from the air conditioner and the cooling tower shall be in accordance with NFPA 70. [NFPA 54:10.2.7 10.2.8]

904.0 Central Heating Boilers and Furnaces.

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

1) Central heating furnaces and boilers having input ratings up to and including 400 000 Btu/hr shall be listed in accordance with the following as applicable:

   a) Furnaces listed in accordance with ANSI Z21.47/CSA 2.3.

   b) Low-pressure boilers listed in accordance with ANSI Z21.13/CSA 4.9. [NFPA 54:10.3.1.1]

2) Furnaces and boilers having input ratings greater than 400 000 Btu/hr shall be listed or in accordance with Section 904.1(2)(a) and Section 904.1(2)(b). [NFPA 54:10.3.1.2]

   a) Acceptance of unlisted appliances, equipment, and accessories shall be on the basis of engineering methods. [NFPA 54:9.1.1.2]

   b) The unlisted appliance, equipment, or accessory shall be safe and suitable for the proposed service and shall be recommended for the service by the manufacturer. [NFPA 54:9.1.1.3]

   (renumber remaining sections)
904.2.2 **Unlisted Units.** Unlisted central heating furnaces and low-pressure boilers shall be installed with clearances from combustible material not less than those specified in Table 904.2.2. [NFPA 54:10.3.2.2 10.3.3.2]

904.2.3 **Listed and Unlisted Units.** Listed and unlisted central heating furnaces and low-pressure boilers shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 303.10.1 and Figure 303.10.1(1) through Figure 303.10.1(3), and such reduction is allowed by the manufacturer’s installation instructions. [NFPA 54:10.3.2.3 10.3.3.3]

904.2.4 **Front Clearance.** Front clearance shall be sufficient for servicing the burner and the furnace or boiler. [NFPA 54:10.3.2.4 10.3.3.4]

904.2.5 **Adjacent to Plaster or Noncombustible Materials.** Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 inches (51 mm) or less. [NFPA 54:10.3.2.5 10.3.3.5]

904.2.6 **Interference.** The clearances to these appliances shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. [NFPA 54:10.3.2.6 10.3.3.6]

904.2.7 **Central Heating Furnaces.** Central heating furnaces other than those listed in Section 603.13.2 or Section 603.13.3 shall have clearances from the supply ducts of not less than 18 inches (457 mm) from the furnace plenum for the first 3 feet (914 mm), then 6 inches (152 mm) for the next 3 feet (914 mm) and 1 inch (25.4 mm) beyond 6 feet (1829 mm). [NFPA 54:10.3.2.7 10.3.3.9]

904.3 **Assembly and Installation.** A central heating boiler or furnace shall be installed in accordance with the manufacturer’s instructions in one of the following manners:

1. On a floor of noncombustible construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof.
2. On fire-resistive slabs or arches having no combustible material against the underside thereof.

**Exceptions:**

1. Appliances listed for installation on a combustible floor.
2. Installation on a floor protected in an approved manner. [NFPA 54:10.3.3 10.3.4]

904.4 **Temperature or Pressure Limiting Devices.** Steam and hot water boilers, respectively, shall be provided with approved automatic limiting devices for shutting down the burner(s) to prevent boiler steam pressure or boiler water temperature from exceeding the maximum allowable working pressure or temperature. Safety limit controls shall not be used as operating controls. [NFPA 54:10.3.4 10.3.5]

904.5 **Low-Water Cutoff.** All water boilers and steam boilers shall be provided with an automatic means to shut off the fuel supply to the burner(s) if the boiler water level drops below the lowest safe water line. In lieu of the low-water cutoff, water tube or coil-type boilers that require forced circulation to prevent overheating and failure shall have an approved flow sensing device arranged to shut down the boiler when the flow rate is inadequate to protect the boiler against overheating. [NFPA 54:10.3.5 10.3.6]

904.6 **Steam Safety and Pressure Relief Valves.** Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or pressure relief valves of appropriate discharge capacity and conforming with ASME requirements. A shutoff valve shall not be placed between the relief valve and the boiler or on discharge pipes between such valves and the atmosphere. [NFPA 54:10.3.6 10.3.7]

904.6.1 **Discharge.** Relief valves shall be piped to discharge near the floor. [NFPA 54:10.3.6.1 10.3.7.1]

904.6.2 **Size.** The entire discharged piping shall be at least the same size as the relief valve discharge piping. [NFPA 54:10.3.6.2 10.3.7.2]

904.6.3 **End Connections.** Discharge piping shall not contain threaded end connection at its termination point. [NFPA 54:10.3.6.3 10.3.7.3]

904.7 **Refrigeration Coils.** The installation of refrigeration coils shall comply with the following requirements:

1. A refrigeration coil shall not be installed in conjunction with a forced air furnace where circulation of cooled air is provided by the furnace blower, unless the blower has sufficient capacity to overcome the external static pressure resistance imposed by the duct system and refrigeration coil at the air flow rate for heating or cooling, whichever is greater.
2. Furnaces shall not be located upstream from refrigeration coils, unless the refrigeration coil is designed or equipped so as not to develop excessive temperature or pressure.
3. Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid condensation in the heating element, unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be sufficiently tight to prevent any circulation of cooled air through the furnace.
4. Means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element. [NFPA 54:10.3.8 10.3.9]

904.8 **Cooling Units Used with Heating Boilers.** Boilers, where used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler. [NFPA 54:10.3.9.4 10.3.10.1]

904.8.1 **Exposed to Refrigerated Air Circulation.** Where hot water heating boilers are connected to heating coils
located in air-handling units where they can be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. [NFPA 54:10.3.9.2 10.3.10.2]

### TABLE 904.2.2
**CLEARANCES TO COMBUSTIBLE MATERIAL FOR UNLISTED FURNACES AND BOILERS***

*(portion of table not shown remain unchanged)*

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**905.0 Duct Furnaces.**

**905.1 Application.** Duct furnaces with inputs of 10 MBtu/hr or less shall be listed in accordance with ANSI Z83.8/CSA 2.6. [NFPA 54:10.9.1]

(renumber remaining sections)

**905.2 Installation of Duct Furnaces.** Duct furnaces shall be installed in accordance with the manufacturer’s instructions. [NFPA 54:10.10.2 10.9.3]

**905.3 Access Panels.** The ducts connected to duct furnaces shall have removable access panels on both the upstream and downstream sides of the furnace. [NFPA 54:10.10.3 10.9.4]

**905.4 Location of Draft Hoods and Controls.** The controls, combustion air inlet, and draft hoods for duct furnaces shall be located outside the ducts. The draft hood shall be located in the same enclosure from which combustion air is taken. [NFPA 54:10.10.4 10.9.5]

**905.5 Circulating Air.** Where a duct furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. The duct furnace shall be installed on the positive-pressure side of the circulating air blower. [NFPA 54:10.10.5 10.9.6]

**905.6 Duct Furnaces Used with Refrigeration Systems.** A duct furnace shall not be installed in conjunction with a refrigeration coil where circulation of cooled air is provided by the blower.

**Exception:** Where the blower has sufficient capacity to overcome the external static resistance imposed by the duct system, the furnace, and the cooling coil and the air throughput necessary for heating or cooling, whichever is greater. [NFPA 54:10.10.6.1 10.9.7.1]

**905.6.1 In Conjunction with Cooling Appliances.** Duct furnaces used in conjunction with cooling appliances shall be installed in parallel with or on the upstream side of cooling coils to avoid condensation within heating elements. With a parallel flow arrangement, the dampers or other means used to control the flow of air shall be sufficiently tight to prevent any circulation of cooled air through the unit.

**Exception:** Where the duct furnace has been specifically listed for downstream installation. [NFPA 54:10.10.6.2 10.9.7.2]

**905.6.2 Located Upstream from Cooling Coils.** Where duct furnaces are located upstream from cooling units, the cooling unit shall be so designed or equipped as to not develop excessive temperatures or pressures. [NFPA 54:10.10.6.3 10.9.7.3]

(renumber remaining sections)

**905.6.3 Heat Exchangers.** Where a duct furnace is installed downstream of an evaporative cooler or air washer, the heat exchanger shall be constructed of corrosion-resistant materials. Stainless steel, ceramic-coated steel, and an aluminum-coated steel in which the bond between the steel and the aluminum is an iron-aluminum alloy are considered to be corrosion resistant. Air washers operating with chilled water that deliver air below the dew point of the ambient air at the duct furnace shall be considered as refrigeration systems. [NFPA 54:10.10.6.4 10.9.7.3]

**905.7 Installation in Commercial Garages and Aircraft Hangars.** Duct furnaces installed in garages for more than three motor vehicles or in aircraft hangars shall be of a listed type and shall be installed in accordance with Section 303.11 and Section 303.12. [NFPA 54:10.10.7 10.9.8]

**906.0 Floor Furnaces.**

**906.1 Application.** Floor furnaces shall be listed in accordance with ANSI Z21.86/CSA 2.32. [NFPA 54:10.10.1]

(renumber remaining sections)

**906.2 Temperature Limit Controls.** Floor furnaces shall be provided with temperature limit controls in accordance with the following requirements:

1. List automatically. Automatically operated floor furnaces shall be equipped with temperature limit controls. [NFPA 54:10.10.2.1 10.10.3]

2. Unlisted automatically. Operated floor furnaces shall be equipped with a temperature limit control arranged to shut off
906.3 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 701.0. [NFPA 54:10.25.1](10.10.4)

906.4 Placement. The following provisions apply to furnaces that serve one story:
1. Floors. Floor furnaces shall not be installed in the floor of any doorway, stairway landing, aisle, or passageway of any enclosure, public or private, or in an exitway from any such room or space.
2. Walls and Corners. The register of a floor furnace with a horizontal warm air outlet shall not be placed closer than 6 inches (152 mm) from the nearest wall. A distance of at least 18 inches (457 mm) from two adjoining sides of the floor furnace register to walls shall be provided to eliminate the necessity of occupants walking over the warm air discharge. The remaining sides shall be a minimum of 6 inches (152 mm) from a wall. Wall register models shall not be placed closer than 6 inches (152 mm) to a corner.
3. Draperies. The furnace shall be placed so that a door, drapery, or similar object cannot be nearer than 12 inches (305 mm) to any portion of the register of the furnace. [NFPA 54:10.26.1.2](10.10.5)

906.5 Bracing. The space provided for the furnace shall be framed with doubled joists and with headers not lighter than the joists. [NFPA 54:10.26.1.2](10.10.6)

906.6 Support. Means shall be provided to support the furnace when the floor register is removed. [NFPA 54:10.25.1](10.10.7)

906.7 Clearance. The lowest portion of the floor furnace shall have at least a 6 inch (152 mm) clearance from the general ground level. A reduced clearance to a minimum of 2 inches (51 mm) shall be permitted, provided the lower 6 inches (152 mm) portion of the floor furnace is sealed by the manufacturer to meet this condition. A copper pan shall be made of not less than 16 ounces (305 mm) to any portion of the register of the furnace. [NFPA 54:10.25.2.1](10.10.8)

906.8 Access. The space in which any floor furnace is installed shall be accessible by an opening in the foundation not less than 24 inches by 18 inches (610 mm by 457 mm) or by a trapdoor not less than 24 inches by 24 inches (610 mm by 610 mm) in any cross-section thereof, and a passageway not less than 24 inches by 18 inches (610 mm by 457 mm) in any cross-section thereof. [NFPA 54:10.4.1](10.10.9)

906.9 Seepage Pan. Where the excavation exceeds 12 inches (305 mm) in depth or water seepage is likely to collect, a watertight copper pan, concrete pit, or other suitable material shall be used, unless adequate drainage is provided or the appliance is sealed by the manufacturer to meet this condition. A copper pan shall be anchored in place so as to prevent floating, and the walls shall extend at least 4 inches (102 mm) above the ground level with at least a 6 inches (152 mm) clearance on all sides, except on the control side, which shall have at least an 18 inch (457 mm) clearance. [NFPA 54:10.4.1](10.10.10)

906.10 Wind Protection. Floor furnaces shall be protected, where necessary, against severe wind conditions. [NFPA 54:10.25.1](10.10.11)

906.11 Upper Floor Installations. Listed floor Floor furnaces shall be permitted to be installed in an upper floor, provided the furnace assembly projects below into a utility room, closet, garage, or similar nonhabitable space. In such installations, the floor furnace shall be enclosed completely (entirely separated from the nonhabitable space) with means for air intake to meet the provisions of Section 701.0, with access for servicing, minimum furnace clearances of 6 inches (152 mm) to all sides and bottom, and with the enclosure constructed of Portland cement plaster or metal lath or other noncombustible material. [NFPA 54:10.25.1](10.10.12)

906.12 First Floor Installation. Listed floor Floor furnaces installed in the first or ground floors of buildings shall not be required to be enclosed unless the basements of these buildings have been converted to apartments or sleeping quarters, in which case the floor furnace shall be enclosed as specified for upper floor installations and shall project into a nonhabitable space. [NFPA 54:10.25.1](10.10.13)

907.0 Wall Furnaces.  
907.1 Application. Wall furnaces shall be listed in accordance with ANSI Z21.86/CSA 2.32. [NFPA 54:10.25.1](10.10.14)

907.1 Installation. Listed wall Wall furnaces shall be installed in accordance with their listings and the manufacturer’s installation instructions. Wall furnaces installed in or attached to combustible material shall be listed for such installation. [NFPA 54:10.25.2.1](10.10.15)

907.1.1 Unlisted Wall Furnaces. Unlisted wall furnaces shall not be installed in or attached to combustible material. [NFPA 54:10.25.2.2](10.10.16)

907.1.2 Vented Wall Furnaces. Vented wall furnaces connected to a Type B-W gas vent system listed only for a single story shall be installed only in single-story buildings or the top story of multistory buildings. Vented wall furnaces connected to a Type B-W gas vent system listed for installation in multistory buildings shall be permitted to be installed in single-story or multistory buildings. Type B-W gas vents shall be attached directly to a solid header plate that serves as a firestop at that point and that shall be permitted to be an integral part of the vented wall furnace, as illustrated in Figure 907.1.2. The stud space in which the vented wall furnace is installed shall be ventilated at the first ceiling level by...
installation of the ceiling plate spacers furnished with the gas vent. Firestop spacers shall be installed at each subsequent ceiling or floor level penetrated by the vent. [NFPA 54:10.26.1.3 10.25.2.2]

907.1.3 Direct Vent Wall Furnaces. Direct vent wall furnaces shall be installed with the vent combustion air intake terminal in the outdoors. The thickness of the walls on which the furnace is mounted shall be within the range of wall thickness marked on the furnace and covered in the manufacturer’s installation instructions. [NFPA 54:10.26.1.4 10.25.2.3]

907.2 Location. Wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture, or doors. Wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building. [NFPA 54:10.26.2 10.25.3]

907.3 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 701.0. [NFPA 54:10.26.3 10.25.4]

908.0 Clothes Dryers.

908.1 Application. Clothes dryers shall be listed in accordance with ANSI Z21.5.1/CSA 7.1 for Type I clothes dryers or ANSI Z21.5.2/CSA 7.2 for Type II clothes dryers. [NFPA 54:10.4.1]

908.2 Clearance. The installation of clothes dryers shall comply with the following requirements:

1. Listed Type 1 clothes dryers shall be installed with a clearance of not less than 6 inches (152 mm) from adjacent combustible material. Clothes dryers listed for installation at reduced clearances shall be installed in accordance with their listing and the manufacturer’s installation instructions. Type 1 clothes dryers installed in closets shall be listed for such installation.

2. Listed Type 2 clothes dryers shall be installed with clearances of not less than those shown on the marking plate and in the manufacturer’s instructions. Type 2 clothes dryers designed and marked, “For use only in noncombustible locations,” shall not be installed elsewhere.

3. Unlisted clothes dryers shall be installed with clearances to combustible material of not less than 18 inches (457 mm). Combustible floors under unlisted clothes dryers shall be protected in an approved manner. [NFPA 54:10.4.2]

908.2.2 Exhausting to the Outdoors. Type 1 and Type 2 clothes dryers shall be exhausted to the outside air in accordance with Section 504.4. [NFPA 54:10.4.3]

908.2.3 Multiple-Family or Public Use. All clothes dryers installed for multiple-family or public use shall be equipped with approved safety shutoff devices and shall be installed as specified for a Type 2 clothes dryer under Section 504.4.3.1. [NFPA 54:10.4.6 10.4.7]

911.0 Decorative Appliances for Installation in Vented Fireplaces.

911.1 Application. Decorative appliances for installation in vented fireplaces shall be listed in accordance with ANSI Z21.60/CSA 2.26. [NFPA 54:10.6.1]

911.1 Prohibited Installations. Decorative appliances for installation in vented fireplaces shall not be installed in bathrooms or bedrooms unless the appliance is listed and the bedroom or bathroom has the required volume in accordance with Section 701.4. [NFPA 54:10.6.4 10.6.2]

911.2 Installation. A decorative appliance for installation in a vented fireplace shall be installed only in a vented fireplace having a working chimney flue and constructed of noncombustible materials. These appliances shall not be thermostatically controlled. [NFPA 54:10.6.2 10.6.3]

911.2.1 Listed Decorative Appliance. A listed decorative appliance for installation in a vented fireplace shall be installed in accordance with its listing and the manufacturer’s installation instructions. [NFPA 54:10.6.3.1]

911.2.2 In Manufactured Homes. A decorative appliance for installation in a vented fireplace, where installed in a manufactured home, shall be listed for installation in manufactured homes. [NFPA 54:10.6.2.2 10.6.3.2]

911.2.3 Unlisted Decorative Appliance. An unlisted decorative appliance for installation in a vented fireplace shall be installed in a fireplace having a permanent free opening, based on appliance input rating and chimney height, equal to or greater than that specified in Table 911.2. [NFPA 54:10.6.2.3]
### TABLE 911.2
FREE OPENING AREA OF CHIMNEY DAMPER FOR VENTING FLUE GASES FROM UNLISTED DECORATIVE APPLIANCES FOR INSTALLATION IN VENTED FIREPLACES [NFPA 54: TABLE 10.6.2.3]

<table>
<thead>
<tr>
<th>CHIMNEY HEIGHT (feet)</th>
<th>APPLIANCE INPUT RATING (Btu/h)</th>
<th>MINIMUM PERMANENT FREE OPENING (square inches)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>8</td>
<td>7800</td>
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<tr>
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<td>138</td>
<td>138600</td>
</tr>
</tbody>
</table>

For SI units: 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²

* The first six minimum permanent free openings [8 square inches (0.005 m²) to 51 square inches (0.03 m²)] correspond approximately to the cross-sectional areas of chimneys having diameters of 3 inches (76 mm) through 8 inches (203 mm), respectively. The 64 square inch (0.04 m²) opening corresponds to the cross-sectional area of a standard 8 inch (203 mm) by 8 inch (203 mm) chimney tile.

911.3 Fireplace Screens. A fireplace screen shall be installed with a decorative appliance for installation in a vented fireplace. [NFPA 54:10.6.3 10.6.4]

912.0 Gas Fireplaces, Vented.

912.1 Application. Vented gas fireplaces shall be listed in accordance with ANSI Z21.50/CSA 2.22. [NFPA 54:10.7.1] (renumber remaining sections)

912.1 Prohibited Installations. Vented gas fireplaces shall not be installed in bathrooms or bedrooms unless the appliance is listed and the bedroom or bathroom has the required volume in accordance with Section 701.4.

Exception: Direct vent gas fireplaces. [NFPA 54:10.7.1 10.7.2]

912.2 Installation. The installation of vented gas fireplaces shall comply with the following requirements:

1. Listed vented Vented gas fireplaces shall be installed in accordance with their listing and the manufacturer's installation instructions and where installed in or attached to combustible material shall be specifically listed for such installation.

2. Unlisted vented gas fireplaces shall not be installed in or attached to combustible material. They shall have a clearance at the sides and rear of not less than 18 inches (457 mm). Combustible floors under unlisted vented gas fireplaces shall be protected in an approved manner. Unlisted appliances of other than the direct vent type shall be equipped with a draft hood and shall be vented in accordance with Section 802.0. Appliances that use metal, asbestos, or ceramic material to direct radiation to the front of the appliance shall have a clearance of 36 inches (914 mm) in front and, where constructed with a double back of metal or ceramic, shall be installed with a clearance of not less than 18 inches (457 mm) at the sides and 12 inches (305 mm) at the rear.

3. Panels, grilles, and access doors that are required to be removed for normal servicing operations shall not be attached to the building.

4. Direct vent gas fireplaces shall be installed with the vent-air intake terminal in the outdoors and in accordance with the manufacturer's installation instructions. [NFPA 54:10.7.3]

912.3 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 701.0. [NFPA 54:10.7.3 10.7.4]

914.0 Non-Recirculating Direct Gas-Fired Industrial Air Heaters.

914.1 Application. Direct gas-fired heating and forced ventilation appliances for commercial and industrial air heaters of the non-recirculating type applications shall be listed in accordance with CSA the following standards as applicable:

1. ANSI Z83.4/CSA 3.7.
2. ANSI Z83.18. [NFPA 54:10.8.1]

914.2 Prohibited Installations. Non-recirculating direct Direct gas-fired industrial air heaters heating and forced ventilation appliances shall not serve any area containing sleeping quarters.

Non-recirculating direct gas-fired industrial air heaters heating and forced ventilation appliances shall not recirculate room air.

Recirculating direct gas-fired industrial air heaters shall not recirculate room air in buildings that contain flammable solids, liquids, or gases; explosive materials; or substances that can become toxic when exposed to flame or heat.
914.3 Installation. Non-recirculating direct gas-fired industrial air heaters heating and forced ventilation appliances shall be installed in accordance with the manufacturer's instructions. [NFPA 54:10.8.3.1]

914.3.1 Fresh Air Ventilation. Non-recirculating direct gas-fired industrial air heaters heating and forced ventilation appliances shall be permitted to provide fresh air ventilation. [NFPA 54:10.8.3.2]

914.3.2 Access Required. Non-recirculating direct gas-fired industrial air heaters heating and forced ventilation appliances shall be provided with access for removal of burners; for replacement of motors, controls, filters, and other working parts; and for adjustment and lubrication of parts requiring maintenance. [NFPA 54:10.8.3.3]

914.4 Clearance from Combustible Materials. Non-recirculating direct gas-fired industrial air heaters heating and forced ventilation appliances shall be installed with a clearance from combustible materials of not less than that shown on the rating plate and the manufacturer's instructions. [NFPA 54:10.8.4]

914.5 Air Supply. All The air supply to the non-recirculating direct gas-fired industrial air heater heating and forced ventilation appliances shall be ducted directly from outdoors. Where outdoor air dampers or closing louvers are used, they shall be verified to be in the open position prior to main burner operation, accordance with Section 914.5.1 through Section 914.5.3. [NFPA 54:10.8.5]

914.5.1 Non-Recirculating Systems. All air to the non-recirculating direct gas-fired heating and forced ventilation appliance shall be ducted directly from outdoors. [NFPA 54:10.8.5.1]

914.5.2 Recirculating Systems. Ventilation air to the recirculating direct gas-fired heating and forced ventilation appliance shall be ducted directly from outdoors. Air in excess of the minimum ventilation air specified on the heater's rating plate shall be taken from the building, ducted directly from outdoors, or a combination of both. [NFPA 54:10.8.5.2]

914.5.3 Dampers or Louvers. Where outdoor air dampers or closing louvers are used, they shall be verified to be in the open position prior to main burner operation. [NFPA 54:10.8.5.3]

914.6 Atmospheric Vents, Gas Reliefs, or Bleeds. Non-recirculating direct gas-fired industrial air heaters heating and forced ventilation appliances with valve train components equipped with atmospheric vents, gas reliefs, or bleeds shall have their vent lines, gas reliefs, or bleeds lead to a safe point outdoors. Means shall be employed on these lines to prevent water from entering and to prevent blockage from insects and foreign matter. An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter. [NFPA 54:10.8.6]

914.7 Relief Openings. The design of the installation shall include adequate provisions to permit the non-recirculating direct gas-fired industrial air heater heating and forced ventilation appliances to operate at its their rated airflow without overpressurizing the space served by the heater by taking into account the structure's designed infiltration rate, properly designed relief openings, or an interlocked powered exhaust system, or a combination of these methods. [NFPA 54:10.8.7]

914.7.1 Infiltration Rate. The structure's designed infiltration rate and the size of relief opening(s) shall be determined by approved engineering methods. [NFPA 54:10.8.7.1]

915.0 Recirculating Direct Gas-Fired Industrial Air Heaters.

915.1 Application. Direct gas-fired industrial air heaters of the recirculating type shall be listed in accordance with CSA Z83.18. [NFPA 54:10.9.1]

915.2 Prohibited Installations. Recirculating direct gas-fired industrial air heaters shall not serve any area containing sleeping quarters. Recirculating direct gas-fired industrial air heaters shall not recirculate room air in buildings that contain flammable solids, liquids, or gases; explosive materials; or substances that can become toxic when exposed to flame or heat. [NFPA 54:10.9.2.1, 10.9.2.2]

915.3 Installation. Recirculating direct gas-fired industrial air heaters shall be installed in accordance with the manufacturer's instructions. [NFPA 54:10.9.3]

915.4 Clearance from Combustible Materials. Recirculating direct gas-fired industrial air heaters shall be installed with a clearance from combustible materials of not less than that shown on the rating plate and the manufacturer's instructions. [NFPA 54:10.9.4]

915.5 Air Supply. Ventilation air to the recirculating direct gas-fired industrial air heater shall be ducted directly from outdoors. Air to the recirculating direct gas-fired industrial air heater in excess of the minimum ventilation air specified on the heater's rating plate shall be taken from the building, ducted directly from outdoors, or a combination of both. Where outdoor air dampers or closing louvers are used, they shall be verified to be in the open position prior to main burner operation. [NFPA 54:10.9.5]

915.6 Atmospheric Vents, Gas Reliefs, or Bleeds. Recirculating direct gas-fired industrial air heaters with valve train components equipped with atmospheric vents, gas reliefs, or bleeds shall have their vent lines, gas reliefs, or bleeds lead to a safe point outdoors. Means shall be employed on these lines to prevent water from entering and to prevent blockage from insects and foreign matter. An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter. [NFPA 54:10.9.6]

915.7 Relief Openings. The design of the installation shall include adequate provisions to permit the recirculating direct gas-fired industrial air heater to operate at its rated airflow without overpressurizing the space served by the heater by taking into account the structure's designed infiltration rate, properly designed relief openings, or an interlocked powered exhaust system, or a combination of these methods. [NFPA 54:10.9.7]

915.7.1 Infiltration Rate. The structure's designed infiltration rate and the size of relief opening(s) shall be determined by approved engineering methods. [NFPA 54:10.9.7.1]
915.7.2 Louver or Gravity Dampers. Louver or counterbalanced gravity damper relief openings shall be permitted. Where motorized dampers or closeable louvers are used, they shall be proved to be in their open position prior to main burner operation. [NFPA 54:10.9.7.2]

915.8 Purging. Inlet ducting, when used, shall be purged with at least four air changes prior to an ignition attempt. [NFPA 54:10.9.8]

916.0 Room Heaters.

916.1 Application. Room heaters shall be listed in accordance with Section 916.1.1 or Section 916.1.2. [NFPA 54:10.21.1]

916.1.1 Vented Room Heaters. Vented room heaters shall be listed in accordance with ANSI Z21.86/CSA 2.32 or ANSI Z21.88/CSA 2.33. [NFPA 54:10.21.1.1]

916.1.2 Unvented Room Heaters. Unvented room heaters shall be listed in accordance with ANSI Z21.11.2. [NFPA 54:10.21.1.2]

916.2.1.1 Unvented Room Heaters. Unvented room heaters shall not be installed in bathrooms or bedrooms. Exceptions:

(1) Where approved by the Authority Having Jurisdiction, one listed wall-mounted, unvented room heater equipped with an oxygen depletion safety shutoff system shall be permitted to be installed in a bathroom, provided that the input rating does not exceed 6000 Btu/h (1.76 kW) and combustion and ventilation air is provided as specified in Section 902.2.

(2) Where approved by the Authority Having Jurisdiction, one listed wall-mounted unvented room heater equipped with an oxygen depletion safety shutoff system shall be permitted to be installed in a bedroom, provided that the input rating does not exceed 10 000 Btu/h (3 kW) and combustion and ventilation air is provided as specified in Section 902.2. [NFPA 54:40.22.4 10.21.2]

(3) Portable oil fired unvented heating appliances used as supplemental heating in storage occupancies, utility occupancies, and in accordance with the fire code.

916.2 Installations in Institutions. Room heaters shall not be installed in the following occupancies:

(1) Residential board and care

(2) Health care [NFPA 54:10.22.3 10.21.3]

916.2.4 Wall-Type Mounted Room Heaters. Wall-type mounted room heaters shall not be installed in or attached to walls of combustible material unless listed for such installation. [NFPA 54:40.22.5 10.21.4]

917.0 Unit Heaters.

917.1 Application. Unit heaters shall be listed in accordance with ANSI Z83.8/CSA 2.6 and installed in accordance with the manufacturer's installation instructions. [NFPA 54:10.24.1]

917.2 Clearance for Suspended-Type Unit Heaters. Suspended-type unit heaters shall comply with the following requirements:

(1) A listed unit heaters shall be installed with clearances from combustible material of not less than 18 inches (457 mm) at the sides, 12 inches (305 mm) at the bottom, and 6 inches (152 mm) above the top where the unit heater has an internal draft hood, or 1 inch (25.4 mm) above the top of the sloping side of a vertical draft hood. A unit heater listed for reduced clearances shall be installed in accordance with its listing and the manufacturer's installation instructions.

(2) Unlisted unit heaters shall be installed with clearances to combustible material of not less than 18 inches (457 mm).

(3) Clearances for servicing shall be in accordance with the manufacturer's installation instructions. [NFPA 54:40.24.3]

917.3 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 701.0. [NFPA 54:40.24.4]

917.4 Ductwork. A unit heater shall not be attached to a warm air duct system unless listed and marked for such installation. [NFPA 54:40.24.5]

917.5 Installation in Commercial Garages and Aircraft Hangars. Unit heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be of a listed type and shall be installed in accordance with Section 303.11 and Section 303.12. [NFPA 54:40.24.6]

918.0 Food Service Appliance, Floor-Mounted.

918.1 Application. Floor-mounted food service appliances shall be listed in accordance with CSA Z83.11. [NFPA 54:10.11.1]

918.2 Clearance for Listed Appliances. Listed floor-mounted food service appliances, such as ranges for hotels and restaurants, deep fat fryers, unit broilers, kettles, steam cookers, steam generators, and baking and roasting ovens, shall be installed not less than 6 inches (152 mm) from combustible material except that at least a 2 inch (51
918.3 Mounting on Combustible Floors. Listed floor-mounted food service appliances that are listed specifically for installation on floors constructed of combustible material shall be permitted to be installed on combustible floors in accordance with its listing and the manufacturer's installation instructions. [NFPA 54:10.11.3.1]

918.3.1 Not Listed for Mounting on Combustible Floors. Floor-mounted food service appliances that are not listed for mounting on a combustible floor shall be mounted in accordance with Section 918.4 or be mounted in accordance with one of the following:

(1) Where the appliance is set on legs that provide not less than 18 inches (457 mm) open space under the base of the appliance or where it has no burners and no portion of any oven or broiler within 18 inches (457 mm) of the floor, it shall be permitted to be mounted on a combustible floor without special floor protection, provided at least one sheet metal baffle is between the burner and the floor.

(2) Where the appliance is set on legs that provide not less than 8 inches (203 mm) open space under the base of the appliance, it shall be permitted to be mounted on combustible floors, provided the floor under the appliance is protected with not less than 3/8 of an inch (9.5 mm) insulating millboard covered with sheet metal not less than 0.0195 of an inch (0.4953 mm) thick. The preceding specified floor protection shall extend not less than 6 inches (152 mm) beyond the appliance on all sides.

(3) Where the appliance is set on legs that provide not less than 4 inches (102 mm) under the base of the appliance, it shall be permitted to be mounted on combustible floors, provided the floor under the appliance is protected with hollow masonry not less than 4 inches (102 mm) in thickness covered with sheet metal not less than 0.0195 of an inch (0.4953 mm) thick. Such masonry courses shall be laid with ends unsealed and joints matched in such a way as to provide for free circulation of air through the masonry.

(4) Where the appliance does not have legs at least 4 inches (102 mm) high, it shall be permitted to be mounted on combustible floors, provided the floor under the appliance is protected by two courses of 4 inch (102 mm) hollow clay tile, or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide for free circulation of air through such masonry courses, and covered with steel plate not less than 3/16 of an inch (4.8 mm) in thickness. [NFPA 54:10.12.3.2 10.11.3.2]

918.4 Installation on Noncombustible Floors. Listed floor-mounted food service appliances that are designed and marked “For use only in noncombustible locations” shall be installed on floors of noncombustible construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof, or on noncombustible slabs or arches having no combustible material against the underside thereof. Such construction shall in all cases extend not less than 12 inches (305 mm) beyond the appliance on all sides. [NFPA 54:10.12.4.1, 10.12.4.2 10.11.4.1, 10.11.4.2]

918.5 Combustible Material Adjacent to Cooking Top. Listed and unlisted food service ranges shall be installed to provide clearance to combustible material of not less than 18 inches (457 mm) horizontally for a distance of up to 2 feet (610 mm) above the surface of the cooking top where the combustible material is not completely shielded by high shelving, a warming closet, or other system. Reduced combustible material clearances are permitted where protected in accordance with Table 303.10.1. [NFPA 54:10.12.6 10.11.5]

918.6 Use with Casters. Floor-mounted appliances with casters shall be listed for such construction and shall be installed in accordance with the manufacturer's installation instructions for limiting the movement of the appliance to prevent strain on the connection. [NFPA 54:10.12.6 10.11.6]

918.7 Level Installation. Floor-mounted food service appliances shall be installed level on a firm foundation. [NFPA 54:10.12.7 10.12.7]

918.8 Ventilation. Means shall be provided to properly ventilate the space in which a food service appliance is installed to permit proper combustion of the gas. [NFPA 54:10.12.8 10.11.8]

919.0 Food Service Appliances, Counter Appliances.

919.1 Application. Food service counter appliances shall be listed in accordance with ANSI Z83.11/CSA 1.8. [NFPA 54:10.12.1]

(renumber remaining sections)

919.1 Vertical Clearance. A vertical distance of not less than 48 inches (1219 mm) shall be provided between the top of all food service hot plates and griddles and combustible material. [NFPA 54:10.13.1 10.12.2]

919.3 Clearance for Unlisted Appliances. Unlisted food service hot plates and griddles shall be installed with a horizontal clearance from combustible material of not less than 18 inches (457 mm). Unlisted gas food service

mm) clearance shall be maintained between a draft hood and combustible material. Floor-mounted food service appliances listed for installation at lesser clearances shall be installed in accordance with its listing and the manufacturer's installation instructions. Appliances designed and marked, “For use only in noncombustible locations,” shall not be installed elsewhere. [NFPA 54:10.11.2]
counter appliances, including coffee brewers and urns, waffle bakers, and hot water immersion sterilizers, where installed on combustible surfaces, shall be installed with a minimum horizontal clearance of 6 inches (152 mm) from combustible material of not less than 12 inches (305 mm) to combustible material of not less than 12 inches (305, except that at least a 2 inches (51 mm)). Reduced clearances for gas food clearance shall be maintained between a draft hood and combustible material. Food service counter appliances listed for installation at lesser clearances shall be installed in accordance with Table 303.10.1. Unlisted food service counter appliances shall be installed with a horizontal clearance from combustible material of not less than 6 inches (152 mm) the manufacturer’s installation instructions. [NFPA 54:10.13.3 10.12.3]

919.4 Mounting of Unlisted Appliances. Unlisted food service counter appliances shall not be set on combustible material unless they have legs that provide not less than 4 inches (102 mm) of open space below the burners and the combustible surface is protected with insulating millboard at least 1/4 of an inch (6.4 mm) thick covered with sheet metal not less than 0.0122 of an inch (0.3099 mm) thick, or with equivalent protection. [NFPA 54:10.13.4]

920.0 Household Cooking Appliances.

920.1 Application. Household cooking appliances shall be listed in accordance with ANSI Z21.1/CSA 1.1. [NFPA 54:10.13.1]

920.3 Clearance from Combustible Material. The clearances specified as follows: Floor-mounted household cooking appliances, where installed on combustible floors, shall be set on their own bases or legs and shall not interfere with combustion air, accessibility for operation, and servicing:

(1) Listed floor-mounted household cooking appliances, where installed on combustible floors, shall be set on their own bases or legs and shall be installed in accordance with their listing and the manufacturer’s installation instructions.

(2) Listed household cooking appliances with listed gas room heater sections shall be installed so that the warm-air discharge side shall have a clearance of not less than 18 inches (457 mm) from adjacent combustible material. A clearance of not less than 36 inches (914 mm) shall be provided between the top of the heater section and the bottom of cabinets.

(3) Listed household cooking appliances that include a solid or liquid fuel burning section shall be spaced from combustible material and otherwise installed in accordance with their listing and the manufacturer’s installation instructions for the supplementary fuel section of the appliance.

(4) Unlisted floor-mounted household cooking appliances shall be installed with not less than 6 inches (152 mm) clearance at the back and sides to combustible material. Combustible floors under unlisted appliances shall be protected in an approved manner. [NFPA 54:10.13.3]

920.3.2 Vertical Clearance Above Cooking Top. Household cooking appliances shall have a vertical clearance above the cooking top of not less than 30 inches (762 mm) to combustible material or metal cabinets. A minimum clearance of 24 inches (610 mm) is shall be permitted where one of the following is installed:

(1) The underside of the combustible material or metal cabinet above the cooking top is protected with not less than 1/4 of an inch (6.4 mm) insulating millboard covered with sheet metal not less than 0.0122 of an inch (0.3099 mm) thick.

(2) A metal ventilating hood of sheet metal not less than 0.0122 of an inch (0.3099 mm) thick is installed above the cooking top with a clearance of not less than 1/4 of an inch (6.4 mm) between the hood and the underside of the combustible material or metal cabinet, and the hood not less than the width of as wide as the appliance and is centered over the appliance.

(3) A listed cooking appliance or microwave oven installed over a listed cooking appliance shall be in accordance with the terms of the upper appliance’s listing and the manufacturer’s installation instructions. [NFPA 54:10.13.3.1]

Microwave ovens shall comply with UL 923.

920.4.3 Level Installation. Cooking appliances shall be installed so that the cooking top, broiler pan, or oven racks are level. [NFPA 54:10.14.3]

922.0 Open-Top Broiler Units.

922.1 Listed Units Application. Listed open-top broiler units shall be listed in accordance with ANSI Z83.11/CSA 1.8 or ANSI Z21.1/CSA 1.1 and installed in accordance with the manufacturer’s installation instructions. [NFPA 54:10.18.1 10.17.1]

922.2 Unlisted Units. Unlisted open-top broiler units shall be installed in accordance with the manufacturer's instructions but shall not be installed in combustible material. [NFPA 54:10.18.2]

922.3 Protection Above Domestic Units. Domestic open-top broiler units shall be provided with a metal ventilating hood not less than 0.0122 of an inch (0.3099 mm) thick with a clearance of not less than 1/4 of an inch (6.4 mm) between the hood and the underside of combustible material or metal cabinets. A clearance of at least 24 inches (610 mm) shall be maintained between the cooking top and the combustible material or metal cabinet, and the hood shall be at least as wide as the open-top broiler unit and centered over the unit. Listed domestic Domestic open-top broiler units incorporating an integral exhaust system and listed for use without a ventilating hood shall not be required to be provided with a ventilating hood if installed in accordance with Section 920.3.2(1). [NFPA 54:10.18.9 10.17.2]

922.4 Commercial Units. Commercial open-top broiler units shall be provided with ventilation in accordance with Chapter 5, Part II. [NFPA 54:10.18.4 10.17.3]
923.0 Outdoor Cooking Appliances.

923.1 Listed Units Application. Listed outdoor cooking appliances shall be installed in accordance with their listing and the manufacturer's installation instructions. Outdoor cooking appliances shall be listed in accordance with ANSI Z83.11/CSA 1.8, ANSI Z21.58/CSA 1.6, or ANSI Z21.89/CSA 1.18, and installed in accordance with the manufacturer's installation instructions. [NFPA 54:10.18]

923.2 Unlisted Units. Unlisted outdoor cooking appliances shall be installed outdoors with clearances to combustible material of not less than 36 inches (914 mm) at the sides and back and not less than 48 inches (1219 mm) at the front. In no case shall the appliance be located under overhead combustible construction. [NFPA 54:10.19.2]

924.0 Illuminating Appliances.

924.1 Clearances for Listed Appliances. Listed illuminating appliances shall be installed in accordance with their listing and the manufacturer's installation instructions. [NFPA 54:10.14.1]

924.2 Clearances for Unlisted Appliances. Clearances for unlisted illuminating appliances shall comply with the following:

1. Unlisted enclosed illuminating appliances installed outdoors shall be installed with clearances in any direction from combustible material of not less than 12 inches (305 mm). [NFPA 54:10.15.2.1(1)]

2. Unlisted enclosed illuminating appliances installed indoors shall be installed with clearances in any direction from combustible material of not less than 18 inches (457 mm). [NFPA 54:10.15.2.1(2)]

924.2.1 Open-Flame Type. Clearances shall comply with the following:

1. Unlisted open-flame illuminating appliances installed outdoors shall have clearances from combustible material not less than that specified in Table 924.2.1. The distance from ground level to the base of the burner shall be a minimum of 7 feet (2134 mm) where installed within 2 feet (610 mm) of walkways. Lesser clearances shall be permitted to be used where acceptable to the Authority Having Jurisdiction.

2. Unlisted open-flame illuminating appliances installed outdoors shall be equipped with a limiting orifice or other limiting devices that maintain a flame height consistent with the clearance from combustible material, as given in Table 924.2.1.

3. Appliances designed for flame heights in excess of 30 inches (762 mm) shall be permitted to be installed if acceptable to the Authority Having Jurisdiction approved. Such appliances shall be equipped with a safety shutoff device or automatic ignition.

4. Unlisted open-flame illuminating appliances installed indoors shall have clearances from combustible material to the Authority Having Jurisdiction shall be approved. [NFPA 54:10.15.2.2]

TABLE 924.2.1
CLEARANCES FOR UNLISTED OUTDOOR OPEN-FLAME ILLUMINATING APPLIANCES
[NFPA 54:TABLE 10.15.2.2 10.14.2.2]
(portion of table not shown remains unchanged)

924.3 Mounting on Buildings. Illuminating appliances designed for installation on a wall or ceiling mounting shall be securely attached to substantial structures in such a manner that they are not dependent on the gas piping for support. [NFPA 54:10.14.3]

924.4 Mounting on Posts. Illuminating appliances designed for installation on a post mounting shall be securely and rigidly attached to a post. Posts shall be rigidly mounted. The strength and rigidity of posts greater than 3 feet (914 mm) in height shall be at least equivalent to that of a 2 1/2 inch (64 mm) diameter post constructed of 0.064 of an inch (1.626 mm) thick steel or a 1 inch (25.4 mm) Schedule 40 steel pipe. Posts 3 feet (914 mm) or less in height shall not be smaller than a 3/4 of an inch (19.1 mm) Schedule 40 steel pipe. Drain openings shall be provided near the base of posts where water collecting inside the posts is possible. [NFPA 54:10.14.4]

924.5 Appliance Pressure Regulators. Where an appliance pressure regulator is not supplied with an illuminating appliance and the service line is not equipped with a service pressure regulator, an appliance pressure regulator shall be installed in the line serving one or more illuminating appliances. [NFPA 54:10.15.5]

926.0 Infrared Heaters.

926.1 Application. Infrared heaters having an input rating of 400 000 Btu/hr or less shall be listed in accordance with ANSI Z83.19/CSA 2.35 or ANSI Z83.20/CSA 2.34. [NFPA 54:10.16.1]

926.1 Support. Suspended-type infrared heaters shall be fixed in position independent of gas and electric supply lines. Hangers and brackets shall be of noncombustible material. Heaters subject to vibration shall be provided with vibration-
isolating hangers. [NFPA 54:10.17.1 10.16.2]

926.2 Clearance. The installation of infrared heaters shall comply with the following clearance requirements:
(1) Listed heaters shall be installed with clearances from combustible material in accordance with their listing and the manufacturer's installation instructions.
(2) Unlisted heaters shall be installed in accordance with clearances from combustible material acceptable to the Authority Having Jurisdiction.
(3) In locations used for the storage of combustible materials, signs shall be posted to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles. [NFPA 54:10.16.3]

926.3 Combustion and Ventilation Air. Where unvented infrared heaters are used, natural or mechanical means shall be provided to supply and exhaust at least 4 ft³/min/1000 Btu/h (0.38 m³/min/kW) input of installed heaters. [NFPA 54:10.17.3.1 10.16.4.1]

926.3.1 Exhaust Openings. Exhaust openings for removing flue products shall be above the level of the heaters. [NFPA 54:10.17.3.2 10.16.4.2]

926.4 Installation in Commercial Garages and Aircraft Hangars. Overhead heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be of a listed type and shall be installed in accordance with Section 303.11 and Section 303.12. [NFPA 54:10.17.4 10.16.5]

927.0 Pool Heaters.

927.1 Application. Pool heaters shall be listed in accordance with ANSI Z21.56/CSA 4.7. [NFPA 54:10.19.1]

927.2 Clearance. The installation of pool heaters shall comply with the following requirements:
(1) No clearances shall interfere with combustion air, draft hood, or vent terminal clearance and relief, and accessibility for servicing.
(2) A listed pool heater shall be installed in accordance with its listing and the manufacturer’s installation instructions. [NFPA 54:10.19.3]
(3) An unlisted pool heater shall be installed with a clearance of not less than 12 inches (305 mm) on the sides and the rear. A combustible floor under an unlisted pool heater shall be protected in an approved manner.

927.3 Temperature or Pressure-Limiting Devices. An unlisted pool heater shall be provided with overtemperature protection or overtemperature and overpressure protection by means of an approved device(s). Where a pool heater is provided with overtemperature protection only and is installed with any device in the discharge line of the heater that can restrict the flow of water from the heater to the pool (such as a check valve, shutoff valve, therapeutic pool valving, or flow nozzles), a pressure relief valve shall be installed either in the heater or between the heater and the restrictive device. [NFPA 54:10.19.4]

927.3.1 Pressure Relief Valve. Where a pool heater is provided with over-temperature protection only and is installed with any device in the discharge line of the heater that can restrict the flow of water from the heater to the pool (such as a check valve, shutoff valve, therapeutic pool valving, or flow nozzles), a pressure relief valve shall be installed either in the heater or between the heater and the restrictive device. [NFPA 54:10.19.4.2]

927.4 Bypass Valves. Where an integral bypass system is not provided as a part of the pool heater, a bypass line and valve shall be installed between the inlet and outlet piping for use in adjusting the flow of water through the heater. [NFPA 54:10.19.5]

927.5 Venting. A pool heater listed for outdoor installation shall be installed with the venting means supplied by the manufacturer and in accordance with the manufacturer’s installation instructions. [NFPA 54:10.19.6]

928.0 Refrigerators.

928.1 Application. Refrigerators shall be listed in accordance with ANSI Z21.19/CSA 1.4. [NFPA 54:10.20.1]

928.2 Venting or Ventilating Kits Approved for Use with a Refrigerator. Where an accessory kit is used for conveying air for burner combustion or unit cooling to the refrigerator from areas outside the room in which it is located, or for conveying combustion products diluted with air containing waste heat from the refrigerator to areas outside the room in which it is located, the kit shall be installed in accordance with the refrigerator manufacturer’s instructions. [NFPA 54:10.21.2 10.20.3]

929.0 Gas-Fired Toilets.

929.1 Clearance. A listed gas-fired toilet shall be installed in accordance with its listing and the manufacturer’s installation instructions, provided that the clearance shall be such to afford ready accessibility for use, cleanout, and necessary servicing. [NFPA 54:10.23.1]

929.2 Installation on Combustible Floors. Listed gas-fired toilets installed on combustible floors shall be listed for
such installation. [NFPA 54:10.24.2 10.23.2]

**929.3 Vents.** Vents or vent connectors that are capable of being contacted during casual use of the room in which the toilet is installed shall be protected or shielded to prevent such contact. [NFPA 54:10.24.3 10.23.3]

**930.0 Appliances for Installation in Manufactured Housing.**

**930.1 General.** Appliances installed in manufactured housing after the initial sale shall be listed for installation in manufactured housing, or approved, and shall be installed in accordance with the requirements of this code and the manufacturer's installation instructions. Appliances installed in the living space of manufactured housing shall be in accordance with the requirements of Section 701.0. [NFPA 54:10.29 10.28]

**932.0 Outdoor Open Flame Decorative Appliances.**

**932.1 General.** Permanently fixed in place outdoor open flame decorative appliances shall be installed in accordance with Section 932.1.1 through Section 932.1.3. [NFPA 54:10.31 10.30]

**932.1.1 Listed Units Application.** Listed outdoor open flame decorative appliances shall be listed in accordance with ANSI Z21.97/CSA 2.41 and shall be installed in accordance with the manufacturer's installation instructions. [NFPA 54:10.31.1 10.30.1]

**932.1.2 Unlisted Units.** Unlisted outdoor open flame decorative appliances shall be installed outdoors in accordance with the manufacturer's installation instructions and with clearances to combustible material of not less than 36 inches (914 mm) from the sides. In no case shall the appliance be located under overhead combustible construction. [NFPA 54:10.31.2]

**932.1.3 Connection to the Piping System.** The connection to the gas piping system shall be in accordance with Section 1312.1(1), Section 1312.1(2), Section 1312.1(4), or Section 1312.1(5). [NFPA 54:10.31.3 10.30.2]

**938.0 Compressed Natural Gas (CNG) Vehicular Fuel Systems.**

**938.1 General.** The installation of compressed natural gas (CNG) fueling (dispensing) systems shall conform to NFPA 52. Residential CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1 and installed in accordance to the appliance manufacturer's installation instructions. Non-residential CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.2 and installed in accordance with the appliance manufacturer's installation instructions. [NFPA 54:10.28 10.27]

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<tr>
<td>ANSI Z21.89/CSA 1.18-2017</td>
<td>Outdoor Cooking Specialty Gas Appliances</td>
<td>Gas Appliances</td>
<td>923.1</td>
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<td>ANSI Z21.97/CSA 2.41-2017</td>
<td>Outdoor Decorative Gas Appliances</td>
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<td>ANSI/CSA NGV 5.2-2017</td>
<td>Vehicle Fueling Appliances (VFA)</td>
<td>Appliances</td>
<td>938.1</td>
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</tbody>
</table>

(potions of table not shown remain unchanged)

Note: The CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**

In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 9 is being revised to the latest edition of NFPA 54-2021.

[Instructions for accessing the CSA standards is provided in KAVI]
Proposals

Item #: 180

UMC 2024  Section: 902.10.1, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

902.0 General.

902.10 Solid-Fuel Burning Appliances. Unless otherwise specified, solid-fuel burning appliances shall be installed in accordance with NFPA 211 and the manufacturer’s installation instructions.

902.10.1 Pellet Fuel-Burning Appliances. Pellet fuel-burning appliances shall be listed and labeled in accordance with ASTM E1509.

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<th>APPLICATION</th>
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<tr>
<td>ASTM E1509-2012</td>
<td>Room Heaters, Pellet Fuel-Burning Type</td>
<td>Room Heaters</td>
<td>902.10.1</td>
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</tbody>
</table>

Note: ASTM E1509 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Pellet burning appliances such as fireplaces and stoves have risen in popularity thanks to their green credentials of burning renewable or otherwise waste products instead of nonrenewable sources of energy such as gas. Pellet burning fireplaces or stoves differ to wood burning stoves or wood burning fireplaces because they use compressed pellets as the fuel rather than pieces of wood. The pellets themselves are highly compressed pieces of material that burn with a hot flame thanks to their density. The ASTM E1509 standard covers performance requirements, test methods, and marking requirements for automatic feed, pellet fuel-burning room heaters that are intended to burn pellets.
Proposals

Item #: 181

UMC 2024  Section: 903.2.7

SUBMITTER: Brad Ketner  
KBE, INC

RECOMMENDATION:
Add new text

903.0 Air-Conditioning Appliances.

903.2 Gas-Fired Air Conditioners and Heat Pumps.

903.2.7 Air-Conditioning Coil Freeze Protection. A sensor shall be attached to the air-conditioning coils that will shut off the equipment if it detects a temperature of 29°F (-2°C) to prevent icing of the coils. A manual reset button that is on the sensor shall be pushed to return the system to normal operation.

SUBSTANTIATION:
When any part of the air conditioning unit fails, i.e., the blower motor, low refrigerant, poor air flow, etc., the coils will begin to freeze. This leads to potential flood damage for the homeowner, mold, mildew, and additional equipment failure due running while frozen (txv fails, compressor slugs...), not to mention it is wasted time for the technicians that are waiting for the system to thaw before they can fix the problem, and the homeowner is financially burdened as well. With this safety sensor in place, hundreds of millions of dollars in property damage and equipment breakage can be alleviated.
Proposals

Item #: 182
UMC 2024  Section: 903.3, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

903.0 Air-Conditioning Appliances.

**903.3 Packaged Terminal Air Conditioners.** Packaged terminal air conditioners and heat pumps shall be listed and labeled in accordance with UL 484 or UL 60335-2-40, and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
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<tr>
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<tr>
<td>UL 484-2014</td>
<td>Room Air Conditioners (with revisions through May 15, 2019)</td>
<td>Room Air Conditioners</td>
<td>903.3</td>
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(Note: UL 484 and UL 60335-2-40 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Installation of Specific Appliances) to address the safety standards for packaged terminal air conditioners and heat pumps to aid the code official in verifying safe installation for such systems.)
Proposals

Item #: 183

UMC 2024  Section: 911.0 - 911.2.2, Table 1701.1

SUBMITTER: Maria Yepremian
County of Los Angeles Building and Safety

RECOMMENDATION:
Revise text

911.0 Decorative Appliances for Installation in Vented Fireplaces.
911.1 Prohibited Installations In Vented Fireplaces. Decorative appliances for installation in vented fireplaces shall not be installed in bathrooms or bedrooms unless the appliance is listed and the bedroom or bathroom has the required volume in accordance with Section 701.4. [NFPA 54:10.6.1]

911.2.1 911.1.1 Installation. A decorative appliance for installation in a vented fireplace shall be installed only in a vented fireplace having a working chimney flue and constructed of noncombustible materials. These appliances shall not be thermostatically controlled. [NFPA 54:10.6.2]

911.2.2 911.1.2 Listed Decorative Appliance. A listed decorative appliance for installation in a vented fireplace shall be installed in accordance with its listing and the manufacturer's installation instructions.

911.2.3 911.1.3 In Manufactured Homes. A decorative appliance for installation in a vented fireplace, where installed in a manufactured home, shall be listed for installation in manufactured homes. [NFPA 54:10.6.2.2]

911.2.4 911.1.4 Unlisted Decorative Appliance. An unlisted decorative appliance for installation in a vented fireplace shall be installed in a fireplace having a permanent free opening, based on appliance input rating and chimney height, equal to or greater than that specified in Table 911.2. [NFPA 54:10.6.2.3]

911.3 911.1.5 Fireplace Screens. A fireplace screen shall be installed with a decorative appliance for installation in a vented fireplace. [NFPA 54:10.6.3]

911.2 Unvented Decorative Appliances. Unvented factory-built decorative appliances shall be installed in accordance with the manufacturer's installation instructions and its listing.

911.2.1 Alcohol Fuel Burning. Factory-built unvented liquid or gelled alcohol based intended to be fixed shall comply with UL 1370. No combustible material shall be within 18 inches (457 mm) of the appliance.

911.2.2 Prohibited Use. Factory-built unvented decorative appliances shall be used for decorative purposes and shall not be used as a primary heat source, a cooking appliance, or in conjunction with a blower assembly.

Unvented decorative appliances shall not be installed in spaces in which flammable vapors or gases may be present.

Unvented decorative appliances shall not be installed in bathrooms or bedrooms unless the appliance is listed for such purpose, and the bedroom or bathroom has the required volume of indoor air in accordance with Section 701.4.

(above shown for reference only)

701.4 Indoor Combustion Air. The required volume of indoor air shall be determined in accordance with the method in Section 701.4.1 or Section 701.4.2, except that where the air infiltration rate is known to be less than 0.40 ACH (air change per hour), the method in Section 701.4.2 shall be used. The total required volume shall be the sum of the required volume calculated for appliances located within the space. Rooms communicating directly with the space in which the appliances are installed through openings not furnished with doors, and through combustion air openings sized and located in accordance with Section 701.5, are considered a part of the required volume. [NFPA 54:9.3.2]
TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
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<tr>
<td>UL 1370-2011</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances (with revisions through March 25, 2016)</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances</td>
<td>911.2.1</td>
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(portions of table not shown remain unchanged)

Note: UL 1370 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The existing code does not provide any information for unvented decorative appliances such as alcohol based space heaters. These systems are being installed more and more every day and the UMC does not provide guidance as to what are the appropriate requirements for the safe installation of such systems. UL 1370 is the appropriate standard for such application. Section 911.2 will clarify that such systems shall be installed in accordance with the manufacturer's installation instructions and its listing. This is necessary because there have been instances where the manufacture's installation instructions conflict with the listing. In such case, where the installation instructions conflict the listing, the more stringent provisions shall prevail in accordance with Section 102.1 of the UMC.
Proposals

Item #: 184
UMC 2024  Section: 911.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Revise text

911.0 Decorative Appliances for Installation in Vented Fireplaces.
911.1 Prohibited Installations. Decorative appliances for installation in vented fireplaces shall not be installed in bathrooms or bedrooms unless the appliance is listed and the bedroom or bathroom has the required volume in accordance with Section 701.4. [NFPA 54:10.6.1] Decorative appliances for installation in vented fireplaces shall not be installed in health care facilities.

SUBSTANTIATION:
Decorative appliances and portable heating devices are unsafe in health care facilities. Although heating devices must always be installed to prevent ignition of combustible materials, due to health and safety concerns, installation of such decorative appliances in health care facilities must not be permitted.
Proposals

Item #: 185
UMC 2024 Section: 913.0 - 913.4, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

913.0 Factory-Built Fireplaces and Fireplace Stoves.  
913.1 Factory-Built Fireplaces.  Factory-built fireplaces shall comply with UL 127 and shall be installed in accordance with the manufacturer's installation instructions.

913.2 Factory-Built Fireplace Stoves.  Fireplace stoves shall comply with UL 737 and shall be installed in accordance with the manufacturer's installation instructions.

913.3 Masonry Fireplace Inserts.  Solid-fuel-type fireplace inserts intended for installation in masonry fireplaces shall comply with UL 1482 and shall be installed in accordance with the manufacturer's installation instructions.

913.4 Fireplace Accessories.  Fireplace accessories for use with masonry fireplaces, including heat exchangers, glass door assemblies, combustion air vents, and termination caps, shall comply with UL 907 and shall be installed in accordance with the manufacturer's installation instructions.

TABLE 1701.1  
REFFERENCED STANDARDS

<table>
<thead>
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<td>UL 1482-2011</td>
<td>Solid-Fuel Type Room Heaters (with revisions through February 25, 2020)</td>
<td>Room Heaters</td>
<td>913.3</td>
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(portions of table not shown remain unchanged)

Note: UL 1482 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address solid-fuel-fired fireplace inserts. UL 907 applies to fireplace accessories that are intended only for field installation into or attachment to existing masonry fireplaces. Fireplace accessories include items such as heat exchangers, glass door assemblies, and the like. For the purpose of these requirements, fireplace accessories do not include fireplace inserts or devices that incorporate a closed fire chamber. UL 1482 is used to evaluate and certify fireplace inserts in masonry fireplaces. Any accessory or addition to a factory built fireplace needs to be evaluated and certified in accordance with UL 127. Determining compliance with a standard is done as "listed and labeled", which are code-defined terms.
Proposals

Item #: 186
UMC 2024  Section: 913.1 - 913.1.2, Table 1701.1, Table 1701.2

SUBMITTER:  Phil Pettit  
Control Air Conditioning Corporation  
Rep. Self

RECOMMENDATION:  
Revise text

913.0 Factory-Built Fireplaces and Fireplace Stoves.  
913.1 Factory-Built Fireplaces. Factory-built fireplaces shall comply with Section 913.1.1 and Section 913.1.2.  
913.1.1 Solid-Fuel Fireplaces. Solid wood or coal fuel factory-built fireplaces shall comply with UL 127 and installed in accordance with the manufacturer’s installation instructions.  
913.1.2 Gas-Fired Fireplaces. Natural gas and propane factory-built fireplaces shall comply with CSA Z21.50 and CSA Z21.88 and installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA Z21.50-2019</td>
<td>Vented Decorative Gas Appliances (same as CSA 2.22)</td>
<td>Decorative Gas Appliances</td>
<td>913.1.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA Z21.88-2017</td>
<td>Vented Gas Fireplace Heaters (same as CSA 2.33)</td>
<td>Fireplace Heaters</td>
</tr>
<tr>
<td>CSA Z21.50-2016</td>
<td>Vented Decorative Gas Appliances (same as CSA 2.22)</td>
<td>Appliances, Decorative Appliances</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:  
Section 913.1 for factory-built fireplaces is being split into 2 sections: solid-fuel and gas-fired. The appropriate standard for factory-built fireplaces depends on the type of fuel it uses:  
• For solid-fuel fireplaces, UL 127, Standard for Factory-Built Fireplaces, applies.  
Proposals

Item #: 187

UMC 2024  Section: 913.4 - 913.4.4, Table 1701.1

SUBMITTER:  Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

913.0 Factory-Built Fireplaces and Fireplace Stoves.

913.4 Gas Log Sets. Gas log sets installed into solid-fuel factory-built fireplaces shall be in accordance with Section 913.4.1 through Section 913.4.4 and installed in accordance with the manufacturer’s installation instructions.

913.4.1 Vented Decorative Gas Log Sets. Vented decorative gas log sets with automatic ignition systems shall be in accordance with CSA Z21.60.

913.4.2 Vented Decorative Gas Log Sets with Manual Ignition. Vented decorative natural gas log sets with manual ignition shall be in accordance with CSA Z21.84.

Exception: This requirement shall not apply to appliances using liquid propane.

913.4.3 Unvented Gas Log Sets. Unvented gas log sets shall be in accordance with CSA Z21.11.2.

913.4.4 Gas Log Sets as Heaters. Gas log sets that are intended to be used as heaters shall be in accordance with CSA Z21.86. Unvented heating gas log sets shall be in accordance with CSA Z21.11.2 and CSA Z21.86.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA Z21.11.2-2019</td>
<td>Gas Fired Room Heaters, Volume II, Unvented Room Heaters</td>
</tr>
<tr>
<td>CSA Z21.60-2017</td>
<td>Decorative Gas Appliances for Installation into Solid-Fuel Burning Fireplaces (Same as CSA 2.26)</td>
</tr>
<tr>
<td>CSA Z21.86-2016</td>
<td>Vented Gas-Fired Space Heating Appliances (Same as CSA 2.32)</td>
</tr>
</tbody>
</table>

( порtions of table not shown remain unchanged)

Note: The CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Gas log sets that are installed in solid-fuel factory-built fireplaces are tested to different standards depending on their intended function and operation. The standards are divided into vented or unvented, decorative or heater, and automatic or manually ignited:

• ANSI/CSA Z21.60, Standard for Decorative Gas Appliances for Installation into Solid-Fuel Burning Fireplaces, applies to decorative gas log sets (vented) with automatic ignition systems.
• ANSI/CSA Z21.84, Manually Lighted, Natural Gas, Decorative Gas Appliances for Installation In Solid-Fuel Burning Fireplaces, applies to decorative gas log sets (vented) with manual ignition. Note: this is for natural gas units only, not for appliances using liquid propane.
• ANSI/CSA Z21.86, Vented Gas-Fired Space Heating Appliances, applies to gas log sets that are intended as heaters. It should be noted that for vent-free heating gas log sets, a combination of the appropriate tests from both ANSI/CSA Z21.11.2 and ANSI/CSA Z21.86 are applicable.
Proposals

Item #: 188

UMC 2024  Section: 917.7

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Add new text

917.0 Unit Heaters.

917.7 Prohibited Uses. In health care facilities, suspended-type unit heaters shall be prohibited in corridors, access or exit stairways and ramps, and patient sleeping areas.

SUBSTANTIATION:
Portable heating devices are unsafe in patient-occupied portions of health care facilities. All heating devices should be designed and installed to prevent ignition of combustible materials. Approved suspended unit heaters may be used, except in means of egress and patient sleeping areas, as long as they are high enough to be out of the reach of persons using the area.
Proposals

Item #: 189
UMC 2024 Section: 920.4.3

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

920.0 Household Cooking Appliances.

920.4 Built-In Units. Built-in units shall be installed in accordance with Section 920.4.1 through Section 920.4.3.

920.4.1 Installation. Listed built-in household cooking appliances shall be installed in accordance with their listing and the manufacturer’s installation instructions. The installation shall not interfere with combustion air, accessibility for operation, and servicing. Unlisted built-in household cooking appliances shall not be installed in or adjacent to combustible material.

920.4.2 Vertical Clearance. Built-in top (or surface) cooking appliances shall have a vertical clearance above the cooking top of not less than 30 inches (762 mm) to combustible material or metal cabinets. A clearance of not less than 24 inches (610 mm) is permitted where one of the following is installed:

1. The underside of the combustible material or metal cabinet above the cooking top is protected with not less than 1/4 of an inch (6.4 mm) insulating millboard covered with sheet metal not less than 0.0122 of an inch (0.3099 mm) thick.
2. A metal ventilating hood of sheet metal not less than 0.0122 of an inch (0.3099 mm) thick is installed above the cooking top with a clearance of not less than 1/4 of an inch (6.4 mm) between the hood and the underside of the combustible material or metal cabinet, and the hood not less than the width of the appliance and is centered over the appliance.
3. A listed cooking appliance or microwave oven installed over a listed cooking appliance shall be in accordance with the terms of the upper appliance listing and the manufacturer’s installation instructions. Microwave ovens shall comply with UL 923.

920.4.3 Level Installation. Cooking appliances shall be installed so that the cooking top, broiler pan, or oven racks are level. [NFPA 54:10.14.3]

SUBSTANTIATION:
This code change relocates Section 920.4.3 (Level Installation) so that household cooking appliances other than only built-in units require level installation.
Proposals

Item #: 190

UMC 2024 Section: 923.3, Table 1701.1, Table 1701.2

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

923.0 Outdoor Cooking Appliances.
923.1 Listed Units. Listed outdoor cooking appliances shall be installed in accordance with their listing and the manufacturer's installation instructions.
923.2 Unlisted Units. Unlisted outdoor cooking appliances shall be installed outdoors with clearances to combustible material of not less than 36 inches (914 mm) at the sides and back and not less than 48 inches (1219 mm) at the front. In no case shall the appliance be located under overhead combustible construction. [NFPA 54:10.19.2]
923.3 Outdoor Gas Cooking Appliances. Outdoor gas cooking appliances shall be in accordance with CSA Z21.58.

Outdoor cooking appliances connected to a fixed gas piping system shall comply with NFPA 54. Outdoor cooking appliances fueled by propane cylinders shall comply with NFPA 58.

### TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA Z21.58-2018</td>
<td>Outdoor Cooking Gas Appliances (same as CSA 1.6)</td>
<td>Cooking Appliances</td>
<td>923.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: CSA Z21.58, NFPA 54/Z223.1, and NFPA 58 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA-Z21.58-2018</td>
<td>Outdoor Cooking Gas Appliances (same as CSA 1.6)</td>
<td>Cooking Appliances</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Outdoor cooking appliances such as built-in barbecue grills and outdoor kitchens are extremely common. The UMC contains listed and unlisted outdoor cooking appliances. To improve Section 923.0 (Outdoor Cooking Appliances), additional information for outdoor gas cooking appliances is added to cover fixed gas pipe connection and propane fueled appliances to ensure safe installation.
Proposals

Item #: 191
UMC 2024  Section: 926.5

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

926.0 Infrared Heaters.

926.5 Electric Infrared Radiant Heaters. Electric infrared radiant heaters shall be listed and labeled in accordance with UL 2021 and installed in accordance with the manufacturer’s installation instructions.

Note: UL 2021 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section for electric infrared radiant heaters is being added to Chapter 9 in order to reference the applicable safety standard, UL 2021.
Proposals

Item #: 192

UMC 2024 Section: 931.4, 1108.2, 1124.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

931.0 Small Ceramic Kilns.

931.4 Electrical Equipment. All electrical equipment used as part of, or in connection with, the installation of a kiln shall be in accordance with the requirements in the electrical code NFPA 70. Electric kilns shall be listed and labeled in accordance with UL 499.

1108.0 Refrigeration Machinery Room Equipment and Controls.

1108.2 Electrical. Electrical equipment and installations shall comply with the electrical code NFPA 70. 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.

1124.0 Electrical.
1124.1 General. Electrical systems shall be in accordance with the electrical code NFPA 70. 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.

Note: NFPA 70 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The reference to “the electrical code” is being replaced with “NFPA 70” for consistency within the code; there are only 3 references to “the electrical code” and 17 references to “NFPA 70” in the UMC. See Sections 301.4, 511.1.6, 512.2.5, 516.2.7, 516.2.9, 602.2.1, 905.8.2, 1104.4, 1107.1.7, 1107.1.8, 1217.8.1, 1310.14.5, 1311.2.4, 1311.7, and E 503.5.
Proposals

Item #: 193

UMC 2024  Section: 933.5

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Add new text

933.0 Evaporative Cooling Systems.

933.5 Evaporative Cooling Systems in Health Care Facilities. In health care facilities, direct evaporative cooling systems where the air directly contacts the wetted surface or spray shall be permitted in nonpatient areas, such as, but not limited to, laundry rooms, food preparation areas, and boiler or machinery rooms.

SUBSTANTIATION:
For health care facilities to maintain a comfortable indoor atmosphere with a consistent mid-range relative humidity and promote the recovery of patients and minimize the spread of airborne diseases, installing of evaporative cooling systems has been a way to efficiently regulate and minimize airborne dust particles, static, premature coagulation, and other threats to overall health. The energy efficiency of these systems allows for otherwise wasted energy to be utilized by vital lifesaving equipment that typically consumes more electricity. It should be stated that these systems must only be installed in nonpatient areas to promote the health and safety of health care facilities.
Proposals

Item #: 194
UMC 2024 Section: 934.1 - 934.5, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

934.0 Refrigeration Appliances.
934.1 Self-Contained Refrigerators and Freezers. Factory-built commercial refrigerators and freezers shall be listed and labeled in accordance with UL 471 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.
934.2 Unit Coolers. Factory-built unit coolers for use in refrigerators, freezers, refrigerated warehouses, and walk-in coolers shall be listed and labeled in accordance with UL 412 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.
934.3 Self-Contained Mechanical Refrigeration Systems. Self-contained mechanical refrigeration systems for use in walk-in coolers shall be listed and labeled in accordance with UL 427 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.
934.4 Refrigerant-Containing Components and Accessories. Non-electrical refrigerant-containing components and accessories shall be listed and labeled in accordance with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.
934.5 Refrigeration Fittings. Refrigeration fittings, including press-connect, flared and threaded shall be listed and labeled in accordance with UL 109 and UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>934.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 109 and UL 207 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Sections are being added to Chapter 9 (Installation of Specific Appliances) to address the safety standards for refrigerant-containing components, accessories, and fittings to aid the code official in verifying safe installation for such systems.
Proposals

Item #: 195
UMC 2024  Section: 935.0 - 935.1.1

SUBMITTER: John Taeker
UL LLC

RECOMMENDATION:
Revise text

935.0 Ductless Mini-Split Systems Installation.
935.1 General. A ductless mini-split systems installation shall be installed in accordance with the manufacturer’s installation instructions and Section 310.2 for condensate control.
935.1.1 Split System Air Conditioners. Split system air conditioners and heat pumps shall be listed and labeled in accordance with UL 1995 or UL 60335-2-40.

Note: UL 1995 and UL 60335-2-40 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Referencing the appropriate product safety standard for ductless mini-split systems in the UMC will aid the code official in verifying safe installation for such systems.
936.0 Air Filter Appliances.  
936.1 Electrostatic Air Cleaners. Electrostatic air cleaners shall comply be listed and labeled in accordance with UL 867 and shall be installed in accordance with the manufacturer’s installation instructions.  
936.2 High-Efficiency Particulate Air Filter Units. High-efficiency particulate air filter units for use in industrial and laboratory exhaust and ventilation systems shall be listed and labeled in accordance with UL 586 and shall be installed in accordance with the manufacturer’s installation instructions.

### TABLE 1701.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 586-2009</td>
<td>High-Efficiency, Particulate, Air Filter Units (with revisions through December 19, 2017)</td>
<td>Air Filters</td>
<td>936.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 586 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The appropriate standard for high-efficiency particulate air filter units is UL 586, “High-Efficiency, Particulate, Air Filter Units” and is being added to Section 936.2 “High-Efficiency Particulate Air Filter Units.”
Proposals

Item #: 197

UMC 2024 Section: 939.0, 939.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

939.0 Dehumidifiers.
939.1 General. Dehumidifiers shall be listed and labeled in accordance with UL 60335-2-40, and shall be installed in accordance with the manufacturer’s installation instructions.

Note: UL 60335-2-40 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Installation of Specific Appliances) to address the safety standard for dehumidifiers to aid the code official in verifying safe installation for such systems.
Proposals

Item #: 198

UMC 2024 Section: 221.0, 939.0, 939.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

939.0 Steam Bath Equipment.
939.1 General. Steam bath equipment shall be listed and labeled in accordance with UL 499 and shall be installed in accordance with their listing and the manufacturer's installation instructions.

221.0 S Steam Bath Equipment. Includes steam bath generators, combination room and steam generator systems, and steam bath cabinets intended for personal bathing.

Note: UL 499 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address steam bath equipment.
Proposals

Item #: 199

UMC 2024 Section: 223.0, 939.0 - 939.2, Table 1701.1

SUBMITTER: Bo Manalo
EcoSmart Inc

RECOMMENDATION:
Add new text

**939.0 Unvented Alcohol Fuel-Burning Decorative Appliances.**
**939.1 General.** Unvented alcohol fuel-burning decorative appliances shall be listed and labeled in accordance with UL 1370 and shall be installed in accordance with the conditions of the listing and manufacturer’s installation instructions.
**939.2 Marking.** Unvented alcohol fuel-burning decorative appliances shall have a permanent factory-applied marking showing the manufacturer’s name, model, thermal output (BTU/hr) (kW), approved fuel type, minimum room volume requirement for installation, and required clearances to combustibles.

**223.0 – U – Unvented Alcohol Fuel Burning Decorative Appliance.** An unvented, self-contained fire feature appliance fueled by alcohol whose only function is providing an aesthetic effect of flames; intended to be directly or indirectly secured to the wall or floor and not for duct connection.

**TABLE 1701.1**
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 1370-2011</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances (with revisions through March 25, 2016)</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances</td>
<td>939.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1370 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
This proposal adds a provision for a newer type of decorative appliance. It provides clear and specific requirements for the installation of unvented, self-contained alcohol fuel burning appliances. The requisite ANSI consensus Standard UL 1370 includes performance-based criteria that provide a consistent application of requirements and best practices to ensure safe installation and operation. The Standard includes combustion testing for carbon dioxide and carbon monoxide emission limits, oxygen depletion, materials and construction requirements. The Standard also tests for user abuse, stability, temperature, and wind tests. There is also a requirement for markings and instruction manual content.

These appliances are intended for decorative purposes and not intended to be utilized as a primary heat source. Denatured alcohol is formulated for the application and limited to a maximum input rate of 0.25 gallons of fuel per hour (0.95 liters per hour). They are not provided with means for duct connection nor is there electric/mechanical assist of heated air movement, such as a fan-blower assembly. The appliances are also labeled with minimum room
volume requirements for installation. The proposal improves the Code by providing installers and building officials with a clear path on the specifications that pertain to these products. Installation is intended to be in accordance with local codes, the manufacturer’s installation instructions and markings on the appliance.

The same proposal was submitted to ICC and approved and are not part of the 2021 ICC Mechanical Code.
Proposals

Item #: 200

UMC 2024  Section: 939.0, 939.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

939.0 Sauna Heaters.
939.1 General. Sauna heaters shall be listed and labeled in accordance with UL 875 and shall be installed in accordance with their listing and the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>TABLE 1701.1 REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
</tr>
<tr>
<td>UL 875-2009</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 875 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address sauna heaters.
Proposals

Item #: 201

UMC 2024  Section: 1001.1(9)

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

1001.0 General.
1001.1 Applicability. The requirements of this chapter shall apply in the construction, installation, operation, repair, and alteration of boilers and pressure vessels. Low-pressure boilers shall comply with this chapter and Section 904.0.

Exceptions:
(1) through (8) remain unchanged.
(9) Pressure vessels used in specific appliances shall comply with Chapter 9.

SUBSTANTIATION:
The product certification standards referenced in Chapter 9 provide specific requirements for pressure vessels and parts under pressure within those specific appliances. This proposal recognizes these requirements are already addressed in Chapter 9 (Installation of Specific Appliances).
Proposals

Item #: 202

UMC 2024  Section: 1002.2.3, Table 1701.1, Table 1701.2

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

1002.0 Standards.

1002.2 Oil-Burning Boilers. Oil-burning boilers shall comply with Section 1002.2.1 and Section 1002.2.2.
1002.2.1 Listing & Labeling. Oil-burning boilers shall be listed and labeled in accordance with UL 726.
1002.2.2 Installation. Tanks, piping, and valves for oil-burning boilers shall be installed in accordance with NFPA 31.
1002.2.3 Oil Gauging Devices. Liquid-level indicating gauges shall be listed and labeled in accordance with UL 180 and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 180-2019</td>
<td>Combustible Liquid Tank Accessories (with revisions through May 8, 2020)</td>
<td>Gauges, Level Gauges</td>
<td>1002.2.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL-180-2012</td>
<td>Liquid Level Gauges for Oil Burner Fuels and other combustible liquids (with revisions through May 12, 2017)</td>
<td>Gauges, Level Gauges</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 180 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
UL 180 is being added to this section as the standard provides requirements that apply to liquid level gauges for oil burner fuels. By referencing this standard in the code, the reference to the standard needs to move from Table 1701.2 to Table 1701.1.
Proposals

Item #: 203
UMC 2024 Section: 1003.4

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

1003.0 Detailed Requirements.

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

Exception: Automatic boilers with prepurge, automatic draft control, and interlock.

SUBSTANTIATION:
This change to Section 1003.4 relocates language from the section into an exception for clarity and ease of use.
Proposals

Item #: 204

UMC 2024  Section: 1004.4

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1004.0 Expansion Tanks.

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

\[
V_f (\text{forced-type}) = \frac{(0.00041t-0.0466)V_s}{(\frac{P_a}{P_f} - \frac{P_a}{P_o})}
\]

\[
V_f (\text{diaphragm-type}) = \frac{(0.00041t-0.0466)V_s}{\left(1 - \frac{P_f}{P_o}\right)}
\]

Where:
- \(V_f\) = Minimum volume of expansion tank, gallons (L).
- \(V_s\) = Volume of system, not including expansion tank, gallons (L).
- \(t\) = Average operating temperature, °F (°C).
- \(P_a\) = Atmospheric pressure, feet H₂O absolute pounds per square inch (kPa).
- \(P_f\) = Fill pressure, feet H₂O absolute pounds per square inch (kPa).
- \(P_o\) = Maximum operating pressure, feet H₂O absolute pounds per square inch (kPa).

For SI units: 1 gallon = 3.785 L, °C = (°F-32)/1.8, 1 foot of water = 2.99 kPa
TABLE 1004.4(1)
EXPLANATION TANK CAPACITIES FOR GRAVITY HOT WATER SYSTEMS

<table>
<thead>
<tr>
<th>INSTALLED EQUIVALENT DIRECT RADIATION (square feet)</th>
<th>TANK CAPACITY (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 350</td>
<td>18</td>
</tr>
<tr>
<td>Up to 450</td>
<td>21</td>
</tr>
<tr>
<td>Up to 650</td>
<td>24</td>
</tr>
<tr>
<td>Up to 900</td>
<td>30</td>
</tr>
<tr>
<td>Up to 1100</td>
<td>35</td>
</tr>
<tr>
<td>Up to 1400</td>
<td>40</td>
</tr>
<tr>
<td>Up to 1600</td>
<td>2 to 30</td>
</tr>
<tr>
<td>Up to 1800</td>
<td>2 to 30</td>
</tr>
<tr>
<td>Up to 2000</td>
<td>2 to 35</td>
</tr>
<tr>
<td>Up to 2400</td>
<td>2 to 40</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon = 3.785 L, 1 square foot = 0.0929 m²

Notes:
1. Based on a two-pipe system with an average operating water temperature of 170°F (77°C), using cast-iron column radiation with a heat emission rate of 150 British thermal units per square foot hour [Btu/(ft²•h)] (473 W/m²) equivalent direct radiation.
2. For systems that exceed 2400 square feet (222.9 m²) of installed equivalent direct water radiation, the required capacity of the cushion tank shall be increased on the basis of 1 gallon (4 L) tank capacity per 33 square feet (3.1 m²) of additional equivalent direct radiation.

TABLE 1004.4(2)
EXPLANATION TANK CAPACITIES FOR FORCED HOT WATER SYSTEMS

<table>
<thead>
<tr>
<th>SYSTEM VOLUME (gallons)</th>
<th>TANK CAPACITY DIAPHRAGM TYPE (gallons)</th>
<th>TANK CAPACITY NON-DIAPHRAGM TYPE (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>200</td>
<td>17</td>
<td>30</td>
</tr>
<tr>
<td>300</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>400</td>
<td>33</td>
<td>60</td>
</tr>
<tr>
<td>500</td>
<td>42</td>
<td>75</td>
</tr>
<tr>
<td>1000</td>
<td>83</td>
<td>150</td>
</tr>
<tr>
<td>2000</td>
<td>165</td>
<td>300</td>
</tr>
</tbody>
</table>

For SI units: 1 gallon = 3.785 L

Notes:
1. Based on an average operating water temperature of 195°F (91°C), a fill pressure of 12 psig (83 kPa), and an operating pressure of not more than 30 psig (207 kPa).
2. Includes volume of water in boiler, radiation, and piping, not including expansion tank.

Substantiation:
Diaphragm tanks are included in Table 1004.4(2), but Equation 1004.4(1) pertains to non-precharged tanks. Including the precharged tank equation is required to allow for more accurate tank sizing.

Sizing the tank is the primary thermal consideration when installing a tank into a system. For precharged tanks, including properly charged diaphragm and bladder tanks, the starting pressure when water first starts to enter the tank is equal to the initial precharge pressure. Hence, the equation reduces to Equation 1004.4(2). If Equation
1004.4(1) is used to calculate the volume of a diaphragm tank, the tank will be oversized for the system.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.

A link for supporting documentation is as follows: http://www.taylor-engineering.com/Websites/taylorengineering/articles/ASHRAE_Journal_-_The_Fundamentals_of_Expansion_Tanks.pdf
Proposals

Item #: 205
UMC 2024  Section: 1005.2(8)

SUBMITTER: Jim Erhardt
Watts Water Technologies

RECOMMENDATION:
Revise text

1005.0 Safety or Relief Valve Discharge.

1005.2 Discharge Piping. The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and provided with the following:
(1) Equal to the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.
(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use.
(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.
(4) Discharge in such a manner that does not cause personal injury or structural damage.
(5) No part of such discharge pipe shall be trapped or subject to freezing.
(6) The terminal end of the pipe shall not be threaded.
(7) Discharge from a relief valve into a water heater pan shall be prohibited.
(8) Discharge to a termination point that is readily observable by the building occupants. If the discharge termination point is not readily observable, discharge monitoring is required.

SUBSTANTIATION:
Continuous low-level discharge (“dribble”) of T&P valve due to over-pressure (failed expansion tank, lack of secondary pressure relief device for thermal expansion, etc.) with hard water conditions can cause build-up of scale in the relief valve discharge port. Such obstruction of discharge port can compromise the relieving capacity of the valve and pose a safety risk to building occupants. Remote monitoring of relief valve discharge will ensure that the condition is immediately known.
Proposals

Item #: 206
UMC 2024  Section: 1005.5, Table 1701.1, Table 1701.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

1005.0 Safety or Relief Valve Discharge.

1005.5 Vacuum Relief Valve. Hot-water heating systems that are subjected to a vacuum while in operation or during shutdown shall be protected with a vacuum relief valve that complies with CSA Z21.22. Where the piping configuration, equipment location, and valve outlets are located below the boiler elevation, the system shall be equipped with a vacuum relief valve at the highest point.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

Note: CSA Z21.22 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA.Z21.22-2015</td>
<td>Relief Valves for Hot Water Supply Systems (same as CSA 4.4)</td>
<td>Valves</td>
</tr>
</tbody>
</table>

SUBSTANTIATION:
CSA Z21.22, Relief Valves for Hot Water Supply Systems, is being added to Section 1005.5 as it is the appropriate standard for vacuum relief valves. The change correlates with existing language in the UPC; the CSA standard is referenced in UPC Sections 607.5 and 608.7 regarding vacuum relief valves.

(below shown for reference only)

2021 UPC:
607.5 Valves. Pressurized tanks shall be provided with a listed pressure-relief valve installed in accordance with the manufacturer’s installation instructions. The relief valve shall be discharged in accordance with Section 608.5. Where a potable water supply tank is located above the fixtures, appliances, or system components it serves, it
shall be equipped with a vacuum relief valve that complies with CSA Z21.22.

608.7 Vacuum Relief Valves. Where a hot-water storage tank or an indirect water heater is located at an elevation above the fixture outlets in the hot-water system, a vacuum relief valve that complies with CSA Z21.22 shall be installed on the storage tank or heater.
Proposals

Item #: 207

UMC 2024  Section: 1008.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

1008.0 Low-Water Cutoff.
1008.1 General. Hot water boilers and steam boilers shall be installed with a low-water cutoff. A coil-type boiler or a water-tube boiler that requires forced circulation to prevent overheating of the coils or tubes shall be installed with a flow-sensing device in the outlet piping in lieu of the low-water cutoff. The low-water cutoff or the flow sensing device shall be installed so as to prevent damage to the boiler and to permit testing of the fuel-supply cutoff without draining the heating system. The low-water cutoff shall shut off the **combustion fuel-supply** at a water level setpoint that is in accordance with the boiler manufacturer’s instructions.

SUBSTANTIATION:
There has been confusion in the field by the requirement in Section 1008.1 to shut off the “combustion.” The intention of the low-water cutoff is to shut off the fuel-supply. The code change replaces “combustion” with “fuel-supply” for clarity.
Proposals

Item #: 208

UMC 2024 Section: 1103.1.1, Table 1103.1.1, 1104.6 - 1104.7

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, A2L Task Group

RECOMMENDATION:
Revise text

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>
<thead>
<tr>
<th>TABLE 1103.1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REFRIGERANT SAFETY GROUP CLASSIFICATIONS</strong></td>
</tr>
<tr>
<td>Higher Flammability</td>
</tr>
<tr>
<td>Flammable</td>
</tr>
<tr>
<td>Lower Flammability</td>
</tr>
<tr>
<td>No Flame Propagation</td>
</tr>
</tbody>
</table>

Lower Toxicity | Higher Toxicity

1104.0 Requirements for Refrigerant and Refrigeration System Use.

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 Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with 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 Detectors. A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:
(1) The charge size of any independent circuit exceeds $0.212 \times LFL$ (lb), where $LFL$ is in pounds per 1000 ft$^3$ $(6 \times LFL$ [kg] where $LFL$ is in kg/m$^3$).
(2) When the occupancy classification is institutional.
(3) When using the provisions of Section 1104.6.4.
**Exception:** For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

**1104.6.2.4 Refrigerant Concentration Above Limit.** When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

1. The minimum airflow rate of the supply air fan shall be in accordance with the following equation.

   \[ Q_{min} = 1000 \times \frac{M}{LFL} \]  
   
   **[Equation 1104.6.2.4]**

   Where:
   
   \( Q_{min} \) = minimum airflow rate, ft\(^3/min\)
   
   \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, lb
   
   \( LFL \) = lower flammability limit, lb per 1000 ft\(^3\)

   For SI units:
   
   \[ Q = 60 000 \times \frac{M}{LFL}, \text{ where } Q \text{ is the supply air flow rate (m}^3/h\text{), } M \text{ is the refrigerant charge (kg), } LFL \text{ is the lower flammability limit (g/m}^3\text{).} \]

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 detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

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. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2). [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 Compressors and Pressure Vessel Located Indoors.** For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

1. The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   
   (a) 6.6 lb (3 kg) for residential and institutional occupancies and
   
   (b) 22 lb (10 kg) for commercial and public/large mercantile occupancies.

2. The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4(3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

3. A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

   \[ Q_{min} = 1000 \times \frac{M}{LFL} \]

   Where:
   
   \( Q_{min} \) = minimum airflow rate, ft\(^3/min\)
   
   \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, lb
   
   \( LFL \) = lower flammability limit in lb per 1000 ft\(^3\)

   For SI units:
   
   \[ Q = 60 000 \times \frac{M}{LFL}, \text{ where } Q \text{ is the supply air flow rate (m}^3/h\text{), } M \text{ is the refrigerant charge (kg), } LFL \text{ is the lower flammability limit (g/m}^3\text{).} \]

4. The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (30 cm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.

5. Air that is exhausted from the ventilation system shall be either:
   
   (a) discharged outside of the building envelope or
   
   (b) discharged to an indoor space, provided that the refrigerant concentration will not exceed the limit specified in Section 1104.6.1.
In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrestor, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. [ASHRAE 15:7.6.4]

**1104.6.5 Refrigerant Detectors.** Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:

1. Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.
2. Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).
3. Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.
   a. For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.
   b. For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (30 cm) above the floor and within a horizontal distance of not more 3.3 feet (1.0 m) with a direct line of sight of the unit.
4. Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. [ASHRAE 15:7.6.5]

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

(substantiation)

**SUBSTANTIATION:**
Task Group Recommendation 1 - Human Comfort: These are the extracted requirements from ASHRAE 15-2019 that regulate low GWP refrigerants used in direct systems that fall into the safety classification of Group A2L. The A2L Task Group modified various portions of the extracted language as needed to address enforceability and health and safety concerns. The requirements follow the extraction policy of IAPMO.
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.

307.0 Labeling.

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, and type of refrigerant designation.
(5) The electrical rating in volts, amperes, and, for other than single phase, the number of phases.
(6) The output rating in Btu/h (kW).
(7) The electrical rating in volts, amperes, or watts of each field replaceable electrical component.
(8) The symbol of an approved agency certifying compliance of the equipment with recognized standards.
(9) The 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, and type of refrigerant designation.
(5) The type of fuel approved for use with the unit.
(6) Cooling capacity Btu/h (kW).
Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.
The symbol of an approved agency certifying compliance of the equipment with recognized standards.

**SUBSTANTIATION:**
Task Group Recommendation 4 - Labeling and Identification: The nameplate requirements in Section 307.3 are specifically for heat pumps and electric cooling appliances. These requirements include electrical ratings. The scope of Section 1115.5 is a broader scope, including products that do not have electrical ratings. Because the scope of Section 1115.5 is specific to products used in Chapter 11, this requirement belongs in Chapter 11 to provide a complete set of requirements for refrigeration installations.
Proposals

Item #: 210

UMC 2024 Section: 220.0, Chapter 11, Table 1701.1

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, A2L Task Group

RECOMMENDATION:
Revise text

1104.0 Requirements for Refrigerant and Refrigeration System Use.
1104.5 Flammable Refrigerants. The total of Group A2, B2, A3, and B3 refrigerants, other than Group A2L and B2L refrigerants shall not exceed 1100 pounds (498.9 kg) without approval by the Authority Having Jurisdiction. Institutional Occupancies shall comply with Section 1104.3. Machinery rooms required in accordance with Section 1106.0 based on flammability shall be constructed and maintained in accordance with Section 1106.2.1 through Section 1106.2.6 and Section 1106.13 for Group A2L and B2L refrigerants.

1106.0 Refrigeration Machinery Rooms.
1106.1 Where Required. (remaining text unchanged)
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 1106.2.5.2.
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 1106.6, 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 a refrigerant leakage from entering the airstream. Access doors and panels in ductwork and air-handling units shall be gasketed and tight fitting. [ASHRAE 15:8.4.4.7.10.3]

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 15:8.4.4.7.10.4]

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 1106.2.2 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 annunciate 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 1106.13.

1106.2.6 Refrigerant Detectors. Refrigerant detectors required in accordance with Section 1106.2.4.
mandatory

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
1106.2.2.1 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
1106.2.2.1 or Section 1107.1.7.

(renumber remaining sections)

1106.2.5 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 1106.2.5.1 or Section 1106.2.5.2.
Where multiple refrigerants are present, then the highest airflow quantity shall apply.
1106.2.5.1 Ventilation - A1, A2, A3, B1, B2L, B2 and B3 Refrigerants. The emergency ventilation for A1, A2, A3, B1,
B2L, B2 and B3 refrigerants shall have the capacity to provide mechanical exhaust at a rate as determined in
accordance with Equation 1106.2.5.1:

\[ Q = 100 vG \quad \text{(Equation 1106.2.5.1)} \]

Where:
- \( Q \) = Air flow rate, cubic feet per minute.
- \( v \) = Refrigerant mass in largest system, pounds.

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

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

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>MINIMUM AIR FLOW(^a) (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-32</td>
<td>32 500</td>
</tr>
<tr>
<td>R-143a</td>
<td>28 600</td>
</tr>
<tr>
<td>R-444A</td>
<td>47 700</td>
</tr>
<tr>
<td>R-444B</td>
<td>49 400</td>
</tr>
<tr>
<td>R-445A</td>
<td>46 400</td>
</tr>
<tr>
<td>R-446A</td>
<td>60 600</td>
</tr>
<tr>
<td>R-447A</td>
<td>60 200</td>
</tr>
<tr>
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<td>16 500</td>
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<tr>
<td>R-1234zeE</td>
<td>12 600</td>
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</table>

For SI units: 1 cubic foot per minute = 0.00047 m³/s
\(^a\) The values were tabulated from the following equation:

\[ Q_{A2L} = \frac{(P \cdot V \cdot A)}{(LFL \cdot 0.50)} \quad \text{(Equation 1106.2.5.2)} \]

Where:
\[ P = \text{Refrigerant density, pounds per cubic feet (kg/m}^3\text{).} \]
\[ V = \text{Refrigerant velocity equal to the refrigerant acoustic velocity (speed of sound), feet per second (m/s).} \]
\[ A = \text{Cross-section flow area of refrigerant leak, square feet (m}^2\text{), } A = 0.00136 \text{ ft}^2\text{ (0.000126 m}^2\text{).} \]
\[ \text{LFL} = \text{Lower Flammability Limit, or ETFL}_{60} \text{ where no LFL exist, published value in accordance with ASHRAE 34.} \]
\[ \text{Q}_{A2L} = \text{Minimum required air flow rate, conversion to other units of measures is permitted, cubic feet per second (m}^3\text{/s).} \]

For exact ventilation rates and for refrigerants not listed, the ventilation rate shall be calculated using this equation:

\[ F = vG \quad \text{(Equation 1106.4)} \]

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 m\(^3\)/s, 1 pound = 0.453 kg

(2) The locations of the gravity ventilation openings shall be based on the relative density of the refrigerant to air. [ASHRAE 15:8.11.5(a), (b) 8.14]

1106.13 Machinery Room, A2L and B2L. When required by Section 1106.1, machinery rooms shall comply with Section 1106.13.1 through Section 1106.13.6. [ASHRAE 15:8.13]

1106.13.1 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]

1106.13.2 Communicating Spaces. Doors communicating with the building shall be approved, self-closing, tight-fitting fire doors. [ASHRAE 15:8.13.2]

1106.13.3 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]

1106.13.4 Exterior Openings. Exterior openings, if present, shall not be under any fire escape or any open stairway. [ASHRAE 15:8.13.4]

1106.13.5 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]

1106.13.6 Machinery Room Designation. When any refrigerant of Groups A2, A3, B2, or B3 are used, the machinery room shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with NFPA 70. When the only flammable refrigerants used are from Group A2L or B2L, the machinery room shall comply with both Section 1106.13.6.1 for ventilation and Section 1106.13.6.2 for refrigerant detection, or shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with NFPA 70. [ASHRAE 15:8.13.6]

1106.13.6.1 Mechanical Ventilation. The machinery room shall have a mechanical ventilation system in accordance with Section 1106.13.11. The mechanical ventilation system shall:

(1) Run continuously, and failure of the mechanical ventilation system actuates an alarm, or

(2) Be activated by one or more refrigerant detectors, conforming to requirements of Section 1106.13.8. [ASHRAE 15:8.13.6.1]

1106.13.6.2 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]

1106.13.7 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]

1106.13.8 Refrigerant Detectors. Each refrigerating machinery room in accordance with Section 1106.13 shall contain one or more refrigerant detectors in accordance with Section 1106.13.9. 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 1106.13.10 for alarms and Section 1106.13.11 for mechanical ventilation. Multiport-type devices shall be prohibited. [ASHRAE 15:8.13.8]

1106.13.9 Refrigerant Detectors Requirements. Refrigerant detectors required by Section 1106.13 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 1106.13.10 and Section 1106.13.11 after exposure to refrigerant concentration exceeding a limit value specified in Section 1106.13.10 and Section 1106.13.11.
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 1106.13.10.4. 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 1106.13.10 and Section 1106.13.11. [ASHRAE 15:8.13.9]

1106.13.10 Alarms. Alarms required by Section 1106.13.8 shall comply with Section 1106.13.10.1 through Section 1106.13.10.4.
1106.13.10.1 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]

1106.13.10.2 Detector Activation. The refrigerant detector set points shall activate an alarm in accordance with the type of reset in Table 1106.13.10.2. Manual reset type alarms shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.10.2]

<table>
<thead>
<tr>
<th>LIMIT VALUE</th>
<th>RESPONSE TIME (seconds)</th>
<th>ALARM TYPE</th>
<th>ALARM RESET TYPE</th>
<th>VENTILATION RATE</th>
<th>VENTILATION RESET TYPE</th>
</tr>
</thead>
<tbody>
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<td>Set point &lt;= OEL</td>
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<td>Trouble Alarm</td>
<td>Automatic</td>
<td>Level 1</td>
<td>Automatic</td>
</tr>
<tr>
<td>Set point &lt;= RCL</td>
<td>&lt;= 15</td>
<td>Emergency Alarm</td>
<td>Manual</td>
<td>Level 2</td>
<td>Manual</td>
</tr>
</tbody>
</table>

1106.13.10.3 Alarm Levels. Alarms set at levels other than Table 1106.13.10.2 (such as IDLH) and automatic reset alarms are permitted in addition to those required by Section 1106.13.10. The meaning of each alarm shall be clearly marked by signage near the annunciators. [ASHRAE 15:8.13.10.3]

1106.13.10.4 Emergency. In the event of a failure during a refrigerant detector self-test in accordance with Section 1106.13.9(5), a trouble alarm signal shall be transmitted to an approved monitored location. [ASHRAE 15:8.13.10.4]

1106.13.11 Mechanical Ventilation. Machinery rooms, in accordance with Section 1106.13, shall be vented to the outdoors, using mechanical ventilation in accordance with Section 1106.13.11.1, Section 1106.13.11.2, and Section 1106.13.11.3. [ASHRAE 15:8.13.11]

1106.13.11.1 Mechanical Ventilation Requirements. Mechanical ventilation referred to in Section 1106.13.11 shall be in accordance with all of the following:
1. Include one or more power-driven fans capable of exhausting air from the machinery room; multispeed fans shall be permitted.
2. Electric motors driving fans shall not be placed inside ducts; fan rotating elements shall be nonferrous or non-sparking, or the casing shall consist of or be lined with such material.
3. Include provision to supply make-up air to replace that being exhausted; ducts for supply to and exhaust from the machinery room shall serve no other area; the makeup air supply locations shall be positioned relative to the exhaust air locations to avoid short circling.
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
(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]

### TABLE 1106.13.11.2

<table>
<thead>
<tr>
<th>STATUS</th>
<th>AIRFLOW</th>
</tr>
</thead>
</table>
| Operated when occupied and operated when activated in accordance with Section 1106.13.10.2 and Table 1106.13.10.2 | The greater of the following:  
(1) 0.5 ft³/min per ft³ (2.54 L/s per m³) of machinery room area, or  
(2) 20 ft³/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. |

### 1106.13.11.2 Level 1 Ventilation Rate. The refrigerating machinery room mechanical ventilation in Section 1106.13.11.1 shall exhaust at an airflow rate not less than shown in Table 1106.13.11.2. [ASHRAE 15:8.13.11.2]

### 1106.13.11.3 Level 2 Ventilation. A part of the refrigerating machinery room mechanical ventilation referred to in Section 1106.13.11.1 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 1106.13.8 shall activate ventilation at a set point and response time in accordance with Table 1106.13.10.2, at an airflow rate not less than the value determined in accordance with Section 1106.13.11.4.

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 1106.13.10.2. Manual-type ventilation reset shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.11.3]

### 1106.13.11.4 Level 2 Ventilation Rate. When required by Section 1106.13.11.3, the total airflow for Level 2 ventilation shall be not less than the airflow rate determined by Figure 1106.13.11.4. [ASHRAE 15:8.13.11.4]

### 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 NFPA 70, 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 4406.2-51106.13.6.1 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 4406.2-2.1 and Section 4406.2-2-11106.13.11.

### 1107.1.7.2 Refrigeration Detectors. For the refrigerant detection required in Section 4406.2-2.4 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 4407.1-81106.13.

### 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 discharged to the interior of a building where in accordance with 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, or B2 or B2L refrigerant.  
(3) The system does not contain any quantity of a Group A3 or B3 refrigerant.  
(4) The system is not required to be installed in a machinery room in accordance with Section 1106.0.
(5) The refrigerant concentration limits in Section 1104.0 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]

**FIGURE 1106.13.11.4(1)**

**LEVEL 2 VENTILATION RATE FOR CLASS 2L REFRIGERANTS**

[ASHRAE 15: FIGURE 8-1]
**Refrigerant Concentration Limit (RCL).** 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]
<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tr>
<td>ASHRAE 15-2016 2019</td>
<td>Safety Standard for Refrigeration Systems</td>
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<td>Designation and Safety Classification of Refrigerants</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** The ASHRAE, NFPA, and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
Task Group Recommendation 2 - Machinery Rooms: The proposed modification would bring the Uniform Mechanical Code in line with ASHRAE 15. The 3rd edition of UL/CSA 60335-2-40 has requirements for testing (and listing) of equipment using Group A2L refrigerants. The A2L Task Group modified various portions of the extracted language as needed to address enforceability and health and safety concerns. The requirements follow the extraction policy of IAPMO. Furthermore, a definition for Refrigerant Concentration Limit (RCL) is being added from ASHRAE 34 as the term is used but currently not defined in the code.
Proposals

Item #: 211
UMC 2024  Section: Table 1104.1

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, A2L Task Group

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>OCCUPANCY GROUP</th>
<th>HIGH-PROBABILITY SYSTEM</th>
<th>LOW PROBABILITY SYSTEM</th>
<th>MACHINERY ROOM</th>
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</table>
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.

SUBSTANTIATION:
Task Group Recommendation 3 - Table 1104.1: This change clarifies the acceptance of Group A2L refrigerants in high probability systems used for human comfort applications. Section 1104.6 already permits Group A2L refrigerants to be used for human comfort in direct systems provided the equipment is listed for A2L refrigerants. Footnote 4 identifies the requirements in Section 1104.6 for A2L refrigerants. This will assure that the equipment meets the listing and safety requirements of Section 1104.6.
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 typical high-probability system shall be one of the following:
(1) a direct system or
(2) 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 typical low-probability system shall be one of the following:
(1) an indirect closed system,
(2) double indirect system, or
(3) 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]

1104.2.2 Nonconnecting Spaces. Where a refrigerating system, or a 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]

1104.7.4 Mixing. Refrigerants, including refrigerant blends, with different refrigerant designations as in accordance with Table 1102.3 shall not be mixed in a system in accordance with the following:
Exception:
(1) The addition of a second refrigerant shall be permitted where specified is allowed 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.
(2) The resulting mixture does not change the refrigerant safety group. [ASHRAE 15:7.5.1.7]

1104.8 Changing Refrigerants. A change in the type of refrigerant in a system shall not be made without notifying the Authority Having Jurisdiction, the user, and due observance of safety requirements. The refrigerant being considered shall be evaluated for suitability. Changes of refrigerant in an existing system to a refrigerant with a different refrigerant designation shall only be allowed where in accordance with Sections 1104.8.1 through Section 1104.8.4. [ASHRAE 15:5.3]

1104.8.1 Approval. The change of refrigerant shall be approved by the owner. [ASHRAE 15:5.3.1]

1104.8.2 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]

1104.8.3 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]

1104.8.4 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]

1106.6 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 15:8.11.7 8.11.3]

1106.11 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 8.11.4]

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

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 any halogenated refrigerants. [ASHRAE 15:9.1.2]

1109.4 Location of Refrigeration Piping. Refrigerant piping crossing an open space that affords passageway in any 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 any elevator, dumbwaiter, or other shaft containing a moving object; or in any 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]

1109.5.1 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]

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 each compressor, compressor unit, or condensing unit.
(2) The discharge of each compressor, compressor unit, or condensing unit.
(3) The outlet of each liquid receiver.

Exceptions:
(1) Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge, or
(2) Systems that are equipped with the provisions for pumpout of the refrigerant.
(3) 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 each compressor, compressor unit, or condensing unit.
(2) The discharge outlet of each compressor, compressor unit, or condensing unit.
(3) The inlet of each 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 each liquid receiver.
(5) The inlets and outlets of condensers where more than one condenser is used in parallel in the system.

Exceptions:
(1) Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge, or
(2) Systems that are equipped with the provisions for pumpout of the refrigerant, or
(3) Self-contained systems. [ASHRAE 15:9.12.5]

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 any other component 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 refrigerating 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]

1112.11.1 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, B2L, or B2 refrigerant.
(3) The system does not contain any quantity of a Group A3 or B3 refrigerant.
(4) The system is not required 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]

1112.11.4 Discharge Location, Special Requirements. Additional requirements for pressure 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 only refrigerant, discharge to a floor drain shall be permitted where all of 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 any refrigerant containing heat exchanger.
(3) Either of the following:
   (a) 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
   (b) 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]

1112.12.3 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>
<thead>
<tr>
<th>TABLE 1112.12.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATMOSPHERIC PRESSURE AT NOMINAL INSTALLATION ELEVATION (Pa)</td>
</tr>
<tr>
<td>[ASHRAE 15: TABLE 9.7.9.3.2 9-2]</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

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).

\[ L = \left( \frac{0.2146 \cdot d^5 \left( P_0^2 - P_2^2 \right)}{f \cdot C_r} \right) - d \cdot \ln \left( \frac{P_0}{P_2} \right) \]

Where:
\( L \) = Equivalent length of discharge piping, feet.
\( C_r \) = Rated capacity as stamped on the pressure relief device in pounds per minute (lb/min), or in standard cubic feet per minute.

\[ [\text{Equation 1112.12.4(1)}] \]
(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.

\( P_2 \) = Absolute pressure at outlet of discharge piping, psia.

\( P_0 \) = 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):

1. For conventional relief valves: 15 percent of set pressure:
   \[ P_0 = (0.15\times P) + P_a \] [Equation 1112.12.4(2)]

2. For balanced relief valves: 25 percent of set pressure:
   \[ P_0 = (0.25\times P) + P_a \] [Equation 1112.12.4(3)]

3. For rupture disks alone, fusible plugs, and pilot-operated relief devices: 50 percent of set pressure:
   \[ P_0 = (0.50\times P) + P_a \] [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 pressure-relief device from exceeding the maximum allowable back pressure in accordance with Section 1112.12.4. [ASHRAE
15:9.7.9.3.3]

1112.14 Rating of Rupture Members and Fusible Plugs. The rated discharge capacity of a rupture member or fusible plug
discharging to the atmosphere under critical flow conditions, in pounds of air per minute (kg/s), shall be determined in accordance with the
following formulas:

\[ C = 0.64P_1d^2 \] [Equation 1112.14(1)]

\[ d = 1.25 \sqrt{C/P_1} \] [Equation 1112.14(2)]

Where:

\( C \) = Rated discharge capacity expressed as mass flow of air, pounds per minute.

\( d \) = Smallest of the internal diameter of the inlet pipe, retaining flanges, fusible plug, or rupture member, inches.

For rupture members:

\[ P_1 = (\text{rated pressure in psig} \times 1.1) + 14.7 \]

For fusible plugs:

\[ P_1 = \text{Absolute saturation pressure, corresponding to the stamped temperature melting point of the fusible plug or the critical pressure of}
\text{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

1113.5 Discharge Capacity. The minimum required discharge capacity of the pressure relief device or fusible plug for each pressure
vessel shall be determined in accordance with Equation 1113.5: ASHRAE 15.

\[ C = fDL \] (Equation 1113.5)

Where:
$C = \text{Minimum required discharge capacity of the relief device expressed as mass flow of air, pounds per minute (kg/s).}$

$D = \text{Outside diameter of vessel, feet (m).}$

$L = \text{Length of vessel, feet (m).}$

$f = \text{Factor dependent upon type of refrigerant from Table 1113.5.}$

Where combustible materials are used within 20 ft (6096 mm) of a pressure vessel, the value of $f$ shall be multiplied 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]

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>VALUE OF $f$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where used on the lowside of a limited-charge cascade system:</td>
<td>-</td>
</tr>
<tr>
<td>R-23, R-170, R-744, R-1150, R-508A; R-508B</td>
<td>4</td>
</tr>
<tr>
<td>R-13, R-13B1, R-503</td>
<td>2</td>
</tr>
<tr>
<td>R-14</td>
<td>2.5</td>
</tr>
<tr>
<td>Other applications:</td>
<td>-</td>
</tr>
<tr>
<td>R-718</td>
<td>0.2</td>
</tr>
<tr>
<td>R-717</td>
<td>0.5</td>
</tr>
<tr>
<td>R-11, R-32, R-113, R-123, R-142b, R-152a, R-290, R-600, R-600a, R-764</td>
<td>4</td>
</tr>
<tr>
<td>R-143a, R-402B, R-403A, R-407A, R-408A, R-413A</td>
<td>2</td>
</tr>
</tbody>
</table>

* 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.

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 gauge) or less shall be marked by the manufacturer with the pressure setting capacity. [ASHRAE 15:9.6.1]

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 either a pressure-limiting device or a pressure-reducing device and a gauge 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, and Class 1 nonflammable refrigerants shall be permitted for factory tests.
(2) Mixtures of dry nitrogen, inert gases, or a combination thereof with flammable Class 2L, Class 2, or Class 3 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]
1116.3 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 gauge 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 thereof such with Class 1 nonflammable refrigerant refrigerants 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 thereof such with flammable Class 2L, Class 2, and Class 3 refrigerants in concentrations not exceeding the lower lesser 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]

220.0 – R –

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

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 11 is being revised to the latest edition of ASHRAE 15-2019 and Addendum J as published on October 30, 2020 to ASHRAE 15-2019.
**TABLE 1104.1**

<table>
<thead>
<tr>
<th>OCCUPANCY GROUP</th>
<th>HIGH-PROBABILITY SYSTEM</th>
<th>LOW PROBABILITY SYSTEM</th>
<th>MACHINERY ROOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>Group A1 or A2L only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>A-2</td>
<td>Group A1 or A2L only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>A-3</td>
<td>Group A1 or A2L only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>A-4</td>
<td>Group A1 or A2L only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>B</td>
<td>Group A1(^2) or A2L(^2) only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>E</td>
<td>Group A1 or A2L only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>F-1</td>
<td>Group A1(^2) or A2L(^2) only</td>
<td>Any</td>
<td>Any</td>
</tr>
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<td>Any</td>
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<tr>
<td>I-2</td>
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<td>Any</td>
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<td>I-3</td>
<td>None</td>
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<td>Any</td>
</tr>
<tr>
<td>I-4</td>
<td>Group A1 or A2L only</td>
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<td>Any</td>
</tr>
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<td>M</td>
<td>Group A1(^2) or A2L(^2) only</td>
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<td>Any</td>
</tr>
<tr>
<td>R-1</td>
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<td>Any</td>
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<td>R-3</td>
<td>Group A1 or A2L only</td>
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<td>Any</td>
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<td>Any(^2)</td>
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</tr>
<tr>
<td>U</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
</tr>
</tbody>
</table>

**Notes:**

\(^1\) See Section 1104.0.
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.


1104.6 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort.

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]

1106.4 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 a refrigerant leakage from entering the airstream. Access doors and panels in ductwork and air-handling units shall be gasketed and tight fitting. [ASHRAE 15:8.11.7 8.11.3]

1106.4.1 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 15:8.11.8 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 1106.2.2.2 1106.2.6 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 annunciate 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 1107.1.7.2. [ASHRAE 15:8.13]

1106.2.2 Refrigerant Detectors. Refrigerant detectors required in accordance with Section 1106.2.4 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 1106.2.4 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 1106.2.4 1106.2.5 or Section 1107.1.7.

1106.2.7 Ventilation. (remaining text unchanged)

1106.2.5 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 1106.2.5.1 for the specified refrigerants, or Section 1106.2.5.2. A2L and B2L refrigerants shall comply with the ventilation requirements specified in ASHRAE 15. Where multiple refrigerants are present, then the highest airflow quantity shall apply. [ASHRAE 15:8.13]

1106.2.5.1 Ventilation - A1, A2, A3, B1, B2L, B2 and B3 refrigerants. The emergency ventilation for A1, A2, A3, B1, B2L, B2, and B3 refrigerants shall have the capacity to provide mechanical exhaust at a rate as determined in accordance with Equation 1106.2.5.1:

\[
Q = 100 \sqrt{G}
\]  

(Equation 1106.2.5.1)

Where:

\[Q\] = Air flow rate, cubic feet per minute.

\[G\] = Refrigerant mass in largest system, pounds.
1106.2.5.2 Ventilation - Group A2L Refrigerants. The emergency ventilation for A2L refrigerants shall have the capacity to provide mechanical exhaust at a rate determined in accordance with Table 1106.2.5.2:

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>MINIMUM AIR-FLOW* (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-32</td>
<td>32,500</td>
</tr>
<tr>
<td>R-143a</td>
<td>28,600</td>
</tr>
<tr>
<td>R-444A</td>
<td>43,700</td>
</tr>
<tr>
<td>R-444B</td>
<td>22,400</td>
</tr>
<tr>
<td>R-445A</td>
<td>46,400</td>
</tr>
<tr>
<td>R-446A</td>
<td>50,500</td>
</tr>
<tr>
<td>R-447A</td>
<td>50,200</td>
</tr>
<tr>
<td>R-447B</td>
<td>29,600</td>
</tr>
<tr>
<td>R-451A</td>
<td>44,900</td>
</tr>
<tr>
<td>R-451B</td>
<td>44,900</td>
</tr>
<tr>
<td>R-452B</td>
<td>31,500</td>
</tr>
<tr>
<td>R-454A</td>
<td>42,900</td>
</tr>
<tr>
<td>R-454B</td>
<td>6650</td>
</tr>
<tr>
<td>R-454C</td>
<td>32,800</td>
</tr>
<tr>
<td>R-455A</td>
<td>4770</td>
</tr>
<tr>
<td>R-457A</td>
<td>31,400</td>
</tr>
<tr>
<td>R-1234yf</td>
<td>16,500</td>
</tr>
<tr>
<td>R-1234zeE</td>
<td>42,600</td>
</tr>
</tbody>
</table>

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

*The values were tabulated from the following equation:

\[ QA_{2L} = \left( \frac{P \cdot V \cdot A}{LFL \cdot 0.50} \right) \] (Equation 1106.2.5.2)

Where:
- \( P \) = Refrigerant density, pounds per cubic feet (kg/m³).
- \( V \) = Refrigerant velocity equal to the refrigerant acoustic velocity (speed of sound), feet per second (m/s).
- \( A \) = Cross-section flow area of refrigerant leak, square feet (m²), \( A = 0.00136 \text{ ft}^2 (0.000126 \text{ m}^2) \).
- \( LFL \) = Lower Flammability Limit, or ETFL60 where no LFL exist, published value in accordance with ASHRAE 34.
- \( QA_{2L} \) = Minimum required air flow rate, conversion to other units of measures is permitted, cubic feet per second (m³/s).

For exact ventilation rates and for refrigerants not listed, the ventilation rate shall be calculated using this equation.

1106.4 Natural Ventilation. Where a refrigerating system is located outdoors more than 20 feet (6096 mm) from buildings opening 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.

\[ F = \sqrt{G} \] (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) The location of the gravity ventilation openings shall be based on the relative density of the refrigerant to air. [ASHRAE 15:8.11.5(a),(b) 8.14]

1107.1.7.1 Mechanical Ventilation. The mechanical ventilation system in the machinery room is run continuously in accordance with Section 1106.2.5 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 1106.2.1.1 and Section 1106.2.2.1106.2.6.

**1107.1.7.2 Refrigeration Detectors.** For the refrigerant detection required in Section 1106.2.2.1 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 1107.1.8 ASHRAE 15. [ASHRAE 15:8.13]

**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 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, or B2 or B2L refrigerant.
3. The system does not contain any quantity of a Group A3 or B3 refrigerant.
4. The system is not required to be installed in a machinery room in accordance with Section 1106.0.
5. The refrigerant concentration limits in Section 1104.0 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]

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 15-2016-2019</td>
<td>Safety Standard for Refrigeration Systems</td>
<td>Refrigeration Systems</td>
<td>1102.1, 1106.1, Table 1113.5</td>
</tr>
<tr>
<td>ASHRAE 34-2016-2019</td>
<td>Designation and Safety Classification of Refrigerants</td>
<td>Refrigeration Classifications</td>
<td>1102.3, 1103.1, Table 1102.3, Table 1106.2.5.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remains unchanged)

**Note:** The ASHRAE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
This change is very important since it addresses the safety measure necessary for the use of Low GWP refrigerants that fall into the category of Group A2L refrigerants. It also updates the requirements for use of Group A2L refrigerants in machinery rooms.

Currently, all of the Low GWP refrigerants recommended for approval by EPA for high probability systems for human comfort fall into the category of Group A2L. The industry is transitioning to Low GWP refrigerants to help the environment and future generations.

Table 1104.1 needs to be updated to address all of the refrigerants in common use for high probability systems. A2L is added to the first column.

Section 1104.6 is a new section regarding the use of Group A2L refrigerants in high probability systems for human comfort. Section 1104.6 are the requirements that were added to the 2019 edition of ASHRAE 15. The section only allows the use of listed equipment when using Group A2L refrigerants in high probability systems.

The section identifies when a refrigerant detector is required for the equipment. This requirement is similar to the requirement found in UL/CSA 60335-2-40. ASHRAE 15 Committee thought it was important for the code to identify when a detector is required while the product standard should identify the installation and testing of the detector.

The activation of the detector signals the mitigation to activate. This results in the mixing of the refrigerant with the surrounding air and the shut down of the equipment.
The machinery room requirements are extracted from the 2019 edition of ASHRAE 15.

New ventilation requirements were added to ASHRAE 15 for machinery rooms using Group A2L refrigerants. The new charts are used for determining the amount of ventilation required based on the amount of refrigerant charge in a system.

There are two levels of annunciation in the event of a refrigerant leak in a machinery room. The first activation is a trouble alarm for a small leak. This requires a minimal amount of ventilation. The second level is an emergency alarm. This signals the activation of the full amount of ventilation for the room.
Proposals

Item #: 214

UMC 2024 Section: 1104.5 - 1112.11.1

SUBMITTER: Automatic Proposal

2019 UMC ROC Item # 091 PC 1 (Previous "HOLD" item)

RECOMMENDATION:
Revise text

1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.5 Flammable Refrigerants. The total of Group A2, B2, A3, and B3 refrigerants, other than Group A2L and B2L refrigerants shall not exceed 1100 pounds (498.9 kg) without approval by the Authority Having Jurisdiction. Institutional Occupancies shall comply with Section 1104.3. Machinery rooms required in accordance with Section 1106.0 based on flammability shall be constructed and maintained in accordance with Section 1106.2.1 through Section 1106.2.6 and Section 1106.13 for Group A2L and B2L refrigerants other than R-717 (ammonia).

1106.0 Refrigeration Machinery Rooms.
1106.1 Where Required. (remaining text unchanged)
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 1106.2.5.2.

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 1106.6, 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 a refrigerant leakage from entering the airstream. Access doors and panels in ductwork and air-handling units shall be gasketed and tight fitting. [ASHRAE 15:8.11.7]

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 15:8.11.8]

1106.2.4.1 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 1106.2.2.2, located 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 annunciate 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, other than ammonia, refrigerant detectors shall comply with Section 1106.13.
1106.2.2 Refrigerant Detectors. Refrigerant detectors required in accordance with Section 1106.2.4.1 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 1106.2.4 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 1106.2.4 or Section 1107.1.7.

(renumber remaining sections)

1106.2.5 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 1106.2.5.1 or Section 1106.2.5.2. Where multiple refrigerants are present, then the highest airflow quantity shall apply.

1106.2.5.1 Ventilation - A1, A2, A3, B1, B2L, B2 and B3 refrigerants. The emergency ventilation for A1, A2, A3, B1, B2L, B2 and B3 refrigerants shall have the capacity to provide mechanical exhaust at a rate as determined in accordance with Equation 1106.2.5.1:

\[ Q = 100 \times G \]  
(Equation 1106.2.5.1)

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

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

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>MINIMUM AIR FLOW* (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-32</td>
<td>32,500</td>
</tr>
<tr>
<td>R-143a</td>
<td>28,600</td>
</tr>
<tr>
<td>R-444A</td>
<td>43,700</td>
</tr>
<tr>
<td>R-444B</td>
<td>22,400</td>
</tr>
<tr>
<td>R-445A</td>
<td>46,400</td>
</tr>
<tr>
<td>R-446A</td>
<td>60,500</td>
</tr>
<tr>
<td>R-447A</td>
<td>60,200</td>
</tr>
<tr>
<td>R-447B</td>
<td>29,600</td>
</tr>
<tr>
<td>R-451A</td>
<td>44,900</td>
</tr>
<tr>
<td>R-451B</td>
<td>44,900</td>
</tr>
<tr>
<td>R-452B</td>
<td>31,600</td>
</tr>
<tr>
<td>R-454A</td>
<td>4290</td>
</tr>
<tr>
<td>R-454B</td>
<td>6650</td>
</tr>
<tr>
<td>R-454C</td>
<td>32,800</td>
</tr>
<tr>
<td>R-455A</td>
<td>4770</td>
</tr>
<tr>
<td>R-457A</td>
<td>31,400</td>
</tr>
<tr>
<td>R-1234yf</td>
<td>16,500</td>
</tr>
<tr>
<td>R-1234zeE</td>
<td>12,600</td>
</tr>
</tbody>
</table>

\[ Q_{A2L} = \frac{(P \times V \times A)}{(LFL \times 0.50)} \]  
(Equation 1106.2.5.2)

Where:

- \( P \) = Refrigerant density, pounds per cubic feet (kg/m³).
1106.4 Natural Ventilation. Where a refrigerating system is located outdoors more than 20 feet (6096 mm) from buildings opening 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.

\[ F = vG \]  
(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 m\(^3\)/s, 1 pound = 0.453 kg

(2) The location of the gravity ventilation openings shall be based on the relative density of the refrigerant to air. [ASHRAE 15:8.11.5(a), (b) 8.14]

1106.13 Machinery Room, A2L and B2L Other than R-717 (Ammonia). When required by Section 1106.1, machinery rooms shall comply with Sections 1106.13.1 through Section 1106.13.6. [ASHRAE 15:8.13]

1106.13.1 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]

1106.13.2 Communicating Spaces. Doors communicating with the building shall be approved, self-closing, tight-fitting fire doors. [ASHRAE 15:8.13.2]

1106.13.3 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]

1106.13.4 Exterior Openings. Exterior openings, if present, shall not be under any fire escape or any open stairway. [ASHRAE 15:8.13.4]

1106.13.5 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]

1106.13.6 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 NFPA 70. When the only flammable refrigerants used are from Group A2L or B2L other than R-717 (ammonia), the machinery room shall comply with both Section 1106.13.6.1 for ventilation and Section 1106.13.6.2 for refrigerant detection, or shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with the NFPA 70. [ASHRAE 15:8.13.6]

1106.13.6.1 Mechanical Ventilation. The machinery room shall have a mechanical ventilation system in accordance with Section 1106.13.11. The mechanical ventilation system shall:

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

1106.13.6.2 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]

1106.13.7 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]

1106.13.8 Refrigerant Detectors. Each refrigerating machinery room in accordance with Section 1106.13 shall contain one or more refrigerant detectors in accordance with Section 1106.13.9, with sensing element located in areas where refrigerant from a leak will concentrate, with one or more set points that activate responses in accordance with Section.
1106.13.10 for alarms and Section 1106.13.11 for mechanical ventilation. Multiport type devices shall be prohibited. [ASHRAE 15:8.13.8]

1106.13.9 Refrigerant Detectors Requirements. Refrigerant detectors required by Section 1106.13 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 Sections 1106.13.10 and 1106.13.11 after exposure to refrigerant concentration exceeding a limit value specified in Section 1106.13.10 and Section 1106.13.11.
(3) The refrigerant detector shall have a set point not greater than the applicable Occupational Exposure Limit (OEL) value as published in 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 a published OEL value in Table 1102.3, use a value determined in accordance with the OEL as defined by Standard Table 1102.3 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 as published in 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 published RCL value in Table 1102.3, use a value determined in accordance with the RCL as defined by Table 1102.3 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 1106.13.10.4. The refrigerant detector shall be tested during installation and annually thereafter, 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 Sections 1106.13.10 and Section 1106.13.11. [ASHRAE 15:8.13.9]

1106.13.10 Alarms. Alarms required by Section 1106.13.8 shall comply with Section 1106.13.10.1 through Section 1106.13.10.4.

1106.13.10.1 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]

1106.13.10.2 Detector Activation. The refrigerant detector set points shall activate an alarm in accordance with the type of reset in Table 1106.13.10.2. Manual reset type alarms shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.10.2]

1106.13.10.3 Alarm Levels. Alarms set at levels other than Table 1106.13.10.2 (such as IDLH) and automatic reset alarms are permitted in addition to those required by Section 1106.13.10. The meaning of each alarm shall be clearly marked by signage near the annunciators. [ASHRAE 15:8.13.10.3]

1106.13.10.4 Emergency. In the event of a failure during a refrigerant detector self-test in accordance with Section 1106.13.9(5), a trouble alarm signal shall be transmitted to an approved monitored location. [ASHRAE 15:8.13.10.4]

1106.13.11 Mechanical Ventilation. Machinery rooms, in accordance with Section 1106.13, shall be vented to the outdoors, using mechanical ventilation in accordance with Section 1106.13.11.1, Section 1106.13.11.2, and Section 1106.13.11.3. [ASHRAE 15:8.13.11.3]

1106.13.11.1 Mechanical Ventilation Requirements. Mechanical ventilation referred to in Section 1106.13.11 shall be in accordance with all of the following:
(1) Include one or more power-driven fans capable of exhausting air from the machinery room; multispeed fans shall be permitted.
(2) Electric motors driving fans shall not be placed inside ducts; fan rotating elements shall be nonferrous or non-sparking, or the casing shall consist of or be lined with such material.
(3) Include provision to supply make-up air to replace that being exhausted; ducts for supply to and exhaust from the machinery room shall serve no other area; the makeup air supply locations shall be positioned relative to the exhaust air locations to avoid short circuiting.
(4) Inlets to the exhaust ducts shall be located in an area where refrigerant from a leak will concentrate, in consideration of the location of the replacement supply air paths, refrigerating machines, and the density of the refrigerant relative to air.
(5) Inlets to exhaust ducts shall be within 1 foot (0.3 m) of the lowest point of the machinery room for refrigerants that are heavier than air and shall be within 1 foot (0.3 m) of the highest point for refrigerants that are lighter than air. [ASHRAE 15:8.13.11.1]
(6) The discharge of the exhaust air shall be to the outdoors in such a manner as not to cause a nuisance or danger.

1106.13.11.2 Level 1 Ventilation. The refrigerating machinery room mechanical ventilation in Section 1106.13.11.1 shall exhaust at an airflow rate not less than shown in Table 1106.13.11.2. [ASHRAE 15:8.13.11.2]

1106.13.11.3 Level 2 Ventilation. A part of the refrigerating machinery room mechanical ventilation referred to in Section 1106.13.11.1 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 1106.13.8 shall activate ventilation at a set point and response time in accordance with Table 1106.13.10.2 at an airflow rate not less than the value determined in accordance with Section 1106.13.11.4. 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 1106.13.10.2. Manual-type ventilation reset shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.11.3]
### 1106.13.11.4 Safety group A2L, B2L Other than Ammonia

When required by Section 1106.13.11.3, the total airflow for Level 2 Ventilation shall be not less than the airflow rate determined by Figure 1106.13.11.4. [ASHRAE 15:8.13.11.4]

#### TABLE 1106.13.10.2
**SAFETY GROUPS: A2L, B2L OTHER THAN R-717 (AMMONIA)**

<table>
<thead>
<tr>
<th>LIMIT VALUE</th>
<th>RESPONSE TIME (seconds)</th>
<th>ALARM TYPE</th>
<th>ALARM RESET TYPE</th>
<th>VENTILATION RATE</th>
<th>VENTILATION RESET TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set point $$\leq$$ OEL</td>
<td>$$\leq$$ 300</td>
<td>Troubled Alarm</td>
<td>Automatic</td>
<td>Level 1</td>
<td>Automatic</td>
</tr>
<tr>
<td>Set point $$\leq$$ RCL</td>
<td>$$\leq$$ 15</td>
<td>Emergency Alarm</td>
<td>Manual</td>
<td>Level 2</td>
<td>Manual</td>
</tr>
</tbody>
</table>

#### TABLE 1106.13.11.2
**LEVEL 1 VENTILATION RATE FOR CLASS 2L REFRIGERANTS**

<table>
<thead>
<tr>
<th>STATUS</th>
<th>AIRFLOW</th>
</tr>
</thead>
</table>
| Operated when occupied and operated when activated in accordance with Section 1106.13.10.2 and Table 1106.13.10.2 | The greater of the following:
- (1) 0.5 ft³/min per ft³ (2.54 L/s per m³) of machinery room area, or
- (2) 20 ft³/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. |

### 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 NFPA 70, 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 1106.2.5 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 1106.2.2.1 and Section 1106.2.2.2.

#### 1107.1.7.2 Refrigeration Detectors

For the refrigerant detection required in Section 1106.2.2.1, 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 1106.13.

### 1112.11 Discharge from Pressure-Relief Devices

Pressure-relief systems designed for vapor shall comply with Section 1112.11 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 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, or B2 or B2L refrigerant.
- (3) The system does not contain any quantity of a Group A3 or B3 refrigerant.
- (4) The system is not required to be installed in a machinery room in accordance with Section 1106.0.
- (5) The refrigerant concentration limits in Section 1104.0 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]

FIGURE 1106.13.11.4
LEVEL 2 VENTILATION RATE FOR CLASS 2L REFRIGERANTS
[ASHRAE 15: FIGURE 8.13.11.4-1]

SUBSTANTIATION:
[This item was placed on “HOLD” by the Technical Committee in the 2019 Report on Comments in accordance with Section 4-4.6.2.2 as it was proposing new information that did not have public review. See 2019 Report on Comments Item # 091 (Public Comment 1)]

In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 11 has been revised to correlate with Addendum h of ASHRAE 15-2016 (published October 9, 2018). This public comment adds the requirements from Addendum h to the code so that the Uniform Mechanical Code remains consistent with ASHRAE 15. This public comment and Addendum h address the safe use of Group A2L refrigerants which fall into the category of lower global warming potential refrigerants.

These requirements are needed for advancing the use of environmentally friendly refrigerants. Many states,
including the State of California, are requiring a switch to lower global warming potential refrigerants. Without these requirements, states will not have the proper tools for the code enforcement community to regulate lower global warming potential refrigerants that fall within Group A2L.

Within the safety requirements of this public comment are limitations on the charge size of refrigerating systems based on their location, as well as, detector requirements. It should be noted that the requirements rely on the equipment being listed. The standard regulating refrigerant equipment is UL/CSA 60335-2-40 which is currently referenced in the UMC.
# Table 1102.3

Refrigerant Groups, Properties, and Allowable Quantities

[ASHRAE 34: Table 4-1, Table 4-2]

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Chemical Formula</th>
<th>Chemical Name (Composition for Blends)</th>
<th>Safety Group</th>
<th>OEL² (ppm)</th>
<th>RCL (Pounds per 1000 cubic feet of space lb/Mcf)</th>
<th>LFL (lb/Mcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-11</td>
<td>CCl₃F</td>
<td>Trichlorofluoromethane</td>
<td>A1</td>
<td>&lt;1000</td>
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<td>R-12</td>
<td>CCl₂F₂</td>
<td>Dichlorodifluoromethane</td>
<td>A1</td>
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<td>5.6</td>
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<tr>
<td>R-12B1</td>
<td>CBrClF₂</td>
<td>Bromochlorodifluoromethane</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td>R-13</td>
<td>CClF₃</td>
<td>Chlorotrifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>R-13B1</td>
<td>CBrF₃</td>
<td>Bromotrifluoromethane</td>
<td>A1</td>
<td>1000</td>
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<tr>
<td>R-13I1</td>
<td>CF₃I</td>
<td>Trifluoriodomethane</td>
<td>A1</td>
<td>500</td>
<td>1.0</td>
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</tr>
<tr>
<td>R-14</td>
<td>CF₄</td>
<td>Tetrafluoromethane (carbon tetrafluoride)</td>
<td>A1</td>
<td>1000</td>
<td>25</td>
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<tr>
<td>R-21</td>
<td>CHCl₂F</td>
<td>Dichlorofluoromethane</td>
<td>B1</td>
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<tr>
<td>R-22</td>
<td>CHClF₂</td>
<td>Chlorodifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>13</td>
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</tr>
<tr>
<td>R-23</td>
<td>CHF₃</td>
<td>Trifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>7.3</td>
<td>—</td>
</tr>
<tr>
<td>R-30</td>
<td>CH₂Cl₂</td>
<td>Dichloromethane (methylene chloride)</td>
<td>B1</td>
<td>—</td>
<td>—</td>
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<tr>
<td>R-31</td>
<td>CH₂ClF</td>
<td>Chlorofluoromethane</td>
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<tr>
<td>R-32</td>
<td>CH₂F₂</td>
<td>Difluoromethane (methylene fluoride)</td>
<td>A2L</td>
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<td>19.1</td>
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<tr>
<td>R-40</td>
<td>CH₃Cl</td>
<td>Chloromethane (methyl chloride)</td>
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<tr>
<td>R-41</td>
<td>CH₃F</td>
<td>Fluoromethane (methyl fluoride)</td>
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<td>—</td>
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<tr>
<td>R-50</td>
<td>CH₄</td>
<td>Methane</td>
<td>A3</td>
<td>1000</td>
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<td>—</td>
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<tr>
<td>R-113</td>
<td>CCl₂FCCl₂</td>
<td>1, 1, 2-trichloro-1, 2, 2₆-trifluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>1.2</td>
<td>—</td>
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<tr>
<td>R-114</td>
<td>CClF₂CCl₂</td>
<td>1, 2-dichloro-1, 1, 2, 2₆-tetrafluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>8.7</td>
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</tr>
<tr>
<td>R-115</td>
<td>CClF₂CF₃</td>
<td>Chloropentafluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>47</td>
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</tr>
<tr>
<td>R-116</td>
<td>CF₃CF₃</td>
<td>Hexafluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>34</td>
<td>—</td>
</tr>
<tr>
<td>R-123</td>
<td>CHCl₂CF₃</td>
<td>2, 2-dichloro-1, 1, 1₆-trifluoroethane</td>
<td>B1</td>
<td>50</td>
<td>3.5</td>
<td>—</td>
</tr>
<tr>
<td>R-124</td>
<td>CHClF₂CF₃</td>
<td>2-chloro-1, 1, 1₆-trifluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>3.5</td>
<td>—</td>
</tr>
</tbody>
</table>

Notes:
- RCL: Refrigerant Concentration Limit
- LFL: Limiting Flammable Limit
- OEL: Occupational Exposure Limit
- A: Acute
- B: Baseline
- L: Long-term
- S: Short-term
- H: High
- M: Medium
- L: Low
- D: Delayed
- F: Fast
- S: Slow
<table>
<thead>
<tr>
<th>Compound</th>
<th>Formula</th>
<th>Type</th>
<th>p.a. (°C)</th>
<th>bp. (°C)</th>
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<tbody>
<tr>
<td>R-125 CHF₂CF₃</td>
<td></td>
<td>Pentafluoroethane</td>
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<tr>
<td>R-134a CH₂FCF₃</td>
<td>1, 1, 1, 2-tetrafluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>13</td>
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<tr>
<td>R-141b CH₂CCl₂F</td>
<td>1, 1-dichloro-1-fluoroethane</td>
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<tr>
<td>R-142b CH₂CCIF₂</td>
<td>1-chloro-1, 1-difluoroethane</td>
<td>A2</td>
<td>1000</td>
<td>5.1</td>
</tr>
<tr>
<td>R-143a CH₂CF₃</td>
<td>1, 1-trifluoroethane</td>
<td>A2L</td>
<td>1000</td>
<td>4.4</td>
</tr>
<tr>
<td>R-152a CH₂CHF₂</td>
<td>1, 1-difluoroethane</td>
<td>A2</td>
<td>1000</td>
<td>2.0</td>
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<tr>
<td>R-170 CH₃CH₃</td>
<td>Ethane</td>
<td>A3</td>
<td>1000</td>
<td>0.54</td>
</tr>
<tr>
<td>R-E170 CH₃OCH₃</td>
<td>Methoxymethane (Dimethyl ether)</td>
<td>A3</td>
<td>1000</td>
<td>1.0</td>
</tr>
<tr>
<td>R-218 CF₃CF₂CF₃</td>
<td>Octafluoropropane</td>
<td>A1</td>
<td>1000</td>
<td>43</td>
</tr>
<tr>
<td>R-227ea CF₃CHFCF₃</td>
<td>1, 1, 1, 2, 3, 3, 3-heptafluoropropane</td>
<td>A1</td>
<td>1000</td>
<td>36</td>
</tr>
<tr>
<td>R-236fa CF₃CCl₂F</td>
<td>1-chloro-1, 1-difluoroethane</td>
<td>A2</td>
<td>1000</td>
<td>5.1</td>
</tr>
<tr>
<td>R-245fa CHF₂CH₂CF₃</td>
<td>1, 1, 1, 3, 3-pentafluoropropane</td>
<td>B1</td>
<td>300</td>
<td>12</td>
</tr>
<tr>
<td>R-290 CH₃CH₂CH₃</td>
<td>Propane</td>
<td>A3</td>
<td>1000</td>
<td>3.6</td>
</tr>
<tr>
<td>R-C318 -(CF₂)₄-</td>
<td>Octafluorocyclobutane</td>
<td>A1</td>
<td>1000</td>
<td>41</td>
</tr>
<tr>
<td>R-400 zeotrope</td>
<td>R-12/114 (50.0/50.0)</td>
<td>A1</td>
<td>1000</td>
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<td>R-400 zeotrope</td>
<td>R-12/114 (60.0/40.0)</td>
<td>A1</td>
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<tr>
<td>R-401A zeotrope</td>
<td>R-22/152a/124 (53.0/13.0/34.0)</td>
<td>A1</td>
<td>1000</td>
<td>6.6</td>
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<tr>
<td>R-401B zeotrope</td>
<td>R-22/152a/124 (61.0/11.0/28.0)</td>
<td>A1</td>
<td>1000</td>
<td>7.2</td>
</tr>
<tr>
<td>R-402A zeotrope</td>
<td>R-125/290/22 (60.0/2.0/38.0)</td>
<td>A1</td>
<td>1000</td>
<td>17</td>
</tr>
<tr>
<td>R-402B zeotrope</td>
<td>R-125/290/22 (38.0/2.0/60.0)</td>
<td>A1</td>
<td>1000</td>
<td>15</td>
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<tr>
<td>R-403A zeotrope</td>
<td>R-290/22/218 (5.0/75.0/20.0)</td>
<td>A2</td>
<td>1000</td>
<td>7.6</td>
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<tr>
<td>R-403B zeotrope</td>
<td>R-290/22/218 (5.0/56.0/39.0)</td>
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<td>18</td>
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<tr>
<td>R-404A zeotrope</td>
<td>R-125/143a/134a (44.0/52.0/4.0)</td>
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<td>1000</td>
<td>31</td>
</tr>
<tr>
<td>R-405A zeotrope</td>
<td>R-22/152a/142b/C318 (45.0/7.0/5.5/42.5)</td>
<td>—</td>
<td>1000</td>
<td>16</td>
</tr>
<tr>
<td>R-406A zeotrope</td>
<td>R-22/600a/142b (55.0/4.0/41.0)</td>
<td>A2</td>
<td>1000</td>
<td>4.7</td>
</tr>
<tr>
<td>R-407A zeotrope</td>
<td>R-32/125/134a (20.0/40.0/40.0)</td>
<td>A1</td>
<td>1000</td>
<td>19</td>
</tr>
<tr>
<td>R-407B zeotrope</td>
<td>R-32/125/134a (10.0/70.0/20.0)</td>
<td>A1</td>
<td>1000</td>
<td>21</td>
</tr>
<tr>
<td>R-407C zeotrope</td>
<td>R-32/125/134a (23.0/25.0/52.0)</td>
<td>A1</td>
<td>1000</td>
<td>18</td>
</tr>
<tr>
<td>R-407D zeotrope</td>
<td>R-32/125/134a (15.0/15.0/70.0)</td>
<td>A1</td>
<td>1000</td>
<td>16</td>
</tr>
<tr>
<td>R-407E zeotrope</td>
<td>R-32/125/134a (25.0/15.0/60.0)</td>
<td>A1</td>
<td>1000</td>
<td>17</td>
</tr>
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<td>R-407F zeotrope</td>
<td>R-32/125/134a (30.0/30.0/40.0)</td>
<td>A1</td>
<td>1000</td>
<td>20</td>
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<tr>
<td>R-407G zeotrope</td>
<td>R-32/125/134a (2.5/2.5/95.0)</td>
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<td>1000</td>
<td>13</td>
</tr>
<tr>
<td>R-407H zeotrope</td>
<td>R-32/125/134a (32.5/15.0/52.5)</td>
<td>A1</td>
<td>1000</td>
<td>19</td>
</tr>
<tr>
<td>R-407I zeotrope</td>
<td>R-32/125/134a (19.5/8.5/72.0)</td>
<td>A1</td>
<td>1000</td>
<td>16.9</td>
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<tr>
<td>R-408A zeotrope</td>
<td>R-125/143a/22 (7.0/46.0/47.0)</td>
<td>A1</td>
<td>1000</td>
<td>21</td>
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<tr>
<td>R-409A zeotrope</td>
<td>R-22/124/142b (60.0/25.0/15.0)</td>
<td>A1</td>
<td>1000</td>
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<td>R-22/124/142b (65.0/25.0/10.0)</td>
<td>A1</td>
<td>1000</td>
<td>7.3</td>
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<td>R-32/125 (50.0/50.0)</td>
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<td>R-32/125 (45.0/55.0)</td>
<td>A1</td>
<td>1000</td>
<td>27</td>
</tr>
<tr>
<td>R-411A⁶ zeotrope</td>
<td>R-1270/22/152a (1.5/87.5/11.0)</td>
<td>A2</td>
<td>970</td>
<td>2.9</td>
</tr>
<tr>
<td>R-411B⁶ zeotrope</td>
<td>R-1270/22/152a (3.0/94.0/3.0)</td>
<td>A2</td>
<td>940</td>
<td>2.8</td>
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<tr>
<td>R-412A zeotrope</td>
<td>R-22/218/142b (70.0/5.0/25.0)</td>
<td>A2</td>
<td>1000</td>
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</tr>
<tr>
<td>R-413A zeotrope</td>
<td>R-218/134a/600a (9.0/88.0/3.0)</td>
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<td>R-22/124/600a/142b (51.0/28.5/4.0/16.5)</td>
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<td>R-22/124/600a/142b (50.0/39.0/1.5/9.5)</td>
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<td>1000</td>
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<td>R-415A zeotrope</td>
<td>R-22/152a (82.0/18.0)</td>
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<td>R-22/152a (25.0/75.0)</td>
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<td>2.1</td>
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<tr>
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<td>R-134a/124/600 (59.0/39.5/1.5)</td>
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<td>R-125/134a/600 (46.6/50.0/3.4)</td>
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<td>R-125/134a/600 (19.5/78.8/1.7)</td>
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<td>Compound</td>
<td>Zeotrope</td>
<td>R-Tuple</td>
<td>Isomeric Points</td>
<td>A1/A2/A3</td>
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<td>R-418A</td>
<td>zeotrope</td>
<td>R-290/22/152a (1.5/96.0/2.5)</td>
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<td>R-419A</td>
<td>zeotrope</td>
<td>R-125/134a/E170 (77.0/19.0/4.0)</td>
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<td>1000</td>
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<tr>
<td>R-419B</td>
<td>zeotrope</td>
<td>R-125/134a.E170 (48.5/48.0/3.5)</td>
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<td>1000</td>
</tr>
<tr>
<td>R-420A</td>
<td>zeotrope</td>
<td>R-134a/142b (88.0/12.0)</td>
<td>A1</td>
<td>1000</td>
</tr>
<tr>
<td>R-421A</td>
<td>zeotrope</td>
<td>R-125/134a (58.0/42.0)</td>
<td>A1</td>
<td>1000</td>
</tr>
<tr>
<td>R-421B</td>
<td>zeotrope</td>
<td>R-125/134a/E170 (85.0/15.0)</td>
<td>A1</td>
<td>1000</td>
</tr>
<tr>
<td>R-422A</td>
<td>zeotrope</td>
<td>R-125/134a/600a (85.1/11.5/3.4)</td>
<td>A1</td>
<td>1000</td>
</tr>
<tr>
<td>R-422B</td>
<td>zeotrope</td>
<td>R-125/134a/600a (55.0/42.0/3.0)</td>
<td>A1</td>
<td>1000</td>
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<td>R-422C</td>
<td>zeotrope</td>
<td>R-125/134a/600a (82.0/15.0/3.0)</td>
<td>A1</td>
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<td>R-422D</td>
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<td>R-125/134a/600a (65.1/31.5/3.4)</td>
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<td>R-423A</td>
<td>zeotrope</td>
<td>R-134a/227ea (52.5/47.5)</td>
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<td>1000</td>
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<tr>
<td>R-426A</td>
<td>zeotrope</td>
<td>R-125/134a/600/601a (50.5/47.0/0.9/1.0/0.6)</td>
<td>A1</td>
<td>970</td>
</tr>
<tr>
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<td>0.18</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>R-601a</td>
<td>(CH₃)₂CHCH₂CH₃</td>
<td>2-methylbutane (isopentane)</td>
<td>A3</td>
<td>600</td>
<td>0.18</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>R-610</td>
<td>CH₃CH₂OHCH₂CH₃</td>
<td>Ethoxyethane (ethyl ether)</td>
<td>—</td>
<td>400</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-611</td>
<td>HCOOCH₃</td>
<td>Methyl formate</td>
<td>B2</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-620</td>
<td>—</td>
<td>(Reserved for future assignment)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-630</td>
<td>CH₃NH₂</td>
<td>Methanamine (methyl amine)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-631</td>
<td>CH₃CH(NH₂)</td>
<td>Ethanamine (ethyl amine)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-702</td>
<td>H₂</td>
<td>Hydrogen</td>
<td>A3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-704</td>
<td>He</td>
<td>Helium</td>
<td>A1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-717</td>
<td>NH₃</td>
<td>Ammonia</td>
<td>B2L</td>
<td>25</td>
<td>0.014</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>R-718</td>
<td>H₂O</td>
<td>Water</td>
<td>A1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-720</td>
<td>Ne</td>
<td>Neon</td>
<td>A1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-728</td>
<td>N₂</td>
<td>Nitrogen</td>
<td>A1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-732</td>
<td>O₂</td>
<td>Oxygen</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-740</td>
<td>Ar</td>
<td>Argon</td>
<td>A1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-744</td>
<td>CO₂</td>
<td>Carbon dioxide</td>
<td>A1</td>
<td>5000</td>
<td>3.4</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-744A</td>
<td>N₂O</td>
<td>Nitrous oxide</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-764</td>
<td>SO₂</td>
<td>Sulfur dioxide</td>
<td>B1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-1130(E)</td>
<td>CHCl=CHCl</td>
<td>Trans-1,2-dichloroethene</td>
<td>B₁ B₂</td>
<td>200</td>
<td>0.25</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>R-1132a</td>
<td>CF₂=CH₂</td>
<td>1, 1-difluoroethylene</td>
<td>A2</td>
<td>500</td>
<td>2.0</td>
<td>8.1</td>
<td></td>
</tr>
<tr>
<td>R-1150</td>
<td>CH₂=CH₂</td>
<td>Ethene (ethylene)</td>
<td>A3</td>
<td>200</td>
<td>—</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>R-1224yd(Z)</td>
<td>CF₃CF=CHCl</td>
<td>(Z)-1-chloro-2,3,3,3-tetrafluoropropene</td>
<td>A1</td>
<td>1000</td>
<td>23</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-1233zd(E)</td>
<td>CF₃CH=CHCl</td>
<td>Trans-1-chloro-3,3,3-trifluoro-1-propene</td>
<td>A1</td>
<td>800</td>
<td>5.3</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-1234yd(f)</td>
<td>CF₃CF=CH₂</td>
<td>2, 3, 3, 3-tetrafluoro-1-propene</td>
<td>A2L</td>
<td>500</td>
<td>4.7</td>
<td>4.5</td>
<td>18.0</td>
</tr>
<tr>
<td>R-1234ze(E)</td>
<td>CF₃CH=CHF- CF₃CH=CFH</td>
<td>Trans-1,3,3,3- tetrafluoro-1-propene</td>
<td>A2L</td>
<td>800</td>
<td>4.7</td>
<td>18.8</td>
<td></td>
</tr>
<tr>
<td>R-1270</td>
<td>CH₃CH=CH₂</td>
<td>Propene (propylene)</td>
<td>A3</td>
<td>500</td>
<td>0.11</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>R-1336mzz(E)</td>
<td>CF₃CH=CHF</td>
<td>Trans-1,1,1,4,4,4-hexafluoro-2-butene</td>
<td>A1</td>
<td>400</td>
<td>3.0</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-1336mzz(Z)</td>
<td>CF₃CHCHCF₃</td>
<td>Cis-1,1,1,4,4,4-hexafluoro-2-butene</td>
<td>A1</td>
<td>500</td>
<td>5.4</td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>
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.

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

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Table 1102.3 is being revised to the latest edition of ASHRAE 34-2019 which includes addendums to ASHRAE 15-2019 (a through y), as applicable.
1102.0 Refrigeration Systems.

1102.1 General. Refrigeration systems using a refrigerant other than ammonia shall comply with this chapter and either ASHRAE 15 or ASHRAE 15.2, as applicable.

### TABLE 1701.1

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Standard Title</th>
<th>Application</th>
<th>Referenced Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 15.2-2021 (WD)</td>
<td>Refrigeration Systems in Residential Applications</td>
<td>Residential Refrigeration Systems</td>
<td>1102.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASHRAE 15.2 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
ASHRAE 15.2 has been developed as the installation standard for individual dwelling units. The user of the code is directed to whichever standard is applicable.
1102.0 Refrigeration Systems.

1102.1 General. Refrigeration systems using a refrigerant other than ammonia shall comply with this chapter and ASHRAE 15. Refrigeration systems containing carbon dioxide as the refrigerant shall also comply with BSR/IIAR CO2.

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 IIAR 6 and shall not be required to comply with this chapter.

### TABLE 1701.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSR/IIAR CO2-2021 (Working Draft)</td>
<td>Safety Standard for Closed-Circuit Carbon Dioxide Refrigeration Systems</td>
<td>Carbon Dioxide Refrigeration Systems</td>
<td>1102.1</td>
</tr>
</tbody>
</table>

Note: IIAR 6 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

Note: BSR/IIAR CO2 is a working draft and is not completed at the time of this monograph.

**SUBSTANTIATION:**

IIAR 6 is a new standard for maintenance and inspection of closed-circuit ammonia refrigeration systems that is part of the suite of IIAR standards regulating ammonia refrigeration systems. Because this standard addresses system maintenance, which is part of the UMC scope in Section 101.2 (Scope), it is important to have the standard referenced by the UMC to provide for proper compliance and enforcement of ammonia system regulations. Mandatory system maintenance regulations covering ammonia refrigeration systems in the UMC is important to safe operation of these systems in UMC jurisdictions.

BSR/IIAR CO2 is in the process of completion for issuance in 2021. It is a new standard governing refrigeration systems that use carbon dioxide as the refrigerant, and it is designed to be a companion to ASHRAE 15, providing additional design requirements that are unique to carbon dioxide systems to supplement ASHRAE 15 and going beyond the scope of ASHRAE 15 by regulating the complete life-cycle of carbon dioxide systems. Carbon dioxide has become increasingly popular as an industrial refrigerant because it is considered efficient and climate friendly. Including IIAR's new standard will assure that these systems are properly regulated.
Item #: 218

UMC 2024  Section: 1108.1

SUBMITTER: Mitch Pinsker
Affiliated Engineers Inc
Rep. ASHRAE Golden Gate Chapter Chair of Government Affairs Committee and Code Review Committee

RECOMMENDATION:
Revise text

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 require access or maintenance by personnel not authorized to access the refrigeration machinery room in accordance with Section 1106.11 shall not be placed in or pass through a refrigeration machinery room.

(below shown for reference only)

1106.11 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 15:8.11.8]

SUBSTANTIATION:
The current wording of Section 1108.1 has been very inconsistently enforced and can be onerous. For instance, AHJs have at times disallowed the following from being inside refrigeration machinery (e.g. chiller) rooms:
1. Roof drain piping from a drain in the roof above the chiller room
2. Hot water piping passing through a corner of the chiller room from an adjacent boiler room
3. Electrical panels that include circuits serving equipment outside the chiller room in addition to equipment inside the room

Locating these elements in the chiller room poses no safety risk provided anyone accessing these elements, e.g. for maintenance, are authorized to access the room. Section 1106.11 says:

1106.11 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 15:8.11.8]

This proposal then disallows equipment and materials to be located inside the refrigeration room if the personnel required to maintain them are not authorized to access the room. For instance, this would disallow the following from being located in the chiller room:
1. Window washing equipment
2. Irrigation control panels and equipment
3. Cellular phone panels

Note that the blanket limitations in Section 1108.1 are unique to the UMC; neither ASHRAE Standard 15 (from which most of this chapter was extracted) nor the International Mechanical Code include a similar requirement. So even with the proposed revisions, the UMC would be more stringent than these other standards and codes.
Proposals

Item #: 219
UMC 2024  Section: 1108.1

SUBMITTER: Vanessa O'Connor
Western Allied Mechanical Inc

RECOMMENDATION:
Revise text

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. Exception: Piping that does not affect the operation of equipment in the refrigeration machinery room.

SUBSTANTIATION:
The additional text is to provide an exception for piping that does not interfere with the refrigeration machinery room equipment. Examples would include pipe for HHW, CHW, or drainage, which would not affect the equipment and do not necessarily need to be rerouted.
Proposals

Item #: 220
UMC 2024  Section: 1108.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

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.

Equipment essential to the refrigeration process permitted to be placed in or pass through a refrigeration machinery room shall include:
(1) Refrigeration compressors.
(2) Condensing units.
(3) Pumps, associated piping and automatic control valves for refrigerant, condenser water, and brine or chilled water.
(4) Refrigeration control devices and panels.
(5) Machinery room ventilation equipment.
(6) Refrigerant receivers and accumulators.
(7) Refrigerant vapor-detection and alarm systems.
(8) Machinery room fire sprinkler system.
(9) Machinery room lighting and service receptacles.
(10) Motor control centers and electrical panels for machinery room systems.

SUBSTANTIATION:
There is confusion in the field as to which equipment is “essential” for the refrigeration process and allowed in a refrigeration machinery room. The list of equipment being added to Section 1108.1 provides clarity as to which equipment is allowed in the refrigeration machinery room. The list was taken from past editions of the UMC.
Proposals

Item #: 221
UMC 2024  Section: 1109.1

SUBMITTER: William E Chapin
Professional Code Consulting, LLC

RECOMMENDATION:
Revise text

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.

SUBSTANTIATION:
The first two sentences of this section clearly states that materials must be safe and reliable for refrigerant systems. The last sentence of this section is overly restrictive by prohibiting current and future piping materials that are tested and listed for conveying refrigerant safely. Additional code change proposals are being introduced this cycle to allow materials have been used for refrigerant systems around the world for decades.
Proposals

Item #: 222
UMC 2024  Section: 1109.1, Table 1109.1, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

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. Materials for refrigerant piping, tubing, and fittings shall be acceptable to the Authority Having Jurisdiction and shall comply with the applicable standards in Table 1109.1 or other approved standards.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PIPING/TUBING</strong></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>ASTM B210, ASTM B491</td>
</tr>
<tr>
<td><strong>FITTINGS</strong></td>
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</tr>
<tr>
<td></td>
<td>ASTM B361</td>
</tr>
<tr>
<td></td>
<td>ASTM A105, ASTM A181, ASTM A193, ASTM A234, ASTM A420, ASTM A707</td>
</tr>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>ASME B16.50-2018</td>
<td>Wrought Copper and Copper Alloy Braze-joint Pressure Fittings</td>
</tr>
<tr>
<td>ASTM A105/A105M-2021</td>
<td>Carbon Steel Forgings for Piping Applications</td>
</tr>
<tr>
<td>ASTM A181/A181M-2014 (R2020)</td>
<td>Carbon Steel Forgings, for General-Purpose Piping</td>
</tr>
<tr>
<td>ASTM A193/A193M-2020</td>
<td>Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications</td>
</tr>
<tr>
<td>ASTM A234/A234M-2019</td>
<td>Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service</td>
</tr>
<tr>
<td>ASTM A333/A333M-2018</td>
<td>Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness</td>
</tr>
<tr>
<td>ASTM A334/A334M-2004a (R2016)</td>
<td>Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service</td>
</tr>
<tr>
<td>ASTM A707/A707M-2019</td>
<td>Forged Carbon and Alloy Steel Flanges for Low-Temperature Service</td>
</tr>
<tr>
<td>ASTM B68/B68M-2019</td>
<td>Seamless Copper Tube, Bright Annealed</td>
</tr>
<tr>
<td>ASTM B361-2016</td>
<td>Factory-made Wrought Aluminum and Aluminum-alloy Welding Fittings</td>
</tr>
<tr>
<td>ASTM B491/ASTM B491M-2015</td>
<td>Aluminum and Aluminum-Alloy Extruded Round Tubes for General-Purpose Applications</td>
</tr>
<tr>
<td>ASTM B819-2019</td>
<td>Seamless Copper Tube for Medical Gas Systems</td>
</tr>
</tbody>
</table>

Note: The ASME and ASTM standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The first step in refrigerant piping design and installation is to gather product and jobsite information. Installing a new HVAC system requires skill and knowledge of appropriate procedures in electrical wiring, controls wiring, and pipework, including the refrigeration piping and fittings. Proper refrigeration piping installation practices requires the use of proper and rated materials for the installation. The new table provides an easy to reference list of acceptable standards for each application to assist the AHJ in approving refrigerant piping.

(portions of table not shown remain unchanged)
Add new text

1109.1.3 Polyethylene of Raised Temperature/Aluminum/Polyethylene of Raised Temperature (PERT/AL/PERT) Linesets. PE-RT/AL/PE-RT piping shall be approved for the intended use and shall comply with ASTM F3346.

(renumber remaining sections)

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F3346-2019</td>
<td>Standard Specification for Polyethylene of Raised Temperature/Aluminum/Polyethylene of Raised Temperature (PERT/AL/PE-RT) Composite Pressure Pipe</td>
<td>Piping</td>
<td>1109.1.3</td>
</tr>
</tbody>
</table>

Note: ASTM F3346 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
ASTM F3346 was published in 2019. The standard includes all of the design and testing requirements of other existing composite piping standards and includes requirements for testing in accordance with UL 207 for each refrigerant intended to be used.
Proposals

Item #: 224
UMC 2024 Section: 218.0, 1109.1.5, Table 1701.1

SUBMITTER: Brad Campbell
Gastite

RECOMMENDATION:
Add new text

1109.0 Refrigeration Piping, Containers, and Valves.
1109.1 Materials.

**1109.1.5 Polyethylene of Raised Temperature-Aluminum-Polyethylene of Raised Temperature (PE-RT/AL/PE-RT) Linesets.** PE-RT/AL/PE-RT linesets shall comply with ASTM FXXXX.

218.0 – P –
PE-RT/AL/PE-RT, Polyethylene of raised temperature-aluminum-polyethylene of raised temperature.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCED STANDARDS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM FXXXX-2021 (Working Draft)</td>
<td>Polyethylene of Raised Temperature - Aluminum - Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems</td>
<td>PE-RT/AL/PE-RT</td>
<td>1109.1.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM FXXXX is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
PERT-AL-PERT pipe material is not listed in the UMC Section 1109.1 Refrigeration Piping Materials section. This type of composite pipe has primarily been used for water conveyance applications but if the pipe is designed and tested to the new ASTM FXXXX Standard for “Polyethylene of Raised Temperature - Aluminum - Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems” will be a comparable line set option. Given previous requests to add PERT/AL/PERT pipe to Sections 1109.1.5 and 1109.2 (for refrigeration pipe material and joints), the definition of PERT/AL/PERT should be defined in Section 218.0. This new ASTM FXXXX standard will be finalized and published in the next 30 days.
Proposals

Item #: 225
UMC 2024 Section: 1109.2, Table 1701.1

SUBMITTER: Donald (DJ) Berger
Self

RECOMMENDATION:
Revise text

1109.0 Refrigeration Piping, Containers, and Valves.

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.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL-207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014)</td>
<td>Refrigeration Components</td>
<td>1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Section 1109.2 of the UMC originally listed only those joint types for refrigeration piping which have been time tested for soundness. Fittings for each joining process were required to be manufactured in accordance with recognized ASME and ASTM Standards, with the intent of the code being a leak-free piping system installed to safely contain the refrigerant within it.

The use of press-connect technology on copper or copper alloy pipe joints of iron pipe size, as well as the use of press-connect technology on copper tubing joints and connections, was introduced into the 2018 UMC through ROP #154 and finally approved into the UMC as being tested per the industry standard, UL 207. It is my intention to substantiate that UL 207 was misapplied for the allowance of press-connect technology into this section of the 2021 UMC.

The Scope: Section 1.1 of the UL 207-2009 Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014) clearly states which nonelectrical refrigerant-containing components and accessories are covered by the requirements of the UL 207. The subsequent paragraph of the Scope; Section 1.2 (a), clearly states “These requirements do not apply to: Electrical valves and electric refrigeration controllers, hermetic refrigerant motor compressors, tubing fittings such as flare or compression type fittings, and the like, which are covered in or as part of separate, individual requirements.”

There is an existing ASME B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings Standard listed in the 2021 UMC, but that standard does not include ASTM B280 copper and copper alloy piping or the use of press-connect technology as a joining process for refrigeration piping.
As press-connect technology for fittings would be covered by other recognized standards, such as the ASME B31.5 Refrigeration Piping and Heat Transfer Components, it is my opinion that the UL 207 was incorrectly substantiated by the Submitter of the original proposal.

Additionally, Section 1109.1 Materials, of the 2021 UMC clearly states “Refrigerant piping shall be metallic.” As press-connect fittings rely upon a non-metallic elastomeric seal to contain refrigerant, press-connect technology for refrigerant piping applications would be considered as non-compliant with the requirements of the 2021 UMC.

As the UMC Technical Committee did not recognize the error in the Submitter’s substantiation, I am requesting the UMC Technical Committee to consider my substantiation for this proposal.

UL 207-2009, Refrigerant Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014), was incorrectly referenced for this section of the 2021 UMC. As there are no additional sections of the 2021 UMC that reference this standard, there is no reason to retain it in the code. Therefore, UL 207 should be deleted from Table 1701.1.
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 109 and 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.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** UL 109 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
UL 109, "Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use," is being added to Section 1109.2 (Joints) as the standard provides requirements that apply to copper tubing joints.
Proposals

Item #: 227
UMC 2024  Section: 1109.2

SUBMITTER: William E Chapin
Professional Code Consulting, LLC

RECOMMENDATION:
Revise text

1109.0 Refrigeration Piping, Containers, and Valves.

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 and PE-RT/AL/PE-RT 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.

SUBSTANTIATION:
This proposals adds the requirement for PE-RT/AL/PE-RT joints to be made by approved means tested and listed by an approved nationally recognized laboratory.
Proposals

Item #: 228
UMC 2024  Section: 1109.2

SUBMITTER: Brad Campbell
Gastite

RECOMMENDATION:
Revise text

1109.0 Refrigeration Piping, Containers, and Valves.

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. **PE-RT/AL/PE-RT pipe joints and connections shall be of approved mechanical or press-connect types.** Piping and tubing shall be installed so as to prevent vibration and strains at joints and connections.

SUBSTANTIATION:
PERT-AL-PERT pipe joints are not listed in the UMC Section 1109.2 Joints section. This type of composite pipe has primarily been used for water conveyance applications but if the pipe is designed and tested to the new ASTM FXXX Standard for “Polyethylene of Raised Temperature - Aluminum - Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems” it will be a comparable Line set option. PERT/AL/PERT pipe can be mechanical or press-connected. This new ASTM FXXX standard will be finalized and published in the next 30 days.
Proposals

Item #: 229

UMC 2024 Section: 1109.1.5, 1109.1.6, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

1109.0 Refrigeration Piping, Containers, and Valves.
1109.1 Materials.

1109.1.5 Refrigerant-Containing Components and Accessories. Nonelectrical refrigerant-containing components and accessories shall be listed and labeled in accordance with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

1109.1.6 Refrigeration Fittings. Refrigeration fittings, including press-connect, flared and threaded shall be listed and labeled in accordance with UL 109 and UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>1109.1.6</td>
</tr>
<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014 January 21, 2020)</td>
<td>Refrigeration Components</td>
<td>1109.1.5, 1109.1.6, 1109.2</td>
</tr>
</tbody>
</table>

( порtions of table not shown remain unchanged)

Note: The UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Sections are being added to Chapter 11 (Refrigeration) to address the safety standards for refrigerant-containing components, accessories, and fittings to aid the code official in verifying safe installation for such systems.
1109.7 Pipe Enclosure Protection of Piping. 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 3/8 inches (35 mm) nominal size. Mechanical joints, other than approved press connect joints, shall not be made on tubing exceeding 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.

SUBSTANTIATION:
Somewhere in the timeline of code development, language for the use of soft annealed copper was added to this section UMC in error. As this section of the 2021 UMC is for the protection requirements of all refrigeration piping, the size limitations of and methods of joining annealed temper copper tube do not belong in this section of the UMC.
Proposals

Item #: 231
UMC 2024  Section: 1116.2, Table 1116.2

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

1116.0 Testing of Refrigeration Equipment.

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 design 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)*

<table>
<thead>
<tr>
<th>REFRIGERANT NUMBER</th>
<th>HIGHSIDE WATER-COOLED</th>
<th>HIGHSIDE AIR COOLED</th>
<th>LOWSIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>45</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>42</td>
<td>140</td>
<td>220</td>
<td>440</td>
</tr>
<tr>
<td>22</td>
<td>230</td>
<td>260</td>
<td>230</td>
</tr>
<tr>
<td>113</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>114</td>
<td>40</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>115</td>
<td>275</td>
<td>340</td>
<td>275</td>
</tr>
<tr>
<td>423</td>
<td>45</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>134a</td>
<td>450</td>
<td>250</td>
<td>450</td>
</tr>
<tr>
<td>152a</td>
<td>130</td>
<td>220</td>
<td>130</td>
</tr>
<tr>
<td>500</td>
<td>165</td>
<td>265</td>
<td>165</td>
</tr>
<tr>
<td>502</td>
<td>265</td>
<td>385</td>
<td>250</td>
</tr>
<tr>
<td>744‡</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

For SI units: 1 pound-force per square inch gauge = 6.8947 kPa
* Special design required; test pressures typically exceed 1000 psig (6895 kPa).

SUBSTANTIATION:
Table 1116.2 is being deleted as it is outdated as it does not include many of the refrigerants used today. Additionally, the field leak test pressures should be “not less than the lower of the design pressure or the setting of the pressure-relief device.” This change correlates with the language found in ASHRAE 15 Section 10.1 (Field Tests) regarding testing at “the lower of the design pressure or the setting of the pressure relief device.”
Proposals

Item #: 232
UMC 2024 Section: 1119.1

SUBMITTER: Julius Ballanco, P.E.
    JB Engineering and Code Consulting, P.C.
    Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Revise text

1119.0 General.
1119.1 Applicability. Cooling towers, evaporative condensers, and fluid coolers, and associated remote sump tanks shall be readily accessible. Where located on roofs, such equipment having combustible exterior surfaces shall be protected with an approved automatic fire-extinguishing system.

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Proposals

Item #: 233
UMC 2024 Section: 1121.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

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 Authority Having Jurisdiction.

SUBSTANTIATION:
The term “regulatory authority” is not defined in the code. The term “Authority Having Jurisdiction” should be used as it is defined in the code and consistent with other requirements within the code.
Proposals

Item #: 234
UMC 2024  Section: 1123.1

SUBMITTER: Julius Ballanco, P.E.
JB Engineering and Code Consulting, P.C.
Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Revise text

1123.0 Location.
1123.1 General. Cooling towers, evaporative condensers, and fluid coolers shall be located such that their plumes cannot 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. Remote sump tanks located in occupied spaces shall have exhaust directly to the outdoors.

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Proposals

Item #: 235

UMC 2024 Section: 218.0, 311.3, 402.4 - 402.4.5, 403.9, 502.2 - 502.2.3, 519.5, 1123.1, Table 1701.1

SUBMITTER: Mitch Pinsker
Affiliated Engineers Inc
Rep. ASHRAE Golden Gate Chapter Chair of Government Affairs Committee and Code Review Committee

RECOMMENDATION:
Revise text

218.0 Property Line. A line of record that divides one lot or parcel from another lot or parcel or from a public or private street or any other public space. For the purposes of separation distances for building openings and device terminations on walls abutting a public way, the effective property line shall be the centerline of the public way.

Public Way. A street (with or without a sidewalk), alley, or walkway not adjacent to a street, that is accessible to the general public.

311.0 Heating or Cooling Air System.

311.3 Prohibited Source. Outside or return air for a heating or cooling air system shall not be taken from the following locations:
(1) Less than 10 feet (3048 mm) in distance from an appliance vent outlet, a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside air inlet the separation distances to vents required by Sections 802.6.1 and 802.8.
(2) Less than 10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway the separation distances required by Section 402.4.
(3) through (6) (remaining text unchanged)

402.0 Ventilation Air.

402.4 Outdoor Air Intake Protection. Required outdoor air intakes shall be covered with a screen having not less than ¼ of an inch (6.4 mm) openings, and shall have not more than ½ 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.

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

402.4.1 Location. Outdoor air intakes (including openings that are required as part of a natural ventilation system) shall be located such that the shortest distance from the intake to any specific potential outdoor contaminant source listed in Table 402.4.1 shall be equal to or greater than the following:
(1) The separation distance in Table 402.4.1 or
(2) The calculation methods in ASHRAE 62.1 Normative Appendix B and shall comply with all other requirements of this section. [ASHRAE 62.1:5.5.1]

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

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

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

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

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

(1) Limit water penetration through the intake to 0.07 oz/ft\(^2\)-h (21.5 g/m\(^2\)-h) of inlet area when tested using the rain test
apparatus described in UL 1995.

(2) Select louvers that limit water penetration to a maximum of 0.01 oz/ft\(^2\) (3 g/m\(^2\)) of louver free area at the maximum
intake velocity. This water penetration rate shall be determined for a minimum 15 minute test duration when subjected to
a water flow rate of 0.25 gal/min (16 mL/s) as described under the water penetration test in AMCA 500-L or equivalent.
Manage the water that penetrates the louver by providing a drainage area or moisture removal devices.

(3) Select louvers that restrict wind-driven rain penetration to less than 2.36 oz/ft\(^2\)-h (721 g/m\(^2\)-h) when subjected to a
simulated rainfall of 3 inches (75 mm) per hour and a 29 mph (13 m/s) wind velocity at the design outdoor air intake rate
with the air velocity calculated based on the louver face area. This performance corresponds to Class A (99 percent
effectiveness) when rated according to AMCA 511 and tested per AMCA 500-L.

(4) Use rain hoods sized for no more than 500 fpm (2.5 m/s) face velocity with a downward-facing intake such that all
intake air passes upward through a horizontal plane that intersects the solid surfaces of the hood before entering the
system.

(5) Manage the water that penetrates the intake opening by providing a drainage area or moisture removal devices.
[ASHRAE 62.1:5.5.2]

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

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

(1) Access doors to permit cleaning of wetted surfaces shall be provided.

(2) Outdoor air ductwork or plenums shall pitch to drains designed in accordance with the requirements of ASHRAE
62.1. [ASHRAE 62.1:5.5.4]

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

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

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MINIMUM DISTANCE (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2 air exhaust/relief outlet</td>
<td>10</td>
</tr>
<tr>
<td>Class 3 air exhaust/relief outlet</td>
<td>15</td>
</tr>
<tr>
<td>Class 4 air exhaust/relief outlet</td>
<td>30</td>
</tr>
<tr>
<td>Cooling tower exhaust</td>
<td>25</td>
</tr>
<tr>
<td>Cooling tower intake or basin</td>
<td>15</td>
</tr>
<tr>
<td>Driveway, street, or parking place</td>
<td>5</td>
</tr>
<tr>
<td>Garage entry, automobile loading area, or drive-in queue</td>
<td>15</td>
</tr>
<tr>
<td>Garbage storage/pick-up area, dumpsters</td>
<td>15</td>
</tr>
<tr>
<td>Plumbing vents terminating at least 3 ft (1000 mm) above the level of the outdoor air intake</td>
<td>3</td>
</tr>
<tr>
<td>Plumbing vents terminating less than 3 ft (1000 mm) above the level of the outdoor air intake</td>
<td>10</td>
</tr>
<tr>
<td>Roof, landscaped grade, or other surface directly below intake</td>
<td>1</td>
</tr>
<tr>
<td>Thoroughfare with high traffic volume</td>
<td>25</td>
</tr>
<tr>
<td>Truck loading area or dock, bus parking/idling area</td>
<td>25</td>
</tr>
<tr>
<td>Vents, chimneys, and flues from combustion appliances and equipment</td>
<td>15</td>
</tr>
</tbody>
</table>
403.0 Ventilation Rates.

403.9 Air Classification and Recirculation. Air shall be classified as shown in Table 402.1, Table 403.7, or Table 403.9, and its recirculation shall be limited in accordance with Section 403.9.1 through Section 403.9.4. Recirculated air shall not be taken from prohibited locations in accordance with Section 311.3.

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

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

502.0 Termination.

502.2 Termination of Exhaust Ducts. Exhaust ducts shall terminate in accordance with Section 502.2.1 through Section 502.2.3. Classes of air shall be as defined in Section 203.0 and classified in Section 403.9.

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

502.2.2 Product Conveying, Flammable, and Class 4 Air Ducts. Ducts conveying Class 4 air or explosive or flammable vapors, fumes, or dusts shall terminate not less than 30 feet (9144 mm) from a property line, 10 feet (3048 mm) from openings into the building, 6 feet (1829 mm) from exterior walls or roofs that are in the direction of the exhaust discharge, 30 feet (9144 mm) from combustible walls or openings into the building that are in the direction of the exhaust discharge, and 10 feet (3048 mm) above adjoining grade, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1. Exception: Type I Hood exhaust termination shall be in accordance with Section 510.9.1.

519.0 Type II Hood Exhaust System Requirements.

519.5 Termination of Type II Hood Exhaust System. The exhaust system shall terminate as follows: in accordance with Section 502.2.2.
(4) Rooftop terminations shall terminate not less than 10 feet (3048 mm) from a property line, and the exhaust flow shall be directed away from the roof surfaces of the roof, not less than within 40 inches (1016 mm).
(2) Horizontal terminations shall terminate not less than 10 feet (3048 mm) from adjacent buildings, property lines, operable openings, and from grade level.
(3) The discharge outlet of moisture conveying exhaust ducts, such as dishwasher exhaust ducts, shall not be directed onto terminate over a public walkway or over an area where condensate or vapor could create a nuisance or hazard.

1123.0 Location.
1123.1 General. Cooling towers, evaporative condensers, and fluid coolers shall be located such that their plumes cannot enter occupied spaces as required by Section 402.4.1. 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 Section 502.2.3.

(below shown for reference only)

203.0 – A –
Air, Class 1. Air with low contaminant concentration, low sensory-irritation intensity, and inoffensive odor. [ASHRAE 62.1:5.16.1]

Air, Class 2. Air with moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors. Class 2 air also includes air that is not necessarily harmful or objectionable, but that is inappropriate for transfer or recirculation to spaces used for different purposes. [ASHRAE 62.1:5.16.1]

Air, Class 3. Air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. [ASHRAE 62.1:5.16.1]

Air, Class 4. Air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases, at concentrations high enough to be considered harmful. [ASHRAE 62.1:5.16.1]

510.9.1 Rooftop Terminations. Rooftop terminations shall be arranged with or provided with the following:
(1) A minimum of 10 feet (3048 mm) of horizontal clearance from the outlet to adjacent buildings, property lines, and air intakes.
(2) A minimum of 5 feet (1524 mm) of horizontal clearance from the outlet (fan housing) to any combustible structure.
(3) A vertical separation of 3 feet (914 mm) above any air intakes within 10 feet (3048 mm) of the exhaust outlet.
(4) The ability to drain grease out of any traps or low points formed in the fan or duct near the termination of the system into a collection container that is noncombustible, closed, rainproof, and structurally sound for the service to which it is applied and that will not sustain combustion.
(5) A grease collection device that is applied to exhaust systems that does not inhibit the performance of any fan.
(6) Listed grease collection systems that meet the requirements of Section 510.9.1(4) and Section 510.9.1(5).
(7) A listed grease duct complying with Section 507.4.7 or ductwork complying with Section 507.4.8.
(8) A hinged upblast fan supplied with flexible weatherproof electrical cable and service hold-open retainer to permit inspection and cleaning that is listed for commercial cooking equipment with the following conditions:
(a) Where the fan attaches to the ductwork, the ductwork is a minimum of 18 inches (457 mm) away from any roof surface, as shown in Figure 510.9.1.
(b) The fan discharges a minimum of 40 inches (1016 mm) away from any roof surface, as shown in Figure 510.9.1.
(9) Other approved fan, provided it meets all of the following criteria:
(a) The fan meets the requirements of Section 510.9.1(3) and Section 511.1.3.
(b) Its discharge or its extended duct discharge meets the requirements of Section 510.9.1(2). (See Section 511.1.3)
(c) Exhaust fan discharge is directed up and away from the roof surface. [NFPA 96:7.8.2.1]

510.9.1.1 Listed Vibration Isolation Connectors. Listed vibration isolation connectors shall be permitted to be used on exterior roof locations where required for proper equipment vibration isolation.

510.9.1.2 Inspection and Cleaning. Fans shall be provided with safe access and a work surface for inspection and cleaning. [NFPA 96:7.8.2.2]

802.6.1 Gas Vent Termination. The termination of gas vents shall comply with the following requirements:
(1) A gas vent shall terminate in accordance with one of the following:
(a) Gas vents that are 12 inches (300 mm) or less in size and located not less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate above the roof in accordance with Figure 802.6.1 and Table 802.6.1.
(b) Gas vents that are over 12 inches (300 mm) in size or are located less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate not less than 2 feet (610 mm) above the highest point where they pass through the roof and not less than 2 feet (610 mm) above a portion of a building within 10 feet (3048 mm) horizontally.
(c) Industrial appliances as provided in Section 802.2.5.
(d) Direct vent systems as provided in Section 802.2.6.
(e) Appliances with integral vents as provided in Section 802.2.7.
(f) Mechanical draft systems as provided in Section 802.3.3 through Section 802.3.3.5.
(g) Ventilating hoods and exhaust systems as provided in Section 802.3.4.
(2) A Type B or a Type L gas vent shall terminate at least 5 feet (1524 mm) in vertical height above the highest connected appliance draft hood or flue collar.
(3) A Type B-W gas vent shall terminate at least 12 feet (3658 mm) in vertical height above the bottom of the wall furnace.
(4) A gas vent extending through an exterior wall shall not terminate adjacent to the wall or below eaves or parapets, except as provided in Section 802.2.6 and Section 802.3.3 through Section 802.3.3.5.
(5) Decorative shrouds shall not be installed at the termination of gas vents except where such shrouds are listed for use with the specific gas venting system and are installed in accordance with the manufacturer’s installation instructions.
(6) All gas vents shall extend through the roof flashing, roof jack, or roof thimble and terminate with a listed cap or listed roof assembly.
(7) A gas vent shall terminate at least 3 feet (914 mm) above a forced air inlet located within 10 feet (3048 mm). [NFPA 54:12.7.3]

802.8 Through-the-Wall Vent Termination. A mechanical draft venting system shall terminate at least 3 feet (914 mm) above any forced air inlet located within 10 feet (3048 mm). (See Figure 802.8)

Exceptions:
(1) This provision shall not apply to the combustion air intake of a direct vent appliance.
(2) This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of listed outdoor appliances. [NFPA 54:12.9.1]

802.8.1 Mechanical Draft Venting System. A mechanical draft venting system of other than direct vent type shall terminate not less than 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window, or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 12 inches (305 mm) above finished ground level. [NFPA 54:12.9.2]

802.8.2 Direct Vent Appliance. The clearances for through-the-wall direct vent terminals shall be in accordance with Table 802.8.2. The bottom of the vent terminal and the air intake shall be located not less than 12 inches (305 mm) above finished ground level. [NFPA 54:12.9.3]

802.8.3 Category I through Category IV and Noncategorized Appliances. Through-the-wall vents for Category II and Category IV appliances and noncategorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment. Where local experience indicates that condensate is a problem with Category I and Category III appliances, this provision shall also apply. Drains for condensate shall be installed in accordance with the appliance and the vent manufacturer’s installation instructions. [NFPA 54:12.9.4]

802.8.4 Annular Spaces. Where vents, including those for direct vent appliances or combustion air intake pipes, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using approved materials to prevent entry of combustion products into the building. [NFPA 54:12.9.5]

802.8.5 Vent Terminals. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building.

Exception: This shall not apply to vent terminals that are 2 feet (610 mm) or more above or 25 feet (7620 mm) or more below operable openings. [NFPA 54:12.9.6]

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<th>REFERENCED SECTION</th>
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<tr>
<td>AMCA 511-2010</td>
<td>Certified Ratings Program Product Rating Manual for Air Control Devices</td>
<td>Air Control Devices</td>
<td>402.4.2 (3)</td>
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<td>AMCA 500-L-2012 (R2015)</td>
<td>Laboratory Methods of Testing Louvers for Rating</td>
<td>Louvers</td>
<td>402.4.2(2), 402.4.2 (3)</td>
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<td>ANSI/ASSP Z9.5-2012</td>
<td>Laboratory Ventilation</td>
<td>Ventilation</td>
<td>402.4.1.4</td>
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(portions of table not shown remain unchanged)
Note: The AMCA, ASSP, ASHRAE, NFPA, and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The purpose of this proposed revision is to:

1. Consolidate exhaust air termination and outdoor air intake requirements which are currently addressed in several sections and not always consistently. For instance, the separation distance to an appliance vent is Section 311.3 is not consistent with those in Sections 802.6.1 and 802.8 for the same application.

2. Update separation distance requirements to meet the those in ASHRAE 62.1-2019 Ventilation and Acceptable Air Quality. Some separation requirements listed in ASHRAE 62.1-2019 are not listed in the UMC. For example, there is no requirement in the UMC that an outdoor intake be located a minimum of 15 feet from dumpsters. The separation requirements listed in Section 502.2.1 also do not distinguish requirements based on Class of Air as is the case in ASHRAE 62.1 2019. For example, the separation requirement between an outdoor air intake and general building relief is the same as the separation requirement for outdoor air intake and janitor closets (10 feet). ASHRAE 62.1 lists more stringent separation requirements for each subsequent Class of Air, which accurately pairs mitigation measures through separation distance with the intensity of contamination. The requirements listed in ASHRAE 62.1 represent the current standard of care for ventilation system design and should be reflected in the UMC.

3. Fully incorporate Standard 62.1 Classes of Air and use them to more clearly define separation distances and exhaust termination. Classes of Air have been included in Table 402.1 (Minimum Ventilation Rates), Table 403.7 (Minimum Exhaust Rates) for several code cycles but they are used only to limit recirculation. Standard 62.1 also includes Table 6-3 Airstreams or Sources (which is incorporated in this proposal as Table 403.9), to fully address all Classes of Air, and uses these Classes to more clearly define separation distances and exhaust termination requirements. Currently Section 502.2 termination requirements are split into three ill-defined categories that are open to interpretation causing confusion: "environmental air ducts," "product conveying ducts conveying explosive or flammable vapors, fumes, or dusts," and "other product conveying outlets." "Environmental air ducts" are defined in Section 207.0 as, "ducting used for conveying air at temperatures not exceeding 250°F (121°C)...such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust ducts, and domestic-type clothes dryer exhaust ducts." Exhaust air can be comprised from many more sources than those currently listed in this definition, leading to an uncertainty of exactly which type of air is categorized as “environmental exhaust”. The term "other product conveying" is not defined anywhere in the UMC and thus is open to interpretation as to what source of exhaust qualifies as "other product conveying." Using the Class of Air more clearly defines what the requirements are for all types of exhaust discharge.

4. Define terms that currently not well defined and thus subject to interpretation.

To resolve these issues, we propose revisions to multiple sections. Below, we provide rationale by section for each revision.

Section 218.0:

Explanation for Section 218.0 Revision:

Figure 1 Section 218.0 Revision:
The term “property line” is used in multiple sections of the UMC, including Section 502.2.1, yet is undefined. Defining "property line" in Section 218.0 provides specificity and ensures consistent application of the term. The definition is adapted from multiple administrative codes found online. On significant inclusion is how to define property lines for the purpose of separation distance requirements in cities where the legal property line is at the building edge. A common interpretation is that separation distances are to the centerline of the street or public way. This definition solidifies that interpretation.

The term “public way” or “public walkway” is used multiple times in the UMC along with references to streets, alleys, and sidewalks. None of these terms are defined and they appear to reference the same basic application. So we propose creating a single term to cover all of them.

Section 311.3:

Explanation for Section 311.3(1) Revision:
Figure 2 Section 311.3(1) Revision:
Separation requirements between appliance vent outlets are already prescribed in Section 802.6.1 and 802.8. Therefore, we propose to delete the separation requirement of “10 feet (3048 mm) in distance from an appliance vent outlet” listed in Section 311.3(1) and instead refer to Sections 802.6.1 and 802.8 to eliminate redundant and conflicting requirements.

The separation requirements for “a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside air inlet” listed in Section 311.3(1) will be addressed in proposed Table 402.4.1 of Section 402.4.1. Therefore, these requirements are redundant and may be deleted.

Explanation for Section 311.3(2) Revision:

Figure 3 Section 311.3(2) Revision:
All separation requirements for outdoor air intakes will be prescribed in proposed Table 402.4.1 extracted from Standard 62.1. Therefore, we propose to delete the phrase, “10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway” and instead refer to Section 402.4. Note that Standard 62.1 separation requirements vary from the blanket 10 feet required here; some are shorter and some are longer, as determined by the ASHRAE 62.1 committee.

Section 402.4:
We propose to replace Section 402.4 in its entirety with verbatim language from ASHRAE 62.1-2019 prescribing outdoor air intake requirements.

Explanation for Section 402.4 Deletion:

Figure 4 Section 402.4 Revision:
We propose to remove this section because outdoor air intake protection will be described in proposed Section 402.4.5 per ASHRAE 62.1 verbatim language.

Explanation for Section 402.4.1 Deletion:

Figure 5 Section 402.4.1 Revision:
We propose to remove existing Section 402.4.1 because rain intrusion and snow entrainment requirements will be described in proposed Sections 402.4.2 through 402.4.4. The proposed section copies the existing ASHRAE 62.1 requirements that the UMC refers to in the 2021 edition. This does not change the content of the code requirement and is purely a clerical change allowing the reader to view rain and snow entrainment requirements directly in the UMC instead of needing to refer to ASHRAE 62.1.

Explanation for Section 402.4.1 Addition:

The proposed section is taken directly from ASHRAE 62.1 and will add specific requirements for separation distances between potential pollution sources and outdoor air intakes. The separation distances listed in this section and in Table 402.4.1 will update the UMC requirements for outdoor air separation to the latest Standard 62.1 requirements. The addition of this section will also consolidate outdoor air intake separation requirements into one section of the code making it easier to reference.

Note that Standard 62.1-2019 includes an alternative approach to separation distances in Normative Appendix B. This is a long and complex procedure that is not as commonly used as using the prescriptive Table 402.4.1, so rather than extract that entire appendix, we propose just referencing it. There is precedence of references to other ASHRAE documents in lieu of extraction already in the UMC, e.g. 102.3.1, 314.1, 402.1.2, 402.4.1, 510.5.6, 1013.3, 1102, 1106.1, and 1106.2, in addition to references to documents by ACCA, UL, ASME, NFPA, etc.

Section 403.9:

Explanation for Section 403.9 Revision:

Figure 6 Section 403.9 Revision:
The added phase indicates the tables where Classes of Air are defined, which makes the code easier to interpret. The current UMC makes no direct reference to the Classes of Air in existing Tables 402.1 and 403.7.
Explanation for Table 403.9 Addition:

ASHRAE classifies sources of air in Table 6-1, 6-2, and 6-3 in Standard 62.1-2019. The UMC currently includes the first two tables in Tables 402.1 and 403.7, but does not currently include Table 6-3 which leaves gaps in air classification. Adding this table to Section 403.9 remedies the issue.

Section 502.2:

Explanation for Section 502.2 Revision:

Figure 7 Section 502.2 Revision:
The added sentence makes it clear where Classes of Air are defined in the UMC.

Explanation for Section 502.2.1 Revision:

Figure 8 Section 502.2.1 Revision:
We propose to revise the title of the section to be more precise and refer to “Class 1 and Class 2” air ducts which are already defined and classified in Section 203.0 and Section 403.9. An “environmental air duct” is too broad of a description, does not align with the method for classifying air located elsewhere in the UMC, and has led to confusion over what types of air fall under this category.

We propose removing the phrase of “10 feet (3048 mm) from a forced air inlet,” because this requirement is prescribed in proposed Table 402.4.1 of Section 402.4.

The term “public walkway” is revised to “public way” to match the proposed definition in Section 213.0. This will provide further clarity and consistency to the term.

The addition of the phrase, “and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1” refers to the ASHRAE 62.1 separation requirements that are proposed be added as part of this proposal.

The phrase, “the discharge of environmental exhaust ducts shall not be directed onto a public walkway” is proposed to be limited to only dryer exhaust, which is the only Class 1 or 2 exhaust composed of near-saturated air. This air can condense in cold weather and drip onto the public way and potentially freeze in cold climates, creating a hazard. The words “directed onto” are revised to “terminate over” since the hazard can exist even if the air is discharged horizontally, and the limitation was expanded to include any area where condensation may be a hazard using the wording from Section 8.2.8.3 for condensing appliance vents. Other Type 1 and 2 exhaust are addressed by the requirements earlier in the section requiring that discharge be at least “10 feet (3048 mm) above a public way”. This allows for dilution to occur before the exhaust odors, if any, are a nuisance. Note that Type I grease exhaust terminations have no limitations relative to public walkways and that exhaust is much more likely to be a nuisance due to odors and smoke.

Explanation for Section 502.2.2 Revision:

Figure 9 Section 502.2.2 Revision:
We propose to split Section 502.2.2 into two sections. One section pertaining to “Class 3 Air” which will replace “other product conveying” air, and one section pertaining to “Flammable and Class 4 Air” in addition to “product conveying” air. (Note that proposed Sections 502.2.2 and 502.2.3 are shown out of order simply to make the proposed changes from the current wording clear. Logically “Class 3” air should be addressed before “Class 4” air; hence the proposed numbering. This is just editorial.)

We propose to replace the term “other product conveying” airstreams to “Class 3 Air” to provide a clear and consistent definition for the type of air that requirements previously listed under “other product conveying” in Section 502.2.2 apply to. The term “other product conveying” is not defined in the UMC, which makes it difficult to understand what type of air is classified as “other product conveying.” The definition and classification of “Class 3 Air” per Section 203.0 and Section 403.9 is consistent with the intent of the meaning of “other product conveying,” is already defined in the UMC, and matches Standard 62.1.

The addition of the phrase, “that are in the direction of the exhaust discharge” will further qualify the requirements of
the location of “Class 3 Air” exhaust termination in relation to adjacent exterior walls and roofs. There is no known benefit to requiring a separation distance to a wall or roof if the exhaust stream is not discharging in the direction of that wall or roof. This will allow a side discharge of Class 3 air, which is very common.

The addition of the phrase, "and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1" to Section 502.2.2 refers to the ASHRAE 62.1 separation requirements that will be added as part of this proposal.

We propose to add the term phrase “Flammable and Class 4 Air” to “product conveying” airstreams to improve clarity and consistency with the air classification references used in the rest of Section 502.2.

The addition of the phrase, “that are in the direction of the exhaust discharge” will further qualify the requirements of the location of “Class 4 Air” exhaust termination in relation to adjacent exterior walls and roofs. There is no known benefit to requiring a separation distance to a wall or roof if the exhaust stream is not discharging in the direction of that wall or roof.

The addition of the phrase, "and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1" to proposed Section 502.2.3 refers to the ASHRAE 62.1 separation requirements that will be added as part of this proposal.

The exception to 502.2.3 for Type I grease exhaust termination is added to ensure there is only one section that applies. Section 510.9.1. is extract from NFPA which is the more definitive source.

Explanation for Section 519.5 Revision:

Figure 10 Section 519.5 Revision:
We propose that separation distances be those required of other Class 3 airstreams per Section 502.2.2. The 40-inch separation to the roof is retained but clarified. The limitation on moisture conveying ducts is the same as that proposed for dryer exhaust in Section 502.2.1. Other Type II hoods not conveying moisture, such as heat generating appliance vents, do not pose a nuisance risk for public ways because of the 10 foot separation above grade required by Section 502.2.2.

Explanation for Section 1123.1 Revision:

Figure 11 Section 1123.1 Revision:
Plume discharge separation requirements will be listed in Section 402.4.1 (Table 402.4.1); thus, we propose to replace the phrase, “Plume discharges shall be not less than 25 feet (7620 mm) away from a ventilation inlet to a building” with “as required by Section 402.4.1” for consistency.

Cooling tower discharge is considered “product conveying” air; thus, location on property is dictated by Section 502.2.3. We have therefore replaced “the building code” with “Section 502.2.3” to provide a more precise reference to location requirements.
Proposals

Item #: 236

UMC 2024  Section: 1127.0, 1127.1

SUBMITTER: Julius Ballanco, P.E.
   JB Engineering and Code Consulting, P.C.
   Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Add new text

Part II – Cooling Towers.

1127.0 Water Supply.
1127.1 General. Cooling towers, evaporative coolers and fluid coolers shall be provided with an approved water supply, sized for peak demand. The quality of water shall be provided in accordance with the equipment manufacturer’s recommendations. The piping system and protection of the potable water supply system shall be installed in accordance with the plumbing code.

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).

An additional section for water supply in the cooling towers sections should be added. The quality of the water supply has a major impact on the safety of the tower. The water supply must be approved by the AHJ and sized for peak demand. Additionally, the plumbing code must govern the piping system and protection of the potable water supply for safety.
Proposals

Item #: 237
UMC 2024  Section: 1201.1

SUBMITTER: Lance MacNevin, P.Eng.
Plastics Pipe Institute

RECOMMENDATION:
Revise text

1201.0 General.
1201.1 Applicability. This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, and ground source heat pump systems, and snow and ice melting systems. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.

SUBSTANTIATION:
The hydronic applications known as radiant heating, radiant cooling, and snow and ice melting are currently listed within Chapter 12 in Sections 1217.0 and 1220.0 but are missing from the Applicability. Therefore, these types of hydronic systems should be listed within the Applicability.
Proposals

Item #: 238

UMC 2024  Section: 1201.6 - 1201.9

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1201.0 General.

1201.6 Heat Emitters. Heat emitters shall be installed in accordance with the manufacturer’s installation instructions.
1201.7 Mechanical Devices. Where listed mechanical devices are used, the manufacturer’s installation instructions as to the location and method of installation shall be followed.
1201.8 Flexible Connectors. Listed flexible connectors shall be installed in readily accessible locations, unless otherwise listed.
1201.9 1215.3 Freeze Protection. Hydronic systems and components shall be designed, installed, and protected from freezing.

SUBSTANTIATION:
Additional sections are being added to Chapter 12 (Hydronics) to address heat emitters, mechanical devices, and flexible connectors for hydronic applications. Section 1215.3 (Freeze Protection) is being relocated to the general section for clarity. The change correlates with the USHGC. This is necessary to ensure correlation between the codes.
Proposals

Item #: 239

UMC 2024 Section: 1201.6, Table 1701.1

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

1201.0 General.

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

### TABLE 1701.1

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<th>STANDARD TITLE</th>
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<td>IAPMO H1001.1:2021</td>
<td>Quality of Heat Transfer Fluids Used in Hydronics Systems</td>
<td>Heat Transfer Fluid</td>
<td>1201.6</td>
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(portions of table not shown remain unchanged)

Note: IAPMO H1001.1 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
The new standard for water quality for hydronic systems is being added to the General section of Chapter 12 (Hydronics).
Proposals

Item #: 240
UMC 2024 Section: 1202.1

SUBMITTER: Julius Ballanco, P.E.
JB Engineering and Code Consulting, P.C.
Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Revise text

1202.0 Protection of Potable Water Supply.
1202.1 Prohibited Sources. Hydronic systems or parts thereof shall be constructed in such a manner that polluted, contaminated water or substances shall not enter a portion of the potable water system either during normal use or where the system is subject to pressure that exceeds the operating pressure in the potable water system. Piping, components and devices in contact with the potable water shall be approved for such use and where an additive or item, such as carbon filter or sodium zeolite, is used it shall not affect the performance of the system, including the residual of municipal water disinfectant.

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Proposals

Item #: 241
UMC 2024 Section: 1202.2, Table 1701.1

SUBMITTER: Jeff Matson
Viega LLC

RECOMMENDATION:
Revise text

1202.0 Protection of Potable Water Supply.

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

TABLE 1701.1
REFERENCED STANDARDS

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<td>ASME A112.1.2–2012 (R2017)</td>
<td>Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors)</td>
<td>Backflow Protection</td>
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(portions of table not shown remain unchanged)

Note: ASME A112.1.2 and ASME A112.1.3 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The above proposed standards are included to provide specifications for air gaps. This modification will ensure that the end user is required to comply with industry standards.

ASME A112.1.2 identifies methods of providing protection against backsiphonage through means of an air gap and establishes physical requirements and methods of testing air gaps for plumbing fixtures and water receptors.

ASME A112.1.3 provides physical requirements and methods of testing for air gap fittings for protection against back siphonage and back pressure backflow.

Furthermore, the last sentence of Section 1202.2 has been relocated to the beginning of the section as this is more appropriate for the provision. This change correlates with changes made to the 2021 USHGC.
Proposals

Item #: 242
UMC 2024 Section: 1202.4

SUBMITTER: Julius Ballanco, P.E.
JB Engineering and Code Consulting, P.C.
Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Add new text

1202.0 Protection of Potable Water Supply.

1202.4 Potable Water Treatment Equipment. Potable water treatment equipment, including, but not limited to, carbon filters, water softeners, and UV filters, that can, by design, reduce the level of disinfectant in potable water, shall be identified in drawings and building manuals as documented to increase risk for Legionella growth.

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Proposals

Item #: 243
UMC 2024  Section: 1202.5

SUBMITTER: Julius Ballanco, P.E.
JB Engineering and Code Consulting, P.C.
Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Add new text

1202.0 Protection of Potable Water Supply.

1202.5 Potable Water System Flow Reducers. Equipment that, by design, will reduce velocity at fixtures to levels lower than design plumbing system velocity of 2 feet per second (0.6 m/s) minimum shall be identified in drawings and manuals as documented to increase risk for Legionella growth.

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Item #: 244
UMC 2024 Section: 1202.6

SUBMITTER: Julius Ballanco, P.E.
JB Engineering and Code Consulting, P.C.
Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Add new text

1202.0 Protection of Potable Water Supply.

1202.6 Water Softeners. Water softeners for non-residential potable use applications shall be sized in accordance with the following:
(1) As small as possible for the application, and
(2) To regenerate, preferably every 24 hours, but no more than every 72 hours, and with a minimum of 10 percent bypass capacity to reduce salt use, water consumption, and corrosivity of water. Water softener installation with parallel units where one unit may be in standby for 24 hours or longer shall have the standby unit flushed to drain for a minimum of 10 minutes immediately prior to being placed in service. When using fixture count to determine peak water demand, the softener sizing shall be based on softener rated peak flow and not continuous flow. Designers shall review with the Authority Having Jurisdiction to determine if installing a softener on water intended for cold potable water consumption results in the building being required to register as a Public Water System.

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Proposals

Item #: 245
UMC 2024  Section: 1203.0, 1203.1, 1203.2

SUBMITTER: Julius Ballanco, P.E.
JB Engineering and Code Consulting, P.C.
Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Add new text

1203.0 Protection of Non-Potable Water Systems.
1203.1 Indoor Ornamental Fountains. Ornamental fountains shall not have submerged lights that add heat to the water (i.e., incandescent). Only LED or other types of low to no heat generation lights shall be used. If all parts and components of an indoor ornamental fountain system are not located in a conditioned space, then a biocide monitoring and feed control system shall be required to control risk associated with Legionella.
1203.2 Public Spas. Spas located in public spaces for general use including, but not limited to hotels, health clubs, etc., shall have an automatic biocide feeder, monitor, and controller with data logging ability.

(renumber remaining sections)

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Proposals

Item #: 246
UMC 2024  Section: 1203.3

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1203.0 Capacity of Heat Source.

1203.3 Tankless Water Heaters. Tankless water heaters used in space-heating applications shall be rated by the manufacturer for space-heating applications, and the output performance shall be determined by the temperature rise and flow rate of water through the unit. The ratings shall be expressed by the water temperature rise at a given flow rate. Manufacturer’s flow rates shall not be exceeded.

SUBSTANTIATION:
The proposed language adds further clarification on tankless water heaters. Tankless water heaters must only be rated by the manufacturer for space heating applications when they are used to provide space heat.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 247

UMC 2024  Section: 1204.7

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

1204.0 Identification of a Potable and Nonpotable Water Systems.

1204.7 Heat Transfer Fluid. Solar thermal piping shall be identified with an orange background with black uppercase lettering, with the words “CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK.” Each solar thermal system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 1204.3.

Each outlet on the solar thermal piping system shall be posted with black uppercase lettering as follows: “CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK.”

SUBSTANTIATION:
A section for heat transfer fluid identification is being added to assist in the requirements for marking such piping.

The change correlates with the USHGC Section 404.7. This is necessary to ensure correlation between the codes.
Proposals

Item #: 248

UMC 2024 Section: 1205.2

SUBMITTER: Pennie L Feehan
Pennie L Feehan Consulting
Rep. Copper Development Association

RECOMMENDATION:
Revise text

1205.0 Installation, Testing, and Inspection.

1205.2 Pressure Testing. System piping and components shall be tested with a pressure of not less than one and one-half times the operating pressure but not less than 100 psi (689 kPa). Piping shall be tested with water or air except that plastic pipe shall not be tested with air. Test pressures shall be held for a period of not less than 30 minutes with no perceptible drop in pressure. These tests shall be made in the presence of the Authority Having Jurisdiction.

Exceptions:
(1) For PEX, PP-R, PP-RCT, PEX-AL-PEX, PE-RT, and PE-AL-PE piping systems, testing with air shall be permitted where authorized by the manufacturer’s instructions for the PEX, PP-R, PP-RCT, PEX-AL-PEX, PE-RT, and PE-AL-PE pipe and fittings products, and air testing is not prohibited by applicable codes, laws, or regulations outside this code.
(2) Copper tubing shall be permitted to be tested at not less than 80 psi (552 kPa).

SUBSTANTIATION:
The phrase “permitted to be” is being stricken as the phrase implies that a test pressure not less than 80 psi is optional and not a requirement. The change also correlates with the action taken by the USHGC Technical Committee.
Proposals

Item #: 249

UMC 2024  Section: 1206.2, Table 1701.1

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1206.0 Pressure and Safety Devices.

1206.2 Discharge Piping. The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and be provided with the following:
(1) Equal Not less than to the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.
(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1.
(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.
(4) Discharge in such a manner that does not cause personal injury or structural damage.
(5) No part of such discharge pipe shall be trapped or subject to freezing.
(6) The terminal end of the pipe shall not be threaded.
(7) Discharge from a relief valve into a water heater pan shall be prohibited.
(8) The discharge termination point shall be readily observable.

TABLE 1701.1
 REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.4.1-2009 (R2019)</td>
<td>Water Heater Relief Valve Drain Tubes</td>
<td>Discharge Piping</td>
<td>1206.2(2)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.4.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The revision to Section 1206.2 item (1) is needed as there are cases where PEX and PE-RT tubing require insert fittings to reduce inner diameters. Requiring the piping to be greater than the valve outlet prevents the PEX tubing inner diameter from being smaller than the valve outlet. ASME A112.4.1 is being included as it is applicable to discharge piping provisions and provides performance requirements and test methods applicable to water heater relief valve drain (or runoff) tubes for use with relief valves having a steam rating of 105,000 Btu/hr or less.

The addition of item (8) makes it clear that the termination point of the drainage line must be visible in order to detect leaks or failed valves. The change correlates with the actions taken by the UPC and USHGC Technical Committees. This is necessary to ensure correlation between the codes.
Item #: 250
UMC 2024 Section: 1207.2.2

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1207.0 Heating Appliances and Equipment.

1207.2 Boilers.

1207.2.2 Noncondensing Boilers. Where the heat exchanger and venting system are not designed to operate with condensed flue gases, the boiler shall be permitted to connect directly to the panel heating system where protected from flue gas condensation. The operating temperature of the boiler shall be more than the fluid temperature in accordance with the manufacturer's instructions. The minimum return-water temperature to the heat source shall comply with Section 1201.5.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 251
UMC 2024  Section: 1207.5, Table 1701.1, Table 1701.2

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

1207.0 Heating Appliances and Equipment.

1207.5 Heat Pumps. Water source heat pumps shall comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Air source heat pumps shall comply with AHRI 210/240. Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

<table>
<thead>
<tr>
<th>TABLE 1701.2</th>
<th>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOCUMENT NUMBER</td>
<td>DOCUMENT TITLE</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: AHRI 210/240, AHRI/ASHRAE/ISO 13256-1, and AHRI/ASHRAE/ISO 13256-2 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 1207.5 is being added to provide standards to address both water- and air-source heat pumps. Both standards provide detailed test methods, performance requirements and marking provisions for water-source heat
pumps. AHRI/ASHRAE/ISO 13256-1 specifically addresses water-to-water and brine-to-water heat pumps while AHRI/ASHRAE/ISO 13256-2 addresses water-to-air and brine-to-air heat pumps. AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2 have been used in the industry since 1998 and have been reaffirmed two times without substantive changes to the requirements. AHRI 210/240 covers air source heat pumps and their classifications, markings, as well as testing and rating requirements.

The inclusion of both water and air source heat pumps is applicable to Chapter 12 (Hydronics) as these heat pumps are used in hydronic space heating applications including radiant flooring and air heating.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Item #: 252

UMC 2024 Section: 1208.1, Table 1701.1

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1208.0 Circulators and Pumps.
1208.1 General. Circulators and pumps shall be selected for their intended use based on the heat transfer fluid, intended operating temperature range and pressure. Circulators and pumps shall be installed to allow for service and maintenance. The manufacturer’s installation instructions shall be followed for correct orientation and installation. Motor Operated pumps rated 600V or less shall be listed and labeled in accordance with CSA C22.2 No. 108 or UL 778.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA C22.2 No. 108 –2014 (R2019)</td>
<td>Liquid Pumps</td>
<td>Pumps</td>
<td>1208.1</td>
</tr>
</tbody>
</table>

Note: CSA C22.2 No. 108 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 1208.1 is being modified to include CSA C22.2 No. 108 as the standard applies to liquid pumps. Various manufacturers are currently making condensate pumps which are being listed to this standard. The standard covers construction, markings, testing, bonding, and enclosures for liquid pumps including condensate pumps. Including this additional listing further enhances the code.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 253
UMC 2024  Section: 1209.1, 1209.3

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Delete text without substitution

1209.0 Expansion Tanks.
1209.1 General. An expansion tank shall be installed in each closed hydronic system to control system pressure due to thermal expansion and contraction. Expansion tanks shall be of the closed or open type. Expansion tanks shall be rated for the pressure of the system.

1209.3 Open-Type Expansion Tanks. Open type expansion tanks shall be located not less than 3 feet (914 mm) above the highest point of the system. An overflow with a diameter of not less than one half the size of the supply or not less than 1 inch (25 mm) in diameter shall be installed at the top of the tank. The overflow shall discharge through an air gap into the drainage system.

SUBSTANTIATION:
Open type expansion tanks are no longer installed in any new or retrofit applications. These types of tanks are not capable of reaching high operating temperatures like that of closed expansion tanks. Open tanks allow for air to migrate into the system resulting in corrosion of components. Additionally, open expansion tanks must be located above the highest heating element, in general on the top of buildings, where they may be exposed to freezing conditions. For these reasons, open type expansion tanks and their listed provisions should be removed from the code.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 254
UMC 2024  Section: Table 1210.1, Table 1701.1

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

<p>| TABLE 1210.1 |
| MATERIAL FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS |</p>
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>PIPING/TUBING</th>
<th>FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypropylene (PP)</td>
<td>ASTM F2165, ASTM F2389, CSA B137.11, NSF 358-2</td>
<td>ASTM F2165, ASTM F2389, CSA B137.11, NSF 358-2</td>
</tr>
<tr>
<td>Raised Temperature Polyethylene (PE-RT)</td>
<td>ASTM F2165, ASTM F2623, ASTM F2769, CSA B137.18</td>
<td>ASSE 1061, ASTM F1807, ASTM F2159, ASTM F2165, ASTM F2735, ASTM F2769, ASTM D3261, ASTM F1055, CSA B137.18</td>
</tr>
<tr>
<td>Polyethylene/Aluminum/Polyethylene (PE-AL-PE)</td>
<td>ASTM F1282, ASTM F2165, CSA B137.9</td>
<td>ASTM F1282, ASTM F1974, ASTM F2165, CSA B137.9</td>
</tr>
</tbody>
</table>

Notes:
1 Ductile and gray iron.
2 Only type K, L, or M tubing allowed to be installed.
### TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F2165-2019</td>
<td>Flexible Pre-Insulated Plastic Piping</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F3347-2020a</td>
<td>Metal Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F3348-2020b</td>
<td>Plastic Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** The ASTM standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
Additional approved standards are being added to Table 1210.1 regarding materials for hydronic system piping, tubing, and fittings. The standards being added have been vetted for correct application. The change correlates with the actions taken by the USHGC Technical Committee.
Proposals

Item #: 255
UMC 2024  Section: Table 1210.1

SUBMITTER: Mark Fasel
Viega LLC

RECOMMENDATION:
Revise text

TABLE 1210.1
MATERIALS FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3226 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
It was an oversight not to include ASTM F3226 Standard Specification for Metallic Press-Connect fittings for piping and tubing systems in the standards fittings column for Copper/Copper alloy fittings during the 2021 code development cycle as it is for stainless steel. The inclusion of ASTM F3226 will align this table with other codes including the 2021 IAPMO USHGC which references ASTM F3226 under fittings for copper and copper alloy materials as this standard was developed for this type of technology and should be referenced here.
Proposals

Item #: 256

UMC 2024  Section: Table 1210.1, Table 1701.1

SUBMITTER: Mark Fasel
Viega LLC

RECOMMENDATION:
Revise text

TABLE 1210.1
MATERIALS FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>ASTM A269, ASTM A312, ASTM A554, ASTM A778</td>
</tr>
<tr>
<td></td>
<td>ASTM F1476, ASTM F1548, ASTM F3226, [IAPMO IGC 353], IAPMO PS 117</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[IAPMO IGC 353-2019]</td>
<td>Branch Connectors</td>
<td>Branch Connectors</td>
<td>Table 1210.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO IGC 353 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The IAPMO IGC 353 Branch Connectors standard was developed for branch connectors NPS 1 1/2" - 6 inches. Branch connectors are defined within the standard as a permanent fitting or connection that allows a NPT threaded branch connection to be added to existing piping. Branch connectors covered by IAPMO IGC 353 shall include (a) Saddle like permanent connection mechanically fixed in place to the host pipe; and (b) leak tight seal realized through the compression of a sealing element between the outer surface of the pipe and body or flange of the branch connector. Note: One method of mechanically fixing the branch connection is via a swaging action which secures the fitting by mechanically deforming a flange of metal attached to the branch connector so that it matches the contour of the inside surface of a host pipe as indicated in Standard Section 1.1.2.

The body of branch connectors covered by this Standard shall be made of carbon steel, stainless steel, copper nickel or other materials with similar strength properties.

Branch connectors meet the current definition of Mechanical Joint as provided in the code: Joint, Mechanical. General form for gastight or liquid-tight joints obtained by the joining of parts through a positive holding mechanical construction.

The addition of this standard to the Materials for hydronic system piping, tubing and fittings table will provide a consensus standard listing requirement for these type of fittings that have been proven through the variety of testing that is mandatory to obtain the listing.
**Proposals**

**Item #: 257**
UMC 2024  Section: Table 1210.1

**SUBMITTER:** Mark Fasel  
Viega LLC

**RECOMMENDATION:**  
Revise text

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
<th>FITTINGS</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

**Note:** IAPMO PS 117 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The inclusion of IAPMO PS 117 to the steel material fittings column was an oversight during the 2021 code development cycle. It was added to stainless steel but not steel. This proposal is to include IAPMO PS 117 into the standard/fitting section of Steel material as Steel is a material covered by this standard and used often in hydronic piping systems.

IAPMO PS 117 is currently referenced in the standard fittings column for copper/copper alloy and stainless steel in this table. The inclusion of this referenced standard in Steel will cover match what has been completed in the 2021 IAPMO USHGC and will align the codes.
Proposals

Item #: 258
UMC 2024  Section: Table 1210.1

SUBMITTER: Mark Fasel
Viega LLC

RECOMMENDATION:
Revise text

TABLE 1210.1
MATERIALS FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3226 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
It was an oversight not to include ASTM F3226 Standard Specification for Metallic Press-Connect fittings for piping and tubing systems in the standards fittings column for steel fittings during the 2021 code development cycle as it is for stainless steel. The inclusion of ASTM F3226 will align this table with other codes including the 2021 IAPMO USHGC which references ASTM F3226 under fittings for steel material as this standard was developed for this type of technology and should be referenced here.
Proposals

Item #: 259

UMC 2024  Section: Table 1210.1, Table 1701.1

SUBMITTER: Mark Fasel
Viega LLC

RECOMMENDATION:
Revise text

TABLE 1210.1
MATERIALS FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
</tr>
</thead>
</table>

Note: IAPMO IGC 353 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The IAPMO IGC 353 Branch Connectors standard was developed for branch connectors NPS 1 1/2" - 6 inches. Branch connectors are defined within the standard as a permanent fitting or connection that allows a NPT threaded branch connection to be added to existing piping. Branch connectors covered by IAPMO IGC 353 shall include:
(a) Saddle like permanent connection mechanically fixed in place to the host pipe; and
(b) leak tight seal realized through the compression of a sealing element between the outer surface of the pipe and body or flange of the branch connector.

Note: One method of mechanically fixing the branch connection is via a swaging action which secures the fitting by mechanically deforming a flange of metal attached to the branch connector so that it matches the contour of the inside surface of a host pipe as indicated in Standard section 1.1.2.

Branch connectors meet the current definition of Mechanical Joint as provided in the code: Joint, Mechanical. General form for gastight or liquid-tight joints obtained by the joining of parts through a positive holding mechanical construction.

The addition of this standard to the Materials for hydronic system piping, tubing and fittings table will provide a consensus standard listing requirement for these type of fittings that have been proven through the variety of testing that is mandatory to obtain the listing.
Proposals

Item #: 260
UMC 2024  Section: Table 1210.1, Table 1701.1

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

TABLE 1210.1
MATERIALS FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-Linked Polyethylene (PEX)</td>
<td>ASTM F876, ASTM F3253, CSA B137.5, NSF 358-3</td>
<td>FITTINGS</td>
</tr>
<tr>
<td>Polyethylene of Raised Temperature Polyethylene (PE-RT)</td>
<td>ASTM F2623, ASTM F2769, CSA B137.18</td>
<td>ASSE 1061, ASTM F1807, ASTM F2159, ASTM F2735, ASTM F2769, ASTM D3261, ASTM F3347, ASTM F3348, ASTM F1055, CSA B137.18</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASTM standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:

TABLE 1701.1
REFERENCES STANDARDS

<table>
<thead>
<tr>
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<td>ASTM F3348-2020b</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)
Proposals

Item #: 261
UMC 2024 Section: 1210.4

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1210.0 Materials.

1210.4 Oxygen Diffusion Corrosion. PEX and PE-RT tubing in closed hydronic systems shall contain an oxygen barrier with an oxygen permeation rate not to exceed 4.59E-04 grains per square foot per day (0.32 mg/m$^2$/day) at 104°F (40°C).

Exception: Closed hydronic systems without ferrous components in contact with the hydronic fluid.

SUBSTANTIATION:
PEX and PE-RT tubing used for hydronic applications requires an oxygen barrier to prevent diffusion of oxygen molecules into the water through the piping walls. An oxygen barrier also prevents corrosion of any cast iron components or parts such as circulator pumps, fill valves and boiler heating elements. The barrier allows for PEX and PE-RT use in hot water hydronic heating applications such as radiator heating, fan coils, and radiant floor heating. The revision of this section is necessary as it provides a maximum limit for oxygen permeation through the tubing.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 262
UMC 2024 Section: 1211.12, Table 1701.1

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

1211.0 Joints and Connections.

1211.12 Polyvinyl Chloride (PVC) Pipe. (remaining text unchanged)
(1) (remaining text unchanged)
(2) Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil, and other foreign material, apply primer purple in color in accordance with ASTM F656. Primer shall be applied until the surface of the pipe and fitting is softened. Solvent cements in accordance with ASTM D2564 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. Two-step joining methods shall be in accordance with ASTM D2855. Hold joint in place and undisturbed for 1 minute after assembly.
(3) (remaining text unchanged)

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D2855-2020</td>
<td>The Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets</td>
<td>Miscellaneous</td>
<td>1211.12(2)</td>
</tr>
</tbody>
</table>

Note: ASTM D2855 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The standard for two step solvent cement joining is ASTM D2855, “Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.”
Proposals

Item #: 263
UMC 2024  Section: 1211.14.1

SUBMITTER: Pennie Feehan
Pennie L Feehan Consulting
Rep. Copper Development Association

RECOMMENDATION:
Revise text

1211.14.1 Copper or Copper Alloy Pipe or Tubing to Threaded Pipe Joints. Joints from copper or copper alloy pipe or tubing to threaded pipe that is not copper or copper alloy shall be made by the use of copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.

SUBSTANTIATION:
The original sentence is not clear and does not specify that the connection is from copper alloy pipe or tubing to threaded pipe of a different material. This proposal does not change the intent of the code section.
Proposals

Item #: 264
UMC 2024  Section: 1211.14.2

SUBMITTER: Anie Rodio
Self

RECOMMENDATION:
Revise text

1211.0 Joints and Connections.

1211.14 Joints Between Various Materials. (remaining text unchanged)

1211.14.2 Plastic Pipe to Other Materials. Where connecting plastic pipe to other types of piping, approved types of adapter or transition fittings designed for the specific transition intended shall be used. Except as provided in the plumbing code, PVC and ABS pipe and fittings shall not be solvent welded to any other unlike material.

SUBSTANTIATION:
The current language allows for a single transition from ABS to PVC or PVC to ABS exterior of the structure. Transition glue is not being represented to be allowable to make transition joints between ABS and PVC anywhere in the building. This code change clarifies that this practice is not approved. I have seen residences where the below slab plumbing was PVC and then the above slab plumbing all PVC with the joints being made with transition glue. This is an improper use of the product. While there is a code change to place this change in Chapter 3 as a prohibited practice it is also important that this be in this section as a prohibited practice to aid the end user and AHJ.
1211.0 Joints and Connections.

1211.2 Chlorinated Polyvinyl Chloride (CPVC) Pipe. (remaining text unchanged)

(1) (remaining text unchanged)

(2) Solvent cement joints for CPVC pipe and fittings shall be clean from dirt and moisture. Solvent cements in accordance with ASTM F493, requiring the use of a primer shall be orange in color. The primer shall be colored and be in accordance with ASTM F656. Listed solvent cement in accordance with ASTM F493 that does not require the use of primers, yellow, green, or red in color, shall be permitted for pipe and fittings manufactured in accordance with ASTM D2846, 1/2 of an inch (15 mm) through 2 inches (50 mm) in diameter or ASTM F442, 1/2 of an inch (15 mm) through 3 inches (80 mm) in diameter. Apply primer where required inside the fitting and to the depth of the fitting on pipe. Apply liberal coat of cement to the outside surface of pipe to depth of fitting and inside of fitting. Place pipe inside fitting to forcefully bottom the pipe in the socket and hold together until joint is set.

(3) (remaining text unchanged)

SUBSTANTIATION:
Currently, it can be difficult to see the yellow solvent cement ring on a tan CTS CPVC joint during inspection. A high contrast cement has been asked for from the field to aid in the inspection of CPVC joints. The color green was chosen because of its high contrast against the tan pipe and fittings and green is not currently used to identify any other type of cement.
Item #: 266
UMC 2024  Section: 1211.5

SUBMITTER: Lance MacNevin, P.Eng.
Plastics Pipe Institute

RECOMMENDATION:
Revise text

1211.0 Joints and Connections.

1211.5 Cross-Linked Polyethylene (PEX) Pipe. Joints between cross-linked polyethylene (PEX) pipe and fittings shall be installed with fittings for PEX tubing that comply with the applicable standards referenced in Table 1210.1. PEX tubing labeled in accordance with ASTM F876 or ASTM F3253 shall be marked with the applicable standard designation for the fittings specified for use with the tubing. Mechanical joints shall be installed in accordance with the manufacturer’s installation instructions.

Note: ASTM F3253 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
ASTM F3253 "Standard Specification for Crosslinked Polyethylene (PEX) Tubing with Oxygen Barrier for Hot- and Cold-Water Hydronic Distribution Systems" was first published in 2017. ASTM Specification F3253 was added into the UMC Table 1210.1 “Materials for Hydronic System Piping, Tubing, and Fittings” in the 2021 edition. It was an oversight that PEX tubing produced in accordance with ASTM F3253 was not added into Section 1211.5 at that time.

This revision will clarify that PEX tubing made to ASTM Specification F3253 must comply with the labelling requirements stated within Section 1211.5.
Proposals

Item #: 267

UMC 2024 Section: 1217.3, 1217.3.1, 1217.4

SUBMITTER: Lance MacNevin, P.Eng.
Chair, UMC Radiant Cooling Working Group

RECOMMENDATION:
Revise text

1217.0 Radiant Heating and Cooling.

1217.3 Radiant Cooling Systems. Radiant cooling systems shall be designed to minimize the potential for condensation. To prevent condensation on any cooled radiant surface, the supply water temperature for a radiant cooling system shall be not less than 3°F (2°C) above the anticipated space dewpoint temperature, or in accordance with the manufacturer’s recommendation.

1217.3.1 Minimum Floor Temperatures. The minimum floor surface temperature shall not be less than 66°F (19°C) in general occupied applications.

1217.4 Chilled Water Supply/Distribution Piping. Chilled water piping, valves, and fittings, and manifolds shall be insulated and vapor sealed to prevent surface condensation.

(Substantiation)

The UMC Radiant Cooling Working Group was formed in January 2020 by members of ASHRAE TC 6.5, Radiant Heating and Cooling, to address concerns with existing UMC language in Section 1217.3. The working group met through a series of calls throughout 2020 to finalize the language submitted in this proposal.

Proposal 1:
The UMC Radiant Cooling Working Group has identified that the current supply water temperature limitation in Section 1217.3 is overly restrictive and represents design guidance rather than a proper code minimum for health and safety.

The new Section 1217.3.1 is required based on ASHRAE Standard 55, “Thermal Environmental Conditions for Human Occupancy,” which defines the minimum acceptable temperature for a radiant floor of 66°F (19°C), which is well accepted in North America and internationally. This proposal, agreed upon by the UMC Radiant Cooling Working Group, improves the code by clarifying that water temps must be above dewpoint for health & safety while adding a clarifying section for cooling comfort temperature which incorporates the ASHRAE minimum similar to existing Section 1217.2 for Radiant Heating.

The requirements of the proposed Section 1217.4 were previously grouped into Section 1217.3 but have been separated for clarity. Manifolds are being added as another part of the distribution system which are common to radiant systems.
Proposals

Item #: 268

UMC 2024 Section: 1217.3, 1217.4

SUBMITTER: Lance MacNevin, P.Eng.
Chair, UMC Radiant Cooling Working Group

RECOMMENDATION:
Revise text

1217.0 Radiant Heating and Cooling.

1217.3 Radiant Cooling Systems. Radiant cooling systems shall be designed to minimize the potential for condensation. To prevent condensation on any cooled radiant surface, the supply water temperature for a radiant cooling system shall be not less than 3°F (2°C) above the anticipated space dewpoint temperature, or in accordance with the manufacturer’s recommendation.

1217.4 Chilled Water Supply/Distribution Piping. Chilled water piping, valves, and fittings, and manifolds shall be insulated and vapor sealed to prevent surface condensation.

Exception: Piping, valves, fittings, and manifolds used to supply radiant cooling systems and where the water temperature is above the space dewpoint temperature shall not require insulation.

(renumber remaining sections)

SUBSTANTIATION:
The UMC Radiant Cooling Working Group was formed in January 2020 by members of ASHRAE TC 6.5, Radiant Heating and Cooling, to address concerns with existing UMC language in Section 1217.3. The working group met through a series of calls throughout 2020 to finalize the language submitted in this proposal.

Proposal 2:
The requirements of the proposed Section 1217.4 were previously grouped into Section 1217.3 but have been separated for clarity. Manifolds are being added as another part of the distribution system which are common to radiant systems.

The UMC Radiant Cooling Working Group proposes that an exception to the 1217.4 insulation requirements be added to clarify that insulation is not required for radiant cooling systems where the piping system will always operate above the dewpoint. The insulation requirements have been amended such that only piping, valves, fittings, and manifolds subject to condensation (below dewpoint) requires vapor sealed insulation. For example, a high temperature cooling system (e.g., Radiant cooling) operating with a water temperature above the dewpoint supplied from a cooling tower.
Proposals

Item #: 269
UMC 2024  Section: 1217.3

SUBMITTER: Lance MacNevin, P.Eng.
Chair, UMC Radiant Cooling Working Group

RECOMMENDATION:
Revise text

1217.0 Radiant Heating and Cooling.

1217.3 Radiant Cooling Systems. Radiant cooling systems shall be designed to minimize the potential for condensation. To prevent condensation on any cooled radiant surface, the supply water temperature for a radiant cooling system shall be not less than 3°F (2°C) above the anticipated space dewpoint temperature, or in accordance with the manufacturer’s recommendation. Chilled water piping, valves, and fittings shall be insulated and vapor sealed to prevent surface condensation.

SUBSTANTIATION:
The UMC Radiant Cooling Working Group was formed in January 2020 by members of ASHRAE TC 6.5, Radiant Heating and Cooling, to address concerns with existing UMC language in Section 1217.3. The working group met through a series of calls throughout 2020 to finalize the language submitted in this proposal.

Proposal 3:
The UMC Radiant Cooling Working Group has identified that the current supply water temperature limitation in Section 1217.3 is overly restrictive and represents design guidance rather than a proper code minimum for health and safety.
Item #: 270
UMC 2024  Section: 1217.4

SUBMITTER: Lance MacNevin, P.Eng.
Plastics Pipe Institute

RECOMMENDATION:
Revise text

1217.4 Tube placement. Hydronic radiant system tubing shall be installed in accordance with the manufacturer’s installation instructions and with the tube layout and spacing in accordance with the system design. Except for distribution mains, the individual loop lengths shall be installed with a variance of not more than ±10 percent from the design. The maximum loop length of continuous tubing from a supply-and-return manifold shall not exceed the lengths specified by the manufacturer or, in the absence of manufacturer’s specifications, the lengths specified in Table 1217.4. Actual loop lengths shall be determined by spacing, flow rate, and pressure drop requirements as specified in the system design.

For the purpose of system balancing, each individual loop shall have a tag or label securely affixed to the manifold to indicate the length of the loop and the room(s) and area(s) served.

SUBSTANTIATION:
Requiring installation of all radiant tube spacing at ± 10% of design is sometimes too restrictive, so “tube spacing” should be removed from the list as shown. For example, a tubing layout intended to be installed at 8 inch on-center spacing would allow a ± of only 0.8 inches (3/4 inch) throughout an entire area. In rooms with irregular shapes or holes or obstructions in the floor, it may be necessary to adjust tube spacing to allow the tubing to pass around such hole or obstruction. These holes or obstructions may be unknown to the designer of the radiant tubing design and, therefore, the installer must deviate from the tubing design to meet as-built conditions. The majority of the tube spacing may be exactly per design, but a portion of the tube spacing must be allowed to deviate from the design. The proposed deletion provides this practical flexibility.

Also, it is important for radiant tubing loops (circuits) to be tagged or labelled to help identify which circuit, attached to a central manifold, is connected to which room. The addition of "or label" provides the installer with flexibility to achieve this objective.
Proposals

Item #: 271
UMC 2024 Section: Table 1220.4.1

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

TABLE 1220.4.1
MAXIMUM LOOP LENGTHS FOR SNOW AND ICE MELT SYSTEMS

<table>
<thead>
<tr>
<th>NOMINAL TUBE SIZE (inches)</th>
<th>MAXIMUM ACTIVE LOOP LENGTH (feet)</th>
<th>TOTAL LOOP LENGTH (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE-RT and PEX Tubing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>115</td>
<td>130 140</td>
</tr>
<tr>
<td>5/8</td>
<td>225</td>
<td>250</td>
</tr>
<tr>
<td>3/4</td>
<td>300</td>
<td>325</td>
</tr>
<tr>
<td>1</td>
<td>450</td>
<td>475</td>
</tr>
<tr>
<td>Copper Tubing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>–</td>
<td>140</td>
</tr>
<tr>
<td>3/4</td>
<td>–</td>
<td>280</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Proposed changes are being made to update Table 1220.4.1 as the original source (CSA B214) of the table has also been updated. The values within this table have been determined based on the head loss, heat outputs, and various nominal tube sizes listed. Each of these changes are harmonized with the newest edition of CSA B214.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 272

UMC 2024 Section: 1221.2, 1221.2.3

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1221.0 Piping Installation.

1221.2 Embedded Piping Materials and Joints. Piping embedded in concrete shall be steel pipe, Type L copper tubing or plastic pipe or tubing rated at not less than 80 psi at 180°F (552 kPa at 82°C). Joints of pipe or tubing that are embedded in a portion of the building, such as concrete or plaster shall be installed in accordance with the requirements of Section 1221.2.1 through Section 1221.2.3.

1221.2.3 Plastics. Plastic pipe and tubing shall be installed in continuous lengths or shall be joined by heat fusion methods or other approved fittings in accordance with Table 1210.1 and the manufacturer’s installation instructions. Exception: Solvent cement joints shall not be used in embedded applications.

SUBSTANTIATION:
Section 1221.2.3 is being modified for clarification on the intent of the exception. The language is being revised to specify that solvent cement joints are not to be used in embedded applications.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 273
UMC 2024  Section: 1221.2.3

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

1221.0 Piping Installation.

1221.2 Embedded Piping Materials and Joints. (remaining text unchanged)

1221.2.3 Plastics. Plastic pipe and tubing shall be installed in continuous lengths or shall be joined by heat fusion methods, solvent cement, or other approved fittings in accordance with Table 1210.1 and the manufacturer's installation instructions.

Exception: Solvent cement joints.

SUBSTANTIATION:
Like welding for steel and brazing for copper, solvent cementing is the optimal joining method for PVC and CPVC plastic piping systems. While use of those materials in hydronics is less frequent than other piping materials, it should not be specifically excepted.
Proposals

Item #: 274

UMC 2024  Section: Chapter 13, Table 1701.1, Table 1701.2

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

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]

(renumber remaining sections)

1308.3 Interconnections Between Gas Piping Systems Supplying Separate Users. Where two or more meters, or two or more service regulators where meters are not provided, are located on the same premises and supply separate users, the gas piping systems shall not be interconnected on the outlet side of the meters or service regulators. [NFPA 54:5.3.2-5.3.2.1]

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 meter is not provided, equipment to prevent backflow shall be installed. A three-way valve installed to admit the standby supply and at the same time shut off the regular supply shall be permitted to be used for this purpose. [NFPA 54:5.3.2-5.3.2.1]

1308.4 Sizing of Gas Piping Systems. Gas piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance. [NFPA 54:5.4.1-5.4.2.1]

1308.4.1 Maximum Gas Demand. The volumetric flow rate of gas to be provided shall be the sum of the maximum input of the appliances served. The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2,000 feet (610 m). [NFPA 54:5.4.2.1-5.4.2.2 5.3.2.1-5.3.2.2] Where the input rating is not indicated, the gas supplier, appliance manufacturer, or a qualified agency shall be contacted or the rating from Table 1308.4.1 shall be used for estimating the volumetric flow rate of gas to be supplied.

The total connected hourly load shall be used as the basis for piping sizing, assuming all appliances are operating at full capacity simultaneously.

Exception: Sizing shall be permitted to be based upon established load diversity factors. [NFPA 54:5.4.2.3-5.4.2.4 5.3.2.3]

1308.4.2 Sizing Methods. Gas piping shall be sized in accordance with one of the following:

(1) Pipe sizing tables or sizing equations in this chapter.

(2) Other approved engineering methods.

(3) Sizing tables included in a listed piping system manufacturer’s installation instructions.

(3) Engineering methods. [NFPA 54:5.4.3 5.3.3]

1308.4.3 Allowable Pressure Drop. The design pressure loss in any a piping system under maximum probable flow conditions, from the point of delivery to the inlet connection of the appliance, all appliances served shall be such that the supply pressure at each appliance inlet is greater than or equal to the minimum pressure required by the appliance. [NFPA 54:5.4.4 5.3.4]

1308.5 Acceptable Piping Materials and Joining Methods. Materials used for piping systems shall either comply with the requirements of this chapter or be acceptable to the Authority Having Jurisdiction. [NFPA 54:5.6.1.1 5.5.1.1]

1308.5.1 Used Materials. Pipe, fittings, valves, or other materials shall not be used again unless they are free of foreign materials and have been ascertained to be adequate for the service intended. [NFPA 54:5.6.1.2 5.5.1.2]

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

(1) Be investigated and tested to determine that it is safe and suitable for the proposed service.

(2) Be recommended for that service by the manufacturer.

(3) Be acceptable to the Authority Having Jurisdiction. [NFPA 54:5.6.1.3]

1308.5.2 Metallic Pipe. Metallic pipe shall be in accordance with Section 1308.5.2.1 through Section 1308.5.2.4.
Cast-iron pipe shall not be used. [NFPA 54: 5.6.2.1 5.5.2.1]

Steel, Stainless Steel, and Wrought-Iron. Steel, stainless steel, and wrought-iron pipe shall be at least Schedule 40 and shall comply with the dimensional standards of ASME B36.10M and one of the following:

1. ASTM A53
2. ASTM A106
3. ASTM A312 [NFPA 54: 6.6.2.2 5.5.2.2]

Copper and Copper Alloy Pipe. Copper and copper alloy pipe shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet (scf) of gas (0.7 mg/100 L). [NFPA 54: 6.6.2.3 5.5.2.3]

Threaded copper, copper alloy, or aluminum alloy pipe shall not be used with gases corrosive to such material. [NFPA 54: 6.6.2.4 5.5.2.4]

Aluminum Alloy Pipe. Aluminum alloy pipe shall comply with ASTM B241 (except that the use of alloy 5456 is prohibited), and shall be marked at each end of each length indicating compliance. Aluminum alloy pipe shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergents, or sewage. [NFPA 54: 6.6.2.5 5.5.2.5]

Aluminum alloy pipe shall not be used in exterior locations or underground. [NFPA 54: 6.6.2.6 5.5.2.6]

Metallic Tubing. Tubing shall not be used with gases corrosive to the tubing material. [NFPA 54: 6.6.3.4 5.5.3.1]

Steel Tubing. Steel tubing shall comply with ASTM A254. [NFPA 54: 6.6.3.2 5.5.3.2]

Stainless Steel Tubing. Stainless steel tubing shall comply with one of the following:

1. ASTM A268
2. ASTM A269 [NFPA 54: 6.6.3.3 5.5.3.3]

Copper and Copper Alloy Tubing. Copper and copper alloy tubing shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 scf of gas (0.7 mg/100 L). Copper tubing shall comply with standard Type K or Type L of ASTM B88 or ASTM B280. [NFPA 54: 5.5.3.4]

Aluminum Alloy Tubing. Aluminum alloy tubing shall comply with ASTM B210 or ASTM B241. Aluminum alloy tubing shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergent, or sewage. Aluminum alloy tubing shall not be used in exterior locations or underground. [NFPA 54: 6.6.3.5 5.5.3.5]

Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing shall be listed in accordance with CSA LC-1. [NFPA 54: 6.6.3.6 5.5.3.6]

Plastic Pipe, Tubing, and Fittings. Polyethylene plastic pipe, tubing, and fittings used to supply fuel gas shall conform to ASTM D2513. Pipe to be used shall be marked “gas” and “ASTM D2513.” [NFPA 54: 5.6.4.1.1 5.5.4.1.1]

Polyamide pipe, tubing, and fittings shall be identified in and conform to ASTM F2945. Pipe to be used shall be marked “gas” and “ASTM F2945.” [NFPA 54: 5.6.4.1.2 5.5.4.1.2]

Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) plastic pipe, tubing, and fittings shall not be used to supply fuel gas. [NFPA 54: 5.6.4.1.3 5.5.4.1.3]

Anodeless Risers. Anodeless risers shall comply with Section 1308.5.4.2.1 through Section 1308.5.4.2.3. [NFPA 54: 5.5.4.3.4]

Factory-Assembled Anodeless Risers. Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used and shall be leak-tested by the manufacturer in accordance with written procedures. [NFPA 54: 5.6.4.3(4) 5.5.4.3(1)]

Service Head Adapters and Field-Assembled Anodeless Risers. Service head adapters and field assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used and shall be design-certified to meet the requirements of Category I of ASTM D2513 and 49 CFR 192.281(e). The manufacturer shall provide the user qualified installation instructions as prescribed by 49 CFR 192.283(b). [NFPA 54: 5.6.4.3(2) 5.5.4.3(2)]

Undiluted Liquefied Petroleum Gas Piping. The use of plastic pipe, tubing, and fittings in undiluted LP-Gas piping systems shall be in accordance with NFPA 58. [NFPA 54: 5.6.4.3(3) 5.5.4.3(3)]

Workmanship and Defects. Gas pipe, tubing, and fittings shall be clear and free from cutting burrs and defects in structure or threading; and shall be thoroughly brushed and chip and scale blown. Defects in pipe, tubing, and fittings shall not be repaired. Defective pipe, tubing, and fittings shall be replaced. [NFPA 54: 5.6.6.5 5.5.5]

Metallic Pipe Threads. Metallic pipe and fitting threads shall be taper pipe threads and shall comply with ASME B1.20.1. [NFPA 54: 5.6.6.6 5.5.6.1]

Damaged Threads. Pipe with threads that are stripped, chipped, corroded, or otherwise damaged shall not be used. Where a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used. [NFPA 54: 5.6.6.2 5.5.6.2]

Number of Threads. Field threading of metallic pipe shall be in accordance with Table 1308.5.6.2. [NFPA 54: 5.6.6.3 5.5.6.3]

Thread Joint Compounds Sealing. Threaded joints shall be made using a thread joint sealing material. [NFPA 54: 5.5.6.4.1] Thread joint sealing materials shall be compatible with the pipe and fitting material on which the compounds are used. [NFPA 54: 5.5.6.4.2] Thread joint compounds sealing materials shall be nonhardening and shall
be resistant to the action of LP-Gas or to any other chemical constituents of the gases to be conducted through the piping. [NFPA 54:5.5.6.4 5.5.6.4.3]

1308.5.7 Metallic Piping Joints and Fittings. The type of piping joint used shall be suitable for the pressure and temperature conditions and shall be selected giving consideration to joint tightness and mechanical strength under the service conditions. The joint shall be able to sustain the maximum end force due to the internal pressure and any additional forces due to temperature expansion or contraction, vibration, fatigue, or the weight of the pipe and its contents. [NFPA 54:5.5.6.7 5.5.7]

1308.5.7.1 Pipe Joints. Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded, or assembled with press-connect fittings listed to CSA LC 4. (1) Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1000°F (538°C). (2) Brazing alloys shall not contain more than 0.05 percent phosphorus. (NFPA 54:5.5.7.1 5.5.7.4)

1308.5.7.2 Copper Tubing Joints. Copper tubing joints shall be assembled with approved gas tubing fittings, shall be brazed with a material having a melting point in excess of 1000°F (538°C), or shall be assembled with press-connect fittings listed to CSA LC 4. Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems. Brazing alloys shall not contain more than 0.05 percent phosphorus. [NFPA 54:5.5.7.2 5.5.7.3]

1308.5.7.3 Stainless Steel Tubing Joints. Stainless steel joints shall be welded, assembled with approved tubing fittings, brazed with a material having a melting point in excess of 1000°F (538°C), or assembled with press-connect fittings listed to CSA LC 4. Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems. Brazing alloys and fluxes shall be recommended by the manufacturer for use on stainless steel alloys. [NFPA 54:5.5.7.3 5.5.7.4]

1308.5.7.4 Flared Joints. Flared joints shall be used only in systems constructed from nonferrous pipe and tubing where experience or tests have demonstrated that the joint is suitable for the conditions and where provisions are made in the design to prevent separation of the joints. [NFPA 54:5.5.7.4 5.5.7.5]

1308.5.7.5 Metallic Pipe Fittings. Metallic fittings shall comply with the following: (1) Threaded fittings in sizes exceeding 4 inches (100 mm) shall not be used. (2) Fittings used with steel, stainless steel, or wrought-iron pipe shall be steel, stainless steel, copper alloy, malleable iron, or cast-iron. (3) Fittings used with copper or copper alloy pipe shall be copper or copper alloy. (4) Fittings used with aluminum alloy pipe shall be aluminum alloy. (5) Cast-iron fittings shall comply with the following: (a) Flanges shall be permitted. (b) Bushings shall be used. (c) Fittings shall not be used in systems containing flammable gas-air mixtures. (d) Fittings in sizes 4 inches (100 mm) and larger shall not be used indoors unless approved by the Authority Having Jurisdiction. (e) Fittings in sizes 6 inches (150 mm) and larger shall not be used unless approved by the Authority Having Jurisdiction. (6) Aluminum alloy fitting threads shall not form the joint seal. (7) Zinc-aluminum alloy fittings shall not be used in systems containing flammable gas-air mixtures. (8) Special fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression-type tubing fittings shall be as follows: (a) Used within the fitting manufacturer's pressure-temperature recommendations. (b) Used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion, or contraction. (c) Acceptable to the Authority Having Jurisdiction. (9) When pipe fittings are drilled and tapped in the field, the operation shall be in accordance with the following: (a) The operation shall be performed on systems having operating pressures of 5 psi (34 kPa) or less. (b) The operation shall be performed by the gas supplier or their designated representative. (c) The drilling and tapping operation shall be performed in accordance with written procedures prepared by the gas supplier. (d) The fittings shall be located outdoors. (e) The tapped fitting assembly shall be inspected and proven to be free of leaks. [NFPA 54:5.5.7.6 5.5.7.7]

1308.5.8 Plastic Piping, Joints, and Fittings. Plastic pipe, tubing, and fittings shall be joined in accordance with the manufacturer's instructions. Section 1308.5.8.1 through Section 1308.5.8.4 shall be observed when making such joints. [NFPA 54:5.5.8 5.5.8.1]

1308.5.8.1 Joint Design. The joint shall be designed and installed so that the longitudinal pullout resistance of the joint will be at least equal to the tensile strength of the plastic piping material. [NFPA 54:5.5.8.1 5.5.8.2]

1308.5.8.2 Heat Fusion Joint. Heat fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gastight joints at least as strong as the pipe or tubing being joined. Joints shall be made with the joining method recommended by the pipe manufacturer. Heat Polyethylene heat fusion fittings shall be marked “ASTM D2513.” Polyamide heat fusion fittings shall be marked “ASTM F2945.” [NFPA 54:5.5.8.2 5.5.8.3]

1308.5.8.3 Compression-Type Mechanical Joints. Where compression-type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed by the system. An internal
tubular rigid stiffener shall be used in conjunction with the fitting. The stiffener shall be flush with the end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. Split tubular stiffeners shall not be used. [NFPA 54:5.6.9.1.1 5.6.9.1.3]

1308.5.8.4 Liquefied Petroleum Gas Piping Systems. Plastic piping joints and fittings for use in LP-Gas piping systems shall be in accordance with NFPA 58. [NFPA 54:5.6.8(4) 5.6.8(4)]

1308.5.9 Flange Specifications. Cast iron flanges shall be in accordance with ASME B16.1. [NFPA 54:5.6.9.1.1 5.6.9.1.3]

1308.5.9.1 Steel Flanges. Steel flanges shall be in accordance with the following:
   (1) ASME B16.5 or
   (2) ASME B16.47. [NFPA 54:5.6.9.1.2 5.6.9.1.2]

1308.5.9.2 Non-Ferrous Flanges. Non-ferrous flanges shall be in accordance with ASME B16.24. [NFPA 54:5.6.9.1.3 5.6.9.1.3]

1308.5.9.3 Ductile Iron Flanges. Ductile iron flanges shall be in accordance with ASME B16.42. [NFPA 54:5.6.9.1.4 5.6.9.1.4]

1308.5.9.4 Dissimilar Flange Connections. Raised-face flanges shall not be joined to flat-faced cast iron, ductile iron or nonferrous material flanges. [NFPA 54:5.6.9.2 5.6.9.2]

1308.5.9.5 Flange Facings. Standard facings shall be permitted for use under this code. Where 150 psi (1034 kPa) steel flanges are bolted to Class 125 cast-iron flanges, the raised face on the steel flange shall be removed. [NFPA 54:5.6.9.3 5.6.9.3]

1308.5.9.6 Lapped Flanges. Lapped flanges shall be used only aboveground or in exposed locations accessible for inspection. [NFPA 54:5.6.9.4 5.5.9.4]

1308.5.10 Flange Gaskets. The material for gaskets shall be capable of withstanding the design temperature and pressure of the piping system and the chemical constituents of the gas being conducted without change to its chemical and physical properties. The effects of fire exposure to the joint shall be considered in choosing the material. [NFPA 54:5.6.10 5.5.10]

1308.5.10.1 Flange Gasket Materials. Acceptable materials shall include the following:
   (a) Metal (plain or corrugated)
   (b) Composition
   (c) Aluminum "O" rings
   (d) Spiral-wound metal gaskets
   (e) Rubber-faced phenolic
   (f) Elastomeric [NFPA 54:5.6.10.1 5.5.10.1]

1308.5.10.2 Metallic Flange Gaskets. Metallic flange gaskets shall be in accordance with ASME B16.20. [NFPA 54:5.6.10.2 5.5.10.2.1]

1308.5.10.3 Non-Metallic Flange Gaskets. Non-metallic flange gaskets shall be in accordance with ASME B16.21. [NFPA 54:5.6.10.3 5.5.10.2.2]

1308.5.10.4 Full-Face Flange Gasket. Full-face flange gaskets shall be used with all non-steel flanges. [NFPA 54:5.6.10.4 5.5.10.3]

1308.5.10.5 Separated Flanges. When a flanged joint is separated, the gasket shall be replaced. [NFPA 54:5.6.10.5 5.5.10.4]

1308.6 Gas Meters. Gas meters shall be selected for the maximum expected pressure and permissible pressure drop. [NFPA 54:5.7.1 5.6.1]

1308.6.1 Location. Gas meters shall be located in ventilated spaces readily accessible for examination, reading, replacement, or necessary maintenance. [NFPA 54:5.7.2.1 5.6.2.1]

1308.6.1.1 Subject to Protection from Damage. Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls, or where they will be subject to excessive corrosion or vibration. [NFPA 54:5.7.2.2 5.6.2.2]

1308.6.1.2 Extreme Temperatures. Gas meters shall not be located where they will be subjected to extreme temperatures or sudden extreme changes in temperature or in areas where they are subjected to temperatures beyond those recommended by the manufacturer. [NFPA 54:5.7.2.3 5.6.2.3]

1308.6.2 Supports. Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters. Where flexible connectors are used to connect a gas meter to downstream piping at mobile homes in mobile home parks, the meter shall be supported by a post or bracket placed in a firm footing or by other means providing equivalent support. [NFPA 54:5.7.9 5.5.6.3]

1308.6.3 Meter Protection. Meters shall be protected against overpressure, backpressure, and vacuum. [NFPA 54:5.7.45.6.4]

1308.6.4 Identification. Gas piping at multiple meter installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied and attached by the installing agency. [NFPA 54:5.7.5 5.5.6.5]

1308.7 Gas Pressure Regulators. A line pressure regulator shall be installed where the gas supply pressure exceeds the maximum allowable inlet pressure of the appliance served. [NFPA 54:5.8.45.7.1]

1308.7.1 Listing. Line pressure regulators shall be listed in accordance with CSA Z21.80 where the outlet pressure is
1308.7.2 Location. The gas pressure regulator shall be accessible for servicing. [NFPA 54:5.8.25.7.2]

1308.7.3 Regulator Protection. Pressure regulators shall be protected against physical damage. [NFPA 54:5.8.45.7.4]

1308.7.4 Regulator Vents Venting of Line Pressure Regulators. Regulator vents shall be in accordance with Section 1308.15. Line pressure regulators shall comply with all of the following:

(1) An independent vent to the exterior of the building, sized in accordance with the regulator manufacturer's instructions, shall be provided where the location of a regulator is such that a ruptured diaphragm will cause a hazard.

(2) Where more than one regulator is at a location, each regulator shall have a separate vent to the outdoors or, if approved by the Authority Having Jurisdiction, the vent lines shall be permitted to be manifolded in accordance with accepted engineering practices to minimize backpressure in the event of diaphragm failure.

(3) The regulator vent shall terminate at least 3 feet (914 mm) from a source of ignition.

(4) At locations where regulators might be submerged during floods, a special antiflood type breather vent fitting shall be installed, or the vent line shall be extended above the height of the expected flood waters.

(5) A regulator shall not be vented to the appliance flue or exhaust system. [NFPA 54:5.8.5.1; 5.7.5]

1308.7.5 Venting of Gas Appliance Pressure Regulators. For venting of gas appliance pressure regulators, see Section 902.15. [NFPA 54:5.8.5.2]

1308.7.6 Bypass Piping. Valved and regulated bypasses shall be permitted to be placed around gas line pressure regulators where continuity of service is imperative. [NFPA 54:5.8.6]

1308.7.7 1308.7.5 Identification. Line pressure regulators at multiple regulator installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied. [NFPA 54:5.8.7.5]

1308.8 Overpressure Protection. Where the serving gas supplier delivers gas at a pressure greater than 2 psi for piping systems serving appliances designed to operate at a gas pressure of 14 inches water column or less, overpressure protection devices shall be installed. Piping systems serving equipment designed to operate at inlet pressures greater than 14 inches water column (3.5 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer's installation instructions. [NFPA 54:5.9.4.13.8.1]

1308.9 Pressure Limitation Requirements. Where piping systems serving appliances designed to operate with a gas supply pressure of 14 inches water column (3.5 kPa) or less are required to be equipped with overpressure protection by Section 1308.8, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance to 2 psi (14 kPa) or less upon a failure of the line pressure regulator. [NFPA 54:5.9.2.1; 5.8.2.1]

1308.9.1 Overpressure Protection Required. Where piping systems serving appliances designed to operate with a gas supply pressure greater than 14 inches water column (3.5 kPa) are required to be equipped with overpressure protection by Section 1308.8, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance as required by the appliance manufacturer's installation instructions. [NFPA 54:5.9.2.2; 5.8.2.2]

1308.9.2 Overpressure Protection Devices. Each overpressure protection device installed to meet the requirements of this section shall be capable of limiting the pressure to its connected appliance(s) as required by this section independently of any other pressure control equipment in the piping system. [NFPA 54:5.9.2.2; 5.8.2.3]

1308.9.3 Detection of Failure. Each gas piping system for which an overpressure protection device is required by this section shall be designed and installed so that a failure of the primary pressure control device(s) is detectable. [NFPA 54:5.9.2.4; 5.8.2.4]

1308.9.4 Flow Capacity. If a pressure relief valve is used to meet the requirements of this section, it shall have a flow capacity such that the pressure in the protected system is maintained at or below the limits specified in Section 1308.9 under the following conditions:

(1) The line pressure regulator for which the relief valve is providing overpressure protection has failed wide open.

(2) The gas pressure at the inlet of the line pressure regulator for which the relief valve is providing overpressure protection is not less than the regulator's normal operating inlet pressure. [NFPA 54:5.9.2.5; 5.8.2.5]

1308.10 Overpressure Protection Devices. Overpressure protection devices shall be one of the following:

(1) Pressure relief valve.

(2) Monitor regulator.

(3) Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator to the maximum values specified by Section 1308.9 or less.

(4) Automatic shutoff device installed in series with the line pressure regulator and set to shut off when the pressure on the downstream piping system reaches the maximum values specified by Section 1308.9 or less. This device shall be designed so that it will remain closed until manually reset. [NFPA 54:5.9.3.45.8.3.1]

1308.10.1 Separate Devices. The devices in Section 1308.10 shall be installed either as an integral part of the service or line pressure regulator or as separate units. Where separate overpressure protection devices are installed, they shall comply with Section 1308.10.2 through Section 1308.10.7. [NFPA 54:5.9.3.2; 5.8.3.2]

1308.10.2 Construction and Installation. All overpressure protection devices shall meet the following requirements:

(1) Be constructed of materials so that the operation of the device is not impaired by corrosion of external parts by the...
operated, or electrically operated low-pressure shutoff valves. [NFPA 54:5.11]

1308.10.3 External Control Piping. External control piping shall be designed and installed so that damage to the control piping of one device does not render both the regulator and the overpressure protective device inoperative. [NFPA 54:5.9.6-5.9.8.5]

1308.10.4 Setting. Each pressure limiting or pressure relieving device shall be set so that the gas pressure supplied to the connected appliance(s) does not exceed the limits specified in Section 1308.9 and Section 1308.9.1. [NFPA 54:5.9.6-5.9.8.6]

1308.10.5 Unauthorized Operation. Where unauthorized operation of any shutoff valve could render a pressure relieving valve or pressure limiting device inoperative, one of the following shall be accomplished:

1. The valve shall be locked in the open position. Instruct authorized personnel in the importance of leaving the shutoff valve open and of being present while the shutoff valve is closed so that it can be locked in the open position before leaving the premises.
2. Duplicate relief valves shall be installed, each having adequate capacity to protect the system, and arrange the isolating valves or three-way valve so that only one relief valve can be rendered inoperative at a time. [NFPA 54:5.9.7-5.9.8.7]

1308.10.6 Discharge of Vents. The discharge stacks, vents, or outlet parts of all pressure relieving and pressure limiting devices shall be located so that gas is safely discharged to the outdoors. Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage. The discharge stack or vent line shall be at least the same size as the outlet of the pressure relieving device. [NFPA 54:5.9.8.1, 5.9.8.2, 5.9.8.8.1, 5.9.8.8.2]

1308.10.7 Size of Fittings, Pipe, and Openings. The fittings, pipe, and openings located between the system to be protected and the pressure relieving device shall be sized to prevent hammering of the valve and to prevent impairment of relief capacity. [NFPA 54:5.9.9-5.9.8.9]

1308.11 Backpressure Protection. Protective devices shall be installed as close to the equipment as practical where the design of equipment connected is such that air, oxygen, or standby gases could be forced into the gas supply system. Gas and air combustion mixers incorporating double diaphragm “zero” or “atmosphere” governors or regulators shall require no further protection unless connected directly to compressed air or oxygen at pressures of 5 psi (34 kPa) or more. [NFPA 54:5.9.10.1, 5.9.10.2, 5.9.10.4, 5.9.10.5, 5.9.10.6]

1308.10.11 Protective Devices. Protective devices shall include but not be limited to the following:

1. Check valves.
2. Reverse flow indicators controlling positive shutoff valves.
3. Normal pressure diaphragm or vacuum relief devices, suitable for the service involved, emergency use, and reliability of operation as listed in accordance with Table 1308.13. [NFPA 54:5.10.1.1, 5.10.1.2]

1308.10.12 Low-Pressure Protection. A protective device shall be installed between the meter and the appliance or equipment if the operation of the appliance or equipment is such that it could produce a vacuum or a dangerous contraction. [NFPA 54:5.11.3]

1308.10.13 Shutoff Valves. Shutoff valves shall be approved and shall be selected giving consideration to pressure drop, service involved, emergency use, and reliability of operation in accordance with Table 1308.13. Shutoff valves of size 1 inch (25 mm) National Pipe Thread and smaller shall be listed and labeled. Where used outdoors, such use shall be in accordance with the manufacturer's recommendation. [NFPA 54:5.12.5.11]

1308.14 Expansion and Flexibility. Piping systems shall be designed to prevent failure from thermal expansion or contraction. [NFPA 54:5.13.1.1]

1308.14.1 Special Local Conditions. Where local conditions include earthquake, tornado, unstable ground, or flood hazards, special consideration shall be given to increased strength and flexibility of piping supports and connections. [NFPA 54:5.13.2]

1308.15 Pressure Regulator and Pressure Control Venting. The venting of the atmospheric side of diaphragms in line pressure regulators, gas appliance regulators, and gas pressure limit controls shall be in accordance with all of the following:

1. An independent vent pipe to the outdoors, sized in accordance with the device manufacturer's instructions, shall be provided where the location of a device is such that a discharge of fuel gas will cause a hazard. For devices other than appliance regulators, vents are not required to be independent where the vents are connected to a common manifold in accordance with engineering methods to minimize backpressure in the event of diaphragm failure and such design is approved. [NFPA 54:5.13.3]

Exceptions:

1. A regulator and vent limiting means combination listed as complying with ANSI Z21.80/CSA 6.22, shall not be required to be vented to the outdoors.
2. A listed gas appliance regulator factory equipped with a vent limiting device is not required to be vented to the outdoors.
3. Materials for vent piping shall be in accordance with Section 1308.5 through Section 1308.5.10.5.
The vent terminus shall be designed to prevent the entry of water, insects, and other foreign matter that could cause blockage.

Vent piping shall be installed to minimize static loads and bending moments placed on the regulators and gas pressure control devices.

Vent shall terminate not less than 3 feet (914 mm) from a possible source of ignition.

At locations where a vent termination could be submerged during floods or snow accumulations, an antiflood-type breather vent fitting shall be installed, or the vent terminal shall be located above the height of the expected flood waters or snow.

Vent piping from pressure regulators and gas pressure controls shall not be connected to a common manifold that serves a bleed line from a diaphragm-type gas valve. [NFPA 54:5.14]

**1309.0 Excess Flow Valve.**

**1309.1 General.** Where automatic excess flow valves are installed, they shall be listed to CSA in accordance with ANSI Z21.93/CSA 6.30 and shall be sized and installed in accordance with the manufacturer’s instructions. [NFPA 54:5.435.12]

**1310.0 Gas Piping Installation.**

**1310.1 Piping Underground.** Underground gas piping shall be installed with sufficient clearance from any other underground structure to avoid contact therewith, to allow maintenance, and to protect against damage from proximity to other structures. In addition, underground plastic piping shall be installed with sufficient clearance or shall be insulated from any source of heat so as to prevent the heat from impairing the serviceability of the pipe. [NFPA 54:7.1.1.1, 7.1.1.2]

**1310.1.1 Cover Requirements.** Underground piping systems shall be installed with a minimum of 12 inches (305 mm) of cover. The minimum cover shall be increased to 18 inches (457 mm) if external damage to the pipe or tubing from external forces is likely to result. Where a minimum of 12 inches (305 mm) of cover cannot be provided, the pipe piping shall be installed in conduit or bridged (shielded). [NFPA 54:7.1.2.1 – 7.1.2.1(B)]

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

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

**1310.1.7 Connections of Plastic Piping.** Plastic piping shall be installed outdoors, underground only. Exceptions:

1. Plastic piping shall be permitted to terminate aboveground where an anodeless riser is used.
2. Plastic piping shall be permitted to terminate with a wall head adapter aboveground in buildings, including basements, where the plastic piping is inserted in a piping material permitted for use in buildings. [NFPA 54:7.1.7.1]

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

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

**1310.3.5.3 Piping on Roofs.** Gas piping installed on the roof surfaces shall be elevated above the roof surface and shall be supported in accordance with Table 1310.3.5.1. Gas piping shall be elevated not less than 3\(\frac{1}{2}\) inches (89 mm) above the roof surface. [NFPA 54:7.2.6.4.1, 7.2.6.4.2]

**1310.4.4 Piping in Floors Industrial Occupancies.** In industrial occupancies, gas piping in solid floors such as concrete shall be laid in channels in the floor and covered to permit access to the piping with a minimum of damage to the building. Where piping in floor channels could be exposed to excessive moisture or corrosive substances, the piping shall be protected in an approved manner. [NFPA 54:7.3.5.1]

**Exception: 1310.4.5 Other Occupancies.** In other than industrial occupancies and where approved by the Authority Having Jurisdiction, gas piping embedded in concrete floor slabs constructed with Portland cement shall be surrounded with a minimum of 1\(\frac{1}{2}\) inches (38 mm) of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. All piping, fittings, and risers shall be protected against corrosion in accordance with Section 1308.5.6. Piping shall not be embedded in concrete slabs containing quick-set quickset additives or cinder aggregate. [NFPA 54:7.3.5.2]

**1310.6 Maximum Operating Pressure in Buildings.** The maximum operating pressure for any piping systems located inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:
(1) The piping joints are welded or brazed.
(2) The piping is joined by fittings listed to ANSI LC 4/CSA 6.32 and installed according to the manufacturer’s installation instructions.
(3) The piping joints are flanged and all pipe-to-flange connections are made by welding or brazing.
(4) The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
(5) The piping is located inside buildings or separate areas of buildings used exclusively for one of the following:
   (a) Industrial processing or heating
   (b) Research
   (c) Warehousing
   (d) Boiler or mechanical rooms
(6) The piping is a temporary installation for buildings under construction.
(7) The piping serves appliances or equipment used for agricultural purposes.
(8) The piping system is an LP-Gas piping system with an operating pressure greater than 20 psi (138 kPa) and complies with NFPA 58. [NFPA 54:5.5.4 5.4.4]

1310.6.1 LP-Gas Systems Operating Below -5°F (-21°C). LP-Gas systems designed to operate below -5°F (-21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-Gas or to prevent LP-Gas vapor from condensing back into a liquid. [NFPA 54:5.5.5 5.4.5] 1310.11 Manual Gas Shutoff Valves. An accessible gas shutoff valve shall be provided upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator. [NFPA 54:7.8.1 7.8.2]

1310.11.1 Accessibility of Gas Valves Controlling Multiple Systems. Main gas System shutoff valves controlling several gas piping systems shall be readily accessible for operation and installed so as to be protected from physical damage. They System shutoff valves shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified. [NFPA 54:7.8.2.1 7.8.1.1, 7.8.1.2]

1310.11.1.1 Shutoff Valves for Multiple House Lines. In multiple-tenant buildings supplied through a master meter, through one service regulator where a meter is not provided, or where meters or service regulators are not readily accessible from the appliance or equipment location, an individual shutoff valve for each apartment or tenant line shall be provided at a convenient point of general accessibility. In a common system serving a number of individual buildings, shutoff valves shall be installed at each building. [NFPA 54:7.8.2.2 7.8.3.1]

1310.11.2 Emergency Shutoff Valves. An exterior shutoff valve to permit turning off the gas supply to each building in an emergency shall be provided. The emergency shutoff valves shall be plainly marked as such and their locations posted as required by the Authority Having Jurisdiction. [NFPA 54:7.8.2.3 7.8.3.2]

1310.11.3 Shutoff Valve for Laboratories. Each laboratory space containing two or more gas outlets installed on tables, benches, or in hoods in educational, research, commercial, and industrial occupancies shall have a single shutoff valve through which all such gas outlets are supplied. The shutoff valve shall be accessible, located within the laboratory or adjacent to the laboratory’s egress door, and identified. [NFPA 54:7.8.2.4 7.8.3.3]

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

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<tr>
<td></td>
<td>ANSI/ASME B16.44</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32</td>
</tr>
<tr>
<td>Valve up to 1/2 psi</td>
<td>ANSI/ASME B16.44</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32</td>
</tr>
<tr>
<td>Valve up to 2 psi</td>
<td>ANSI/ASME B16.44 labeled 2G</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 labeled 2G or labeled 5G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td>Valve up to 5 psi</td>
<td>ANSI/ASME B16.44 labeled 5G</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 marked 5G</td>
</tr>
</tbody>
</table>
1310.14.5 Installation of Gas-Mixing Machines. Installation of gas-mixing machines shall comply with the following:
(1) **1310.14.5.1 Location.** The gas-mixing machine shall be located in a well-ventilated area or in a detached building or cutoff room provided with room construction and explosion vents in accordance with sound engineering principles. Such rooms or below-grade installations shall have adequate positive ventilation. [NFPA 54:7.11.5.1]
(2) **1310.14.5.2 Electrical Requirements.** Where gas-mixing machines are installed in well-ventilated areas, the type of electrical equipment shall be in accordance with NFPA 70 for general service conditions unless other hazards in the area prevail. Where gas-mixing machines are installed in small detached buildings or cutoff rooms, the electrical equipment and wiring shall be installed in accordance with NFPA 70 for hazardous locations (Articles 500 and 501, Class I, Division 2). [NFPA 54:7.11.5.2]
(3) **1310.14.5.3 Air Intakes.** Air intakes for gas-mixing machines using compressors or blowers shall be taken from outdoors whenever practical. [NFPA 54:7.11.5.3]
(4) **1310.14.5.4 Controls.** Controls for gas-mixing machines shall include interlocks and a safety shutoff valve of the manual reset type in the gas supply connection to each machine arranged to automatically shut off the gas supply in the event of high or low gas pressure. Except for open burner installations only, the controls shall be interlocked so that the blower or compressor stops operating following a gas supply failure. Where a system employs pressurized air, means shall be provided to shut off the gas supply in the event of air failure. [NFPA 54:7.11.5.4]
(5) **1310.14.5.5 Installation in Parallel.** Centrifugal gas-mixing machines in parallel shall be reviewed by the user and equipment manufacturer before installation, and means or plans for minimizing the effects of downstream pulsation and equipment overload shall be prepared and utilized as needed. [NFPA 54:7.11.5.1 – 7.11.5.5]

1311.0 Electrical Bonding and Grounding.
1311.4 Prohibited Use. Gas piping shall not be used as a grounding conductor or electrode. [NFPA 54:7.42.4 7.12.4.1]

1312.0 Appliance and Equipment Connections to Building Piping.
1312.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with Section 1312.6 through Section 1312.8 by one of the following:
(1) Rigid metallic pipe and fittings.
(2) Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
(3) A listed connector for gas appliances listed in compliance with CSA Z21.24. The connector shall be used in accordance with the manufacturer’s installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
(4) A listed connector for outdoor gas appliances and manufactured homes listed in compliance with CSA Z21.75. Only one connector shall be used per appliance.
(5) CSST where installed in accordance with the manufacturer’s installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.
(6) Listed nonmetallic gas hose connectors in accordance with Section 1312.3.
(7) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with Section 1312.4. [NFPA 54:9.6.1]

1312.1.1 Commercial Cooking Appliances Food Service Appliance Connectors. Connectors used with commercial cooking food service appliances that are moved for cleaning and sanitation purposes shall be installed in accordance with the connector manufacturer’s installation instructions. Such connectors shall be listed in accordance with CSA Z21.69. [NFPA 54:9.6.1.3]

1312.7 Quick-Disconnect Devices. Quick-disconnect devices used to connect appliances to the building piping shall be listed in accordance with CSA Z21.41. Where installed indoors, an approved manual shutoff valve with a nondisplaceable valve member shall be installed upstream of the quick-disconnect device. [NFPA 54:9.6.6 – 9.6.6.2]

<table>
<thead>
<tr>
<th><strong>TABLE 1308.4.1</strong></th>
<th><strong>APPROXIMATE GAS INPUT FOR TYPICAL APPLIANCES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TABLE 1308.5.6.2</strong></td>
<td><strong>SPECIFICATIONS FOR THREADING METALLIC PIPE</strong></td>
</tr>
</tbody>
</table>

---

Valve up to 125 psi
ANSI/ASME B16.33 marked 125 G
ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G

SI Units: 1 pound-force per square inch = 6.8947 kPa
TABLE 1310.3.5.1
SUPPORT OF PIPING
[NFPA 54: TABLE 7.2.6.2]

<table>
<thead>
<tr>
<th>STEEL PIPE, NOMINAL SIZE OF PIPE (inches)</th>
<th>SPACING OF SUPPORTS (feet)</th>
<th>NOMINAL SIZE OF TUBING SMOOTH-WALL SMOOTH WALL (inches O.D.)</th>
<th>SPACING OF SUPPORTS (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>6</td>
<td>1/2</td>
<td>4</td>
</tr>
<tr>
<td>3/4 or 1</td>
<td>8</td>
<td>5/8 or 3/4</td>
<td>6</td>
</tr>
<tr>
<td>1 1/4 or larger (horizontal)</td>
<td>10</td>
<td>7/8 or 1 (horizontal)</td>
<td>8</td>
</tr>
<tr>
<td>1 1/4 or larger (vertical)</td>
<td>Every floor level</td>
<td>1 or larger (vertical)</td>
<td>Every floor level</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

TABLE 1313.6.1
SIZE AND LENGTH OF PIPING
[NFPA 54: TABLE 8.3.1]*
(portion of table not shown remains unchanged)

* CSST EHD size of 62 is equivalent to nominal 2 inches (50 mm) nominal size pipe or tubing size.

TABLE 1315.2(27)
SCHEDULE 40 METALLIC PIPE [NFPA 54: TABLE 6.3.1(d)]

<table>
<thead>
<tr>
<th>GAS: UNDILUTED PROPANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INLET PRESSURE: 11.0 In. w.c.</td>
</tr>
<tr>
<td>PRESSURE DROP: 0.5 In. w.c.</td>
</tr>
<tr>
<td>SPECIFIC GRAVITY: 1.50</td>
</tr>
</tbody>
</table>

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (LOW-PRESSURE) REGULATOR AND APPLIANCE.

<table>
<thead>
<tr>
<th>PIPE SIZE (inch)</th>
<th>NOMINAL INSIDE 1/2</th>
<th>3/4</th>
<th>1</th>
<th>1 1/4</th>
<th>1 1/2</th>
<th>2</th>
<th>2 1/2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOMINAL ID:</td>
<td>0.622</td>
<td>0.824</td>
<td>1.049</td>
<td>10.380</td>
<td>1.610</td>
<td>2.067</td>
<td>2.469</td>
<td>3.068</td>
<td>4.026</td>
</tr>
<tr>
<td>LENGTH (feet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPACITY IN THOUSANDS OF BTU PER HOUR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>291</td>
<td>608</td>
<td>1150</td>
<td>2350</td>
<td>3520</td>
<td>6790</td>
<td>10 800</td>
<td>19 100</td>
<td>39 000</td>
</tr>
<tr>
<td>20</td>
<td>200</td>
<td>418</td>
<td>787</td>
<td>1620</td>
<td>2420</td>
<td>4660</td>
<td>13 100</td>
<td>26 800</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>160</td>
<td>336</td>
<td>632</td>
<td>1300</td>
<td>1940</td>
<td>3750</td>
<td>10 600</td>
<td>21 500</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>137</td>
<td>287</td>
<td>541</td>
<td>1110</td>
<td>1660</td>
<td>3210</td>
<td>9030</td>
<td>18 400</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>122</td>
<td>255</td>
<td>480</td>
<td>985</td>
<td>1480</td>
<td>2840</td>
<td>8000</td>
<td>16 300</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>110</td>
<td>231</td>
<td>434</td>
<td>892</td>
<td>1340</td>
<td>2570</td>
<td>4100</td>
<td>7250</td>
<td>14 800</td>
</tr>
<tr>
<td>8670</td>
<td>101</td>
<td>212</td>
<td>400</td>
<td>821</td>
<td>1230</td>
<td>2370</td>
<td>3770</td>
<td>6670</td>
<td>13 600</td>
</tr>
<tr>
<td>4290</td>
<td>94</td>
<td>197</td>
<td>372</td>
<td>763</td>
<td>1140</td>
<td>2200</td>
<td>3510</td>
<td>6210</td>
<td>12 700</td>
</tr>
<tr>
<td>4500</td>
<td>89</td>
<td>185</td>
<td>349</td>
<td>716</td>
<td>1070</td>
<td>2070</td>
<td>3290</td>
<td>5820</td>
<td>11 900</td>
</tr>
<tr>
<td>450100</td>
<td>84</td>
<td>175</td>
<td>330</td>
<td>677</td>
<td>1010</td>
<td>1950</td>
<td>3110</td>
<td>5500</td>
<td>11 200</td>
</tr>
<tr>
<td>476125</td>
<td>74</td>
<td>155</td>
<td>292</td>
<td>600</td>
<td>899</td>
<td>1730</td>
<td>2760</td>
<td>4880</td>
<td>9950</td>
</tr>
<tr>
<td>299150</td>
<td>67</td>
<td>140</td>
<td>265</td>
<td>543</td>
<td>814</td>
<td>1570</td>
<td>2500</td>
<td>4420</td>
<td>9010</td>
</tr>
<tr>
<td>250175</td>
<td>62</td>
<td>129</td>
<td>243</td>
<td>500</td>
<td>749</td>
<td>1440</td>
<td>2300</td>
<td>4060</td>
<td>8290</td>
</tr>
<tr>
<td>399200</td>
<td>58</td>
<td>120</td>
<td>227</td>
<td>465</td>
<td>697</td>
<td>1340</td>
<td>2140</td>
<td>3780</td>
<td>7710</td>
</tr>
<tr>
<td>359250</td>
<td>51</td>
<td>107</td>
<td>201</td>
<td>412</td>
<td>618</td>
<td>1190</td>
<td>1900</td>
<td>3350</td>
<td>6840</td>
</tr>
</tbody>
</table>
For SI units: 1 inch = 25 mm, 1 foot = 304.8, 1000 British thermal units per hour = 0.293 kW, 1 inch water column = 0.249 kPa

* Table entries are rounded to 3 significant digits.

**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME B16.33-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS 1/2 through NPS 2)</td>
<td>Valves</td>
<td>Table 1308.13</td>
</tr>
<tr>
<td>ASME B16.44-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi</td>
<td>Valves</td>
<td>Table 1308.13</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** The ASME and CSA standards meet the requirements for mandatory reference standards in accordance with Section 3.3.7.1 of IAPMO's Regulations Governing Committee Projects.

**TABLE 1701.2**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME B16.33-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS 1/2 through NPS 2)</td>
<td>Valves</td>
</tr>
<tr>
<td>CSA Z21.15b-2013 (R2014)</td>
<td>Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves (same as CSA 9.1b)</td>
<td>Fuel Gas</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**

In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 13 is being revised to the latest edition of NFPA 54-2021.
Proposals

Item #: 275
UMC 2024  Section: 1301.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

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 shall be installed in accordance with NFPA 31 and the manufacturer’s installation instructions. Above-ground piping systems shall be listed and labeled in accordance with UL 1369. Metallic underground piping systems shall be listed and labeled in accordance with UL 971A. Non-metallic underground piping systems shall be listed and labeled in accordance with UL 971.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 971-1995</td>
<td>Nonmetallic Underground Piping for Flammable Liquids (with revisions through March 2, 2006)</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
<tr>
<td>UL 971A-2006</td>
<td>Outline of Investigation for Metallic Underground Fuel Pipe</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
<tr>
<td>UL 1369-2018</td>
<td>Aboveground Piping for Flammable and Combustible Liquids (with revisions through August 25, 2020)</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1369 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

Note: UL 971 and UL 971A were not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Applicable standards for above ground and below ground piping are being added to Section 1301.1 to clarify the requirements for such applications to aid the code official in verifying safe installation for such systems.
Proposals

Item #: 276
UMC 2024  Section: 1302.3

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

1302.0 Coverage of Piping System.

1302.3 Applications. This eede chapter shall not apply to the following items:
(1) through (20) remain unchanged {NFPA 54:1.1.1.2}

SUBSTANTIATION:
The code change clarifies that Chapter 13 shall not apply to the items listed in Section 1302.3 rather than "this code." Simple fix.
Proposals

Item #: 277
UMC 2024  Section: 1308.5

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

1308.0 Gas Piping System Design, Materials, and Components.

1308.5 Acceptable Piping Materials and Joining Methods. Materials used for piping systems shall either comply with the requirements of this chapter Section 1308.5.1 through Section 1308.5.4.2.3 or be acceptable to the Authority Having Jurisdiction. \[\text{NFPA 54:5.6.4.1-5.5.1.1}\]

SUBSTANTIATION:
The phrase “this chapter” is being changed to “Section 1308.5 through Section 1308.5.4.2.3” to clarify that the piping material requirements from those subsections of Section 1308.5 shall comply to aid the code official in approving piping materials. The last part of the sentence is being removed as the AHJ is already authorized by Chapters 1 and 3 to approve/accept materials.
Proposals

Item #: 278

UMC 2024  Section: 1308.5, Table 1308.5, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

1308.0 Gas Piping System Design, Materials, and Components.

1308.5 Acceptable Piping Materials and Joining Methods. Materials used for piping systems shall either comply with the requirements of this chapter or be acceptable to the Authority Having Jurisdiction. [NFPA 54:5.6.1.1 5.5.1.1]
Materials for fuel gas piping, tubing, and fittings shall comply with the applicable standards in Table 1308.5 or other approved standards.

TABLE 1308.5
MATERIALS FOR FUEL GAS PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum alloy</td>
<td>ASTM B210, ASTM B241</td>
<td></td>
</tr>
<tr>
<td>Fiberglass</td>
<td>ASTM D2996</td>
<td></td>
</tr>
<tr>
<td>Plastic</td>
<td>ASTM D2513, ASTM F2945</td>
<td>ASTM D2513, ASTM F2945</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D2996-2017</td>
<td>Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe</td>
<td>Piping</td>
<td>Table 1308.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASME and ASTM standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The new table provides an easy to reference list of acceptable fuel gas piping and fitting standards for each application to assist the AHJ in approving gas piping.
Proposals

Item #: 279

UMC 2024  Section: 1308.5.3.5, Table 1701.1

SUBMITTER: Robert Torbin
OmegaFlex

RECOMMENDATION:
Revise text

1308.5.2 Metallic Pipe.

1308.5.3.5 Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing shall be listed in accordance with CSA LC-1. [NFPA 54:5.6.3.6] Corrugated stainless steel tubing shall also comply with IAPMO IGC 201 when a listed encasement system is required.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 201-2018</td>
<td>Polyethylene Sleeved-Corrugated Stainless-Steel Tubing for use in Fuel Gas Piping Systems</td>
<td>Gas Tubing</td>
<td>1308.5.3.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO IGC 201 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed standard covers polyethylene sleeved-corrugated stainless steel tubing (CSST) which is used in fuel gas systems. PE sleeved CSST have been tested and installed for over 10 years and continues to be installed today. Reference to the proper standard for this product will ensure public health and safety by clearly identifying products that are approved for this application assisting to the installers, inspectors, and other end users of the code.
Proposals

Item #: 280
UMC 2024  Section: 1310.1.3.2

SUBMITTER: Shane Peters
City of Santa Monica

RECOMMENDATION:
Revise text

1310.0 Gas Piping Installation.
1310.1 Piping Underground. (remaining text unchanged)

1310.1.3 Protection Against Corrosion. (remaining text unchanged)
1310.1.3.2 Underground Piping. Underground piping shall comply with one or more of the following unless approved technical justification is provided to demonstrate that protection is unnecessary:

1. The piping shall be made of corrosion-resistant material that is suitable for the environment in which it will be installed.
2. Pipe shall have a factory-applied, electrically insulating coating. Fittings and joints between sections of coated pipe shall be coated in accordance with the coating manufacturer’s instructions.
3. The piping shall have a cathodic protection system installed, and the system shall be maintained in accordance with Section 1310.1.3.3 or Section 1310.1.3.6. [NFPA 54:7.1.3.2]

Underground metallic gas piping shall be protected from corrosion by approved coatings or wrapping materials. Gas pipe protective coatings shall be in accordance with the following:

1. Approved types, factory-applied, and conform to approved standards.
2. Field wrapping shall provide equivalent protection and is restricted to those sections and fittings that are necessarily stripped for threading or welding.
3. Risers shall be coated or wrapped to a point at least 6 inches (152 mm) above ground.

SUBSTANTIATION:
The above recommended language gives specific direction on how to protect underground gas piping. The current section is not clear as to what requirements are required.
Proposals

Item #: 281
UMC 2024 Section: 1310.3.5, Table 1701.1

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

1310.0 Gas Piping Installation.

1310.3 Installation of Aboveground Piping.

1310.3.5 Hangers, Supports, and Anchors. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and equipment and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of MSS SP-58. [NFPA 54:7.2.6.1] Pipe support hangers and hooks shall comply with IAPMO PS 95.

<table>
<thead>
<tr>
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<td>Pipe Support Hangers and Hooks</td>
<td>Hangers and Supports</td>
<td>1310.3.5</td>
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(Note: IAPMO PS 95 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Pipe hangers and supports can meet either the requirements of MSS SP-58 or IAPMO PS 95. Therefore, a reference to the IAPMO standard is being added for completeness.)
Proposals

Item #: 282

UMC 2024  Section: Chapter 16

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

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 in accordance with ANSI/CSA FC 1 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 54:10.29, 10.29] Stationary fuel cell power plants shall be tested in accordance with CSA FC-1.

1602.1 General. The installation of gas engines shall conform to NFPA 37. [NFPA 54:10.22]
1602.2 Connection to the Gas Supply Piping. Stationary gas engines shall not be rigidly connected to the gas supply piping. [NFPA 54:10.22.1]

Note: ANSI/CSA FC 1 standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 16 is being revised to the latest edition of NFPA 54-2021.
Chapter 17
(renumber remaining chapters)
Indoor Cannabis and Horticultural Facilities

1701.0 General.
1701.1 Indoor Spaces. Indoor spaces using environmental controls for cannabis and horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall comply with this section. Equipment and appliances shall be installed in accordance with the manufacturer’s installation instructions and this code. Piping, tubing, materials, and structures shall be protected in accordance with Section 316.0.

1702.0 Classification of Facilities.
1702.1 General. Facilities used for indoor cannabis and horticultural cultivation and processing shall be as classified in accordance with the building code, the electrical code, and the Authority Having Jurisdiction.
1702.2 Approved Locations. Facilities used for indoor cannabis and horticultural cultivation and processing shall be located in accordance with the building code and the Authority Having Jurisdiction.

1703.0 Documentation.
1703.1 General. Documentation for permitting shall be provided in accordance with the requirements of Section 104.0 and the Authority Having Jurisdiction. The documentation shall show compliance with this section and other requirements in accordance with the Authority Having Jurisdiction.

1704.0 Fire Protection.
1704.1 General. Fire protection shall be provided for indoor cannabis and horticultural facilities in accordance with the building code, fire code, Section 1704.1.1 through Section 1704.1.3, and the Authority Having Jurisdiction.
1704.1.1 Smoke Detectors and Fire Alarms. Smoke detectors, heat detectors, and fire alarms shall be provided in accordance with NFPA 72 and shall provide visible and audible notification. Smoke detectors shall comply with UL 268. In spaces where smoke detectors cannot be utilized due to ambient conditions, approved automatic heat detectors shall be permitted in lieu of smoke detectors in accordance Section 1704.2.
1704.1.2 Heat Detectors. Where ambient conditions prohibit installation of smoke detectors, an automatic heat detector in accordance with UL 521 shall be permitted where approved by the Authority Having Jurisdiction.
1704.1.3 Fire Suppression. Where fire suppression is required, an automatic fire suppression system shall be provided within hoods, enclosures, and ductwork in accordance with the following:
(1) A carbon dioxide extinguishing system in accordance with NFPA 12.
(2) An automatic water sprinkler system in accordance with NFPA 13.
(3) A dry chemical extinguishing system in accordance with NFPA 17.

1705.0 Carbon Dioxide Detection System.
1705.1 General. A gas detection system shall be provided in indoor spaces using a carbon dioxide enrichment process.
in indoor spaces where carbon dioxide containers and/or generating systems are located, and in other adjoining indoor
spaces where fugitive carbon dioxide is expected to accumulate. The gas detection system shall activate audible alarms
distinguishable from the fire alarm system and visual alarms with visual notification and shall be calibrated for the types
of fuels or gases used.
1705.1.1 Listings. The gas detection control units shall comply with UL 864 or UL 2017. Gas detectors shall comply
with UL 2075.
1705.1.2 Carbon Dioxide Sensor Location. Carbon dioxide sensors shall be located not more than 12 inches (305
mm) above the finished floor.
1705.1.3 Activation. Activation of the gas detection system shall be in accordance with Section 1705.1.3.1 through
Section 1705.1.3.2.
1705.1.3.1 Low-Level Activation. Upon detection of a carbon dioxide concentration of 5,000 ppm (9000 mg/m$^3$), the
following shall be automatically performed:
(1) Stop the flow of carbon dioxide to the supply piping system.
(2) Activate the mechanical purge ventilation system.
(3) Activate an audible and visual supervisory alarm signal at an approved location within the facility.
1705.1.3.2 High-Level Activation. Upon detection of a carbon dioxide concentration of 30,000 ppm (54 000 mg/m$^3$),
the following shall be automatically performed:
(1) Stop the flow of carbon dioxide to the supply piping system.
(2) Activate the mechanical purge ventilation system.
(3) Activate audible and visual alarms inside and outside of the indoor space using a carbon dioxide enrichment
process, and inside and outside the space where carbon dioxide containers, generating systems, or both are located.
Visual notification of the carbon dioxide alarms shall be colored as required by the Authority Having Jurisdiction.
1705.2 Carbon Dioxide Enrichment System. Indoor spaces using a carbon dioxide enrichment process shall have
carbon dioxide detectors, audible and visual alarms, and mechanical purge ventilation with odor control which shall
independently exhaust directly to the exterior. The design, installation, and maintenance of carbon dioxide enrichment
systems with more than 100 pounds (45.4 kg) of carbon dioxide, and carbon dioxide enrichment systems with any
quantity of carbon dioxide having a remote fill connection shall comply with Sections 1705.2.1 through 1705.2.3.
1705.2.1 Equipment. Pressure relief, vent piping, fill indicators, fill connections, vent terminations, piping systems and
the storage, use and handling of the carbon dioxide shall be in accordance with this section and NFPA 55.
1705.2.2 Carbon Dioxide Control. Indoor spaces using a carbon dioxide enrichment process shall be maintained with
a negative pressure in relation to adjoining indoor spaces or with a positive pressure and intervening entrance/exit
pressurization vestibules with the adjoining indoor spaces.
1705.2.3 Carbon Dioxide Supply Piping. Carbon dioxide supply piping shall be in accordance with ASME B31.3.

1706.0 Flammable Solvents.
1706.1 General. Processes using flammable solvents shall be provided with a flammable gas detection system in
accordance with the fire code. The flammable gas detection system shall be installed in accordance with the
manufacturer’s installation instructions and shall not be interlocked with other equipment. The flammable gas detection
system shall be calibrated to detect gas levels of not more than 10 percent of the Lower Flammable Limit (LFL) and to
activate audible and visual alarms of not more than 25 percent of the LFL.
1706.2 Control Area. Pumps, motors, chemical fume hoods, equipment, and wiring in control areas and containment
booths used for flammable solvent processing shall be as Class 1/Division 1 location for potentially explosive gas and
vapor Groups A, B, C, and D in accordance with NFPA 70. Containment booths shall be listed and labeled in
accordance with UL 1389.
1706.3 Extraction Equipment. Extraction equipment using flammable solvents and located in an indoor space shall be
listed for the intended use. Plant extraction booths shall comply with UL 1389. Extraction equipment using LPG, Butane
or other volatile solvents shall be a closed-loop control system and shall comply with ASME BPVC Section VIII.1, ASME
B31.3, and NFPA 58, as applicable.

1707.0 Ventilation and Exhaust System.
1707.1 General. The indoor air quality in indoor spaces using environmental controls for cannabis and horticultural
cultivation, and processing shall comply with Chapter 4 and Section 1707.1.1. The ventilation and exhaust system shall
comply with Section 1707.1.2 through Section 1707.1.6. Indoor spaces used for cannabis and horticultural cultivation
shall have an independent ventilation system.
1707.1.1 Breathing Zone Outdoor Airflow Rate. 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 1707.1.1.

\[ V_{bz} = R_pP_z + R_aA_z \]  
(Equation 1707.1.1)

Where:
Sample Solution: Determine the outdoor airflow required in the breathing zone (Vbz) of an indoor space used for cannabis cultivation with an occupiable floor area of 800 square feet and a maximum of 5 people expected to occupy the zone.

\[ V_{bz} = (60 \text{ CFM/person} \times 5 \text{ people}) + (1 \text{ CFM} \times 800 \text{ SF}) \]

\[ V_{bz} = 1,100 \text{ CFM}. \] The ventilation system shall be capable of providing not less than 1,100 CFM of outdoor air.

### 1707.1.2 Ventilation System Requirements
When activated by the gas detection system required by Section 1705.1, the mechanical purge ventilation system shall remain on until manually reset. The purge ventilation system ducting shall terminate outdoors in an approved location. The ventilation system shall be designed to operate at a negative pressure of 0.01 inches water column (0.02 kPa) in relation to the exhausted indoor space.

### 1707.1.3 Ventilation for Indoor Cultivation and Storage Spaces
Indoor spaces used for cannabis and horticultural cultivation and processing shall be provided with ventilation in accordance with Section 402.2. Where mechanical ventilation is provided, the systems shall be operational when the indoor space(s) are occupied. Air in indoor cultivation and storage spaces shall be classified as Class 2 Air in accordance with Section 403.9.2.

### 1707.1.4 Exhaust Ventilation Rate
The exhaust and ventilation system required in this section shall not create a lesser standard of installation than prescribed by the minimum safety standards adopted by the Authority Having Jurisdiction. Exhaust airflow shall be provided at not less than 0.2 CFM/ft\(^2\) \([0.001016 \text{ m}\(^3\)/s/m\(^2\)]\) of floor area. Exhaust air shall not be used as makeup air, recirculated air, or transfer air. Makeup air shall be provided for more than 150 CFM exhaust.

### 1707.1.5 Exhaust System Requirements
An exhaust system shall be installed in accordance with Section 505.0 and the following requirements:
1. Exhaust outlet location(s) in accordance with Section 502.2.2 for product conveying ducts as classified in Section 505.8.
2. Exhaust air shall terminate directly to the outdoors.
3. The exhaust inlet shall be not less than 12 inches (305 mm) above the finished floor.
4. Chemical fume hoods shall be required for flammable solvent processing, shall be listed, and shall be installed in accordance with the manufacturer’s installation instructions.
5. Exhaust ducts shall be independent of all other exhaust systems.

### 1707.1.6 Automatic Shutoff
Automatic shutoff in air moving systems shall be provided in accordance with Section 608.0.

### 1708.0 Particulate and Odor Control

#### 1708.1 General
Particulates and odors from indoor cannabis and horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall be filtered and controlled so that it is not detectable above nuisance levels not exceeding applicable exposure limits at the exterior of the facility or at adjoining properties or as required by the Authority Having Jurisdiction. Odor control shall be required in the exhaust system and shall include, but not be limited to, one of the following types:
1. Charcoal filters shall be installed on the discharge of all exhaust ducts and shall be installed in accordance with the manufacturer’s installation instructions.
2. Ozone generators shall be installed in all exhaust ducts to neutralize odor by oxidizing such odors with ozone.
3. Ionizers shall be installed in accordance with the manufacturer’s installation instructions.
4. Photo-catalytic oxidation shall be installed in accordance with the manufacturer’s installation instructions.
5. Photo-hydroxyl oxidation shall be installed in accordance with the manufacturer’s installation instructions.
6. Carbon filtration shall be installed in accordance with the manufacturer’s installation instructions.
7. UV-C lights shall be installed in accordance with the manufacturer’s installation instructions.
8. Where approved by the Authority Having Jurisdiction, a plume discharge termination method shall be permitted to be used for odor control. The exhaust fan of such a system shall discharge exhaust air vertically into the outdoors. The plume heights shall be not less than 20 feet above the nozzle. Escaping air at the nozzle shall be no less than 3,000 feet per minute.

#### 1708.2 Filters
Where filters are used, the minimum filtration rate shall be in accordance with Equation 1709.2. The design airflow velocity across the face area of the chemical absorption filter(s) shall not exceed 350 feet per minute (1.8 m/s).
Minimum Filtration Rate = (Room Volume)/3  (Equation 1709.2)

1709.0 Duct Construction and Installation.
1709.1 General. Ducts shall be in accordance with Section 506.0 and Chapter 6. Ducts less than 18 inches (457 mm) in diameter shall be constructed of rigid metal with a thickness of not less than 0.018 of an inch (0.457 mm) (26 gauge). Ducts greater than 18 inches (457 mm) in diameter shall be constructed of rigid metal with a thickness of not less than 0.024 of an inch (0.508 mm) (24 gauge). All ducts and duct connections shall be mechanically fastened and supported in accordance with Chapter 6 at intervals not exceeding 12 feet (3658 mm). Where approved by the Authority Having Jurisdiction, flexible air ducts shall be permitted in accordance with Section 603.4.

1710.0 Motors and Fans.
1710.1 General. Motors and fans used shall comply with the applicable requirements in Section 503.0.

1711.0 Storage of Chemicals.
1711.1 General. Storage of chemicals shall comply with the building code and fire code, and NFPA 58 for liquid petroleum gas and NFPA 400 for the storage, use and handling of hazardous materials. Hazardous, combustible, and flammable materials shall not be stored in cultivation rooms.

1712.0 Walls and Ceilings.
1712.1 General. Walls and ceilings of indoor spaces used for cannabis and horticultural cultivation shall be in accordance with the following requirements:
(1) Be of corrosion resistant materials.
(2) Include air and vapor barriers.
(3) Be insulated in accordance with the building code.

1713.0 Dehumidification.
1713.1 General. Dehumidification shall be required to maintain humidity levels in accordance with the requirements of the Authority Having Jurisdiction, cultivator, and equipment listing. Dehumidification shall be permitted to be accomplished by means of standalone dehumidifiers, desiccant wheels, or reheat coils.

1714.0 Fumigation.
1714.1 General. Any cannabis or horticultural growing facility that is fumigated shall comply with Section 1714.1.1 through Section 1714.1.3 and the Authority Having Jurisdiction.
1714.1.1 Sources of Ignition. Areas intended to be fumigated shall not contained any open flames or any other sources of ignition.
1714.1.2 Fumigation Activity Warning. Areas and entrances to areas intended for fumigation, repellant, pesticide, or insecticide fogging operation shall be clearly marked to indicate fumigation activity.
1714.1.3 Ventilation. Areas intended for fumigation shall be continuously mechanically ventilated in accordance with Section 1707.0.

1715.0 Luminaires.
1715.1 General. Horticultural lighting equipment and systems used for indoor cannabis and horticultural cultivation shall be listed and labeled in accordance with UL 8800. Luminaires installed in ductwork shall be installed in accordance with NFPA 90A and the manufacturer’s installation instructions.

1716.0 Signage.
1716.1 General. Caution or warning signs complying with NFPA 704 shall be provided at the entrance of the facility and/or indoor spaces identifying hazards such as flammables, asphyxiants, and toxics.

205.0 – C –
Cannabis Facility. A business, facility, or establishment where retail Cannabis is grown, cultivated, tested, stored, dried, extracted, weighed, packaged, sold, or processed, including dispensaries, cultivators, manufacturers, distributors, or testing laboratories.
Cultivation Room. A room of any size where plants are grown under controlled conditions. Also known as a grow room.

207.0 – E –
Extraction Equipment. Equipment used to extract cannabinoids such as tetrahydrocannabinol (THC), cannabidiol (CBD), and terpenes from cannabis plants.
Extraction Equipment, Non-Volatile. Extraction equipment utilizing any solvent that is not considered volatile (i.e., carbon dioxide).
Extraction Equipment, Volatile. Extraction equipment utilizing any solvent that is considered flammable and hazardous.
Gas Detection Control Units. A digital or analog controller that continuously monitors the presence of toxic, anoxic, and explosive gases in the ambient air to prevent the risks of explosion linked to such gases.

Indoor Horticulture. The cultivation and processing of floricultural and horticultural plants, including cannabis, in an indoor space by controlling various interior environmental variables including, but not limited to, temperature, air quality, humidity, artificial lighting, nutrients, and carbon dioxide.

TABLE 1701.1
REFERENCED STANDARDS

<table>
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<td>NFPA 72-2019</td>
<td>National Fire Alarm and Signaling Code</td>
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<td>Clean Agent Fire Extinguishing Systems</td>
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<td>UL 268-2016</td>
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<td>UL 864-2014</td>
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<td>Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations (with revisions through October 13, 2020)</td>
<td>Plant Oil Extraction</td>
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<td>UL 2017-2008</td>
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<td>Horticultural Lighting Equipment and Systems</td>
<td>Electrical</td>
<td>1715.1</td>
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</table>

Note: The ASME, NFPA, and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This code change adds requirements for controlling the indoor environment of cannabis and horticulture facilities, including ventilation and exhaust rates, filter requirements, odor control, humidity control, and duct requirements. These HVAC requirements have been used by jurisdictions for cannabis and horticulture facilities and are commonly used in the industry. Growing plants transpire water vapor, causing very high humidity if not controlled, and creates a conducive environment for mold and pathogenic organisms. The basic necessities of cannabis are light, air, water, nutrients, a growing medium, and heat to create the necessary energy to grow. When growing indoors, the requirements are the same, though it is necessary that the indoor environment remain safe for occupants. To maximize public health and safety, safe indoor air quality conditions must be maintained.
Proposals

Item #: 284

UMC 2024  Section: B 103.1

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

B 103.0 Safety Shutoff Devices.
B 103.1 General. Where a safety shutoff device is provided, it shall be checked for proper operation and adjustment in accordance with the appliance manufacturer’s instructions. Where the device does not function properly to turn off the gas supply in the event of pilot outage or other improper operation, it ignition malfunction, the device shall be properly serviced or replaced with a new device. [NFPA 54:11.3]

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Appendix B is being revised to the latest edition of NFPA 54-2021.
Proposals

Item #: 285

UMC 2024  Section: C 102.1, E 101.2, E 201.1, F 102.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

C 102.0 Definitions.
C 102.1 General. For the purpose of this appendix, the following definitions shall apply:

E 101.0 General.
E 101.2 Definition of Terms. For the purposes of this code, the definitions shall apply to this appendix. No attempt is made to define ordinary words, which are used in accordance with their established dictionary meanings, except where a word has been used loosely, and it is necessary to define its meaning as used in this appendix to avoid misunderstanding.
The definitions of terms are arranged alphabetically according to the first word of the term.

E 201.0 Definitions.
E 201.1 Definitions. For the purpose of this appendix, the following definitions shall apply:

F 102.0 Definitions.
F 102.1 Definitions. For the purpose of this appendix, the following definitions shall apply:

(below shown for reference only)

201.0 General.
201.1 Applicability. For the purpose of this code, the following terms have the meanings indicated in this chapter.
No attempt is made to define ordinary words, which are used in accordance with their established dictionary meanings, except where a word has been used loosely, and it is necessary to define its meaning as used in this code to avoid misunderstanding.

SUBSTANTIATION:
The above change intends to correlate the opening statement for definitions used throughout the code. Currently the appendices’ opening statement for definitions are different. The change updates all appropriate sections to the same statement to clarify that the definitions in the appendices are specific to the appendices. The main appendix statement already clarifies that Chapter 2 definitions apply to all sections of the code. Furthermore, Appendix E is being modified to match the other appendices as the statement is a repeat of what is in Chapter 2.
Proposals

Item #: 286
UMC 2024  Section: D 107.1

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 501A Extract Update

RECOMMENDATION:
Revise text

D 107.0 Required Gas Supply.
D 107.1 General. The minimum hourly volume of gas required at each manufactured home site outlet or any section of
the manufactured home community gas piping system shall be calculated as shown in Table D 107.1. [NFPA
501A:4.3.4.1]
In extreme climate areas, additional capacities other than those shown in Table D 107.1 shall be considered. [NFPA
501A:4.3.4.1, 4.3.4.2]

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Appendix D is being
D 112.3 Oil Supply Connections. Oil supply connections at manufactured home sites, where provided from a centralized oil distribution system, shall be located and arranged to permit attachment to a manufactured home utilizing the stand. [NFPA 501A:4.3.11.1] The installation of such facilities shall comply with the following requirements:

1. The main distribution pipeline shall be permitted to be connected to a tank or tanks having an aggregate capacity not exceeding 20,000 gallons (75,708 L) at a point below the liquid level.
2. Where this piping is so connected, a readily accessible internal or external shutoff valve shall be installed in the piping as close as practicable to the tank.
3. If external and aboveground, the shutoff valve and its tank connections shall be made of steel.
4. Connections between the tank(s) and the main pipeline shall be made with double swing joints or flexible connectors, or shall otherwise be arranged to permit the tank(s) to settle without damaging the system.
5. If located aboveground, the connections specified in Section D 112.3(4) shall be located within the diked area.
6. A readily accessible and identified manual shutoff valve shall be installed either inside or outside of the structure in each branch supply pipeline that enters a building, mobile home, travel trailer, or other structure. If outside, the valve shall be protected from weather and damage. If inside, the valve shall be located directly adjacent to the point at which the supply line enters the structure.
7. A device shall be provided in the supply line at or ahead of the point where it enters the interior of the structure that will automatically shut off the oil supply, if the supply line between this device and the appliance is broken. This device shall be located on the appliance side of the manual shutoff valve required in Section D 112.3(6) and shall be solidly supported and protected from damage.
8. Means shall be provided to limit the oil pressure at the appliance inlet to a maximum gauge pressure of 3 pound-force per square inch gauge (psig) (21 kPa). If a pressure-reducing valve is used, it shall be a type approved for the service.
9. A device shall be provided that will automatically shut off the oil supply to the appliance if the oil pressure at the appliance inlet exceeds a gauge pressure of 8 psig (55 kPa). The device shall not be required under either of the following conditions:
   a. Where the distribution system is supplied from a gravity tank and the maximum hydrostatic head of oil in the tank is such that the oil pressure at the appliance inlet will not exceed a gauge pressure of 8 psig (55 kPa).
   b. Where a means is provided to automatically shut off the oil supply if the pressure-regulating device provided in accordance with Section D 112.3(8) fails to regulate the pressure as required.
10. Only appliances equipped with primary safety controls specifically listed for the appliance shall be connected to a centralized oil distribution system. [NFPA 31:9.2.10–9.2.15]

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Appendix D is being revised to the latest edition of NFPA 31-2020.
Proposals

Item #: 288
UMC 2024 Section: Appendix E, Table 1701.2

SUBMITTER: IAPMO Staff - Update Extracts
ASHRAE 62.2 Extract Update

RECOMMENDATION:
Revise text

E 605.1.3 Dwelling-Unit Ventilation. A Mechanical exhaust system, supply system, or combination thereof shall be installed designed and provided with the capacity to operate for each deliver outdoor air ventilation to the whole dwelling unit to provide at a continuous dwelling-unit ventilation with outdoor air at a rate not less than the rate that specified in Section E 605.1.3.1 through Section E 605.1.3.5. [ASHRAE 62.2:4.1.1]

E 605.1.3.2 Effective Annual Average Infiltration Rate (Qinf) Using a Single-Point Envelope Leakage Test. Effective Annual Average Infiltration Rate (Qinf) shall be calculated using Equation E 605.1.3.2:

(Equation E-605.1.3.2)

\[ Q_{inf} (\text{CFM}) = \frac{(NL \times wsf \times Afloor)}{(7.3)*} \]

Where:
- \( NL \) = normalized leakage
- \( wsf \) = weather and shielding factor from ASHRAE 62.2.
- \( Afloor \) = floor area of residence, \( \text{ft}^2 (\text{m}^2) \)

* Replace 7.3 with 1.44 for metric units. [ASHRAE 62.2:4.1.2(e)]

Effective Annual Average Infiltration Rate (Qinf) shall be calculated using a single-point test at 50 Pa. The Effective Annual Average Infiltration Rate (Qinf) shall be calculated using Equation 605.1.3.2:

\[ Q_{inf} = 0.052 \times Q_{50} \times wsf \times (H/Hr)z \] (Equation 605.1.3.2)

Where:
- \( Q_{inf} \) = estimated infiltration rate, \( \text{cfm (L/s)} \)
- \( Q_{50} \) = leakage rate at 50 Pa depressurization or pressurization, \( \text{cfm (L/s)} \)
- \( wsf \) = weather and shielding factor from ASHRAE 62.2
- \( H \) = vertical distance between the lowest and highest above-grade points within the pressure boundary, \( \text{ft (m)} \)
- \( Hr \) = reference height, 8.2 ft (2.5 m)
- \( z = 0.4 \) for the purpose of calculating the Effective Annual Average Infiltration Rate. (ASHRAE 62.2:4.1.2.1)

E 605.1.3.3 Required Mechanical Ventilation Rate (Qfan). If a blower door test has been performed, then a credit for estimated infiltration may be taken for detached dwelling units using either the procedure in Section E 605.1.3.2 or E 605.1.3.4. Attached dwelling units other than horizontally attached shall not be permitted to take an infiltration credit. Horizontally attached dwelling units shall be permitted to use a blower door test result to take this credit, subject to the reduction factor Aext in Equation E 605.1.3.3.

If this credit is taken, then the Required Mechanical Ventilation Rate (Qfan) shall be calculated using Equation E 605.1.3.3:

(Equation E 605.1.3.3)
\[ Q_{\text{fan}} = Q_{\text{tot}} - \Phi (Q_{\text{inf}} \times A_{\text{ext}}) \]

Where:
- \( Q_{\text{fan}} \) = required mechanical ventilation rate, CFM (L/s)
- \( Q_{\text{tot}} \) = total required ventilation rate, CFM (L/s)
- \( Q_{\text{inf}} \) = may be not greater than \( \frac{2}{3} \times Q_{\text{tot}} \) infiltration, cfm (L/s)

(see ASHRAE 62.2 for exceptions for existing buildings)

\( A_{\text{ext}} = 1 \) for single family detached homes, detached dwelling units; otherwise, for horizontally attached dwelling units, or the ratio of exterior envelope surface area that is not attached to garages or other dwelling units to total envelope surface area for single family attached homes.

\( \Phi = 1 \) for balanced ventilation systems, and \( Q_{\text{inf}} / Q_{\text{tot}} \) otherwise

**Exception:** Where \( Q_{\text{fan}} \), calculated for unbalanced ventilation, is less than or equal to 15 cfm (7 L/s), a dwelling-unit ventilation system is not required. [ASHRAE 62.2:4.1.2(f) 4.1.2]

**E 605.1.3.4 Effective Annual Average Infiltration Rate (Q_{inf}) Using a Multipoint Envelope Leakage Test.** Effective Annual Average Infiltration Rate (\( Q_{inf} \)) shall be calculated using the normalized leakage calculated from measurements of envelope leakage using a multipoint test from either ASTM E779 in accordance with Section E 605.1.3.4(A) or CGSB 149.10 in accordance with Section E 605.1.3.4(B).

**E 605.1.3.4(A) ASTM Procedure.** To calculate the effective leak area (\( ELA \)) from ASTM E779, the leakage area for pressurization and depressurization (using a 4 Pa reference pressure) shall be averaged using Equation E 605.1.3.4(A):

\[ ELA = \frac{(L_{\text{press}} + L_{\text{depress}})}{2} \quad \text{[Equation E 605.1.3.4(A)]} \]

Where:
- \( ELA \) = effective leakage area, ft\(^2\) (m\(^2\))
- \( L_{\text{press}} \) = leakage area from pressurization, ft\(^2\) (m\(^2\))
- \( L_{\text{depress}} \) = leakage area from depressurization, ft\(^2\) (m\(^2\))

**E 605.1.3.4(B) CGSB Procedure.** To calculate the \( ELA \) from CGSB 149.10, the following modifications to the test procedure must be made:

a. All vents and intentional openings must be in the same configuration as specified in ASTM E779 (i.e., HVAC dampers and registers should be in the normal operating position; fireplace and other dampers should be closed unless they are required for test operation).

b. Height and floor area must be reported consistently with the definitions of this standard.

c. The leakage area as calculated from the CGSB procedure must be converted using Equation E 605.1.3.4(B):

\[ ELA = 0.61 \times (0.4)^n - 0.5 \times L_{\text{cgsb}} \quad \text{[Equation E 605.1.3.4(B)]} \]

Where:
- \( n \) = exponent measured from the CGSB 149.10
- \( L_{\text{cgsb}} \) = CGSB leakage area as modified above, ft\(^2\) (m\(^2\))

Normalized leakage shall be calculated using Equation E 605.1.3.4(B)(1):

\[ NL = \frac{1000 \times ELA}{A_{\text{floor}}} \times \left[ \frac{H}{H_r} \right]^z \]

[Equation E 605.1.3.4(B)(1)]

Where:
- \( NL \) = normalized leakage
- \( ELA \) = effective leakage area, ft\(^2\) (m\(^2\))
- \( A_{\text{floor}} \) = floor area of residence, ft\(^2\) (m\(^2\))
- \( H \) = vertical distance between the lowest and highest above-grade points within the pressure boundary, ft (m)
- \( H_r \) = reference height, 8.2 ft (2.5 m)
- \( z = 0.4 \) for the purpose of calculating the Effective Annual Infiltration Rate

Effective Annual Average Infiltration Rate (\( Q_{inf} \)) shall be calculated using Equation E 605.1.3.4(B):
Where:
\[ Q_{inf} (\text{cfm}) = \frac{NL \times wsf \times A_{floor}}{7.3} \]

Where:
- \( NL \) = normalized leakage
- \( wsf \) = weather and shielding factor from ASHRAE 62.2
- \( A_{floor} \) = floor area of residence, \( \text{ft}^2 \)

[ASHRAE 62.2:4.1.2.2]

**E 605.1.3.4 605.1.3.5 Different Occupant Density.** (remaining text unchanged)

**E 605.1.4 System Type.** The dwelling-unit mechanical ventilation system shall consist of one or more supply or exhaust fans and associated ducts and controls. Local exhaust fans shall be permitted to be part of a mechanical exhaust system. Where local exhaust fans are used to provide dwelling-unit ventilation, the local exhaust airflow shall be permitted to be credited toward the dwelling-unit ventilation airflow requirement. Outdoor air ducts connected to the return side of an air handler shall be permitted as supply ventilation where manufacturer’s requirements for return air temperature are met. See ASHRAE 62-2 Indoor Air Quality Guide for guidance on selection of methods. [ASHRAE 62.2:4.2]

**E 605.1.5 Airflow Measurement.** The airflow required by this section shall be the quantity of outdoor ventilation air supplied and/or indoor air exhausted by the mechanical ventilation system as installed and shall be measured according to the ventilation equipment manufacturer’s installation instructions, or by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan’s inlet terminals/grilles, outlet terminals/grilles, or in the connected ventilation ducts. Balanced mechanical ventilation system airflow shall be the average of the supply fan and exhaust fan flows. Ventilation airflow of systems with multiple operating modes shall be tested in all modes designed to meet this section. [ASHRAE 62.2:4.3]

**E 605.1.6 Control and Operation.**

- **A** An ON-OFF control readily accessible manual ON-OFF control to the dwelling-unit occupant, including but not limited to a fan switch or a dedicated branch-circuit overcurrent device, shall be provided. Controls shall include text or an icon indicating the system’s function.
- **Exception:** For multifamily dwelling units, the manual ON-OFF control shall not be required to be readily accessible to the dwelling-unit occupant. [ASHRAE 62.2:4.4, 4.4.1]

**E 605.1.6.1 Operation.** The system shall be operated as designed. [ASHRAE 62.2:4.4.2]

**E 605.1.7 Variable Mechanical Ventilation.** Dwelling-unit mechanical ventilation systems designed to provide variable ventilation shall comply with Section E 605.1.7.1 or Section E 605.1.7.2 or Section E 605.1.7.3. Section E 605.1.7.2 and Section E 605.1.7.3 also require compliance with ASHRAE 62.2 and require verification with supporting documentation from the manufacturer, designer, or specifier of the ventilation control system that the system meets the requirements of these sections. Where the dwelling-unit ventilation rate varies based on occupancy, occupancy shall be determined by occupancy sensors or by an occupant-programmable schedule. Operation shall comply with Section E 605.1.6.1. [ASHRAE 62.2:4.5]

**E 605.1.7.1 Short-Term Average Ventilation.** To comply with this section, a variable ventilation system shall be installed to provide an average dwelling-unit ventilation rate over any each consecutive period of three-hours period or less that is greater than or equal to \( Q_{fan} \) as calculated using Section E 605.1.3.3, and shall not provide a ventilation rate of zero over any three-hour interval. [ASHRAE 62.2:4.5.1]

**E 605.1.7.2 Scheduled Ventilation.** This section shall only be allowed to be used where when one or more fixed patterns of designed ventilation are known at the time compliance to Section E 605.0 is being determined. Such patterns include those both clock-driven and driven by typical meteorological data. Compliance with this section shall be demonstrated with either Section E 605.1.7.2.1 or Section E 605.1.7.2.2. [ASHRAE 62.2:4.5.2]

**E 605.1.7.2.1 Annual Average Schedule.** An annual schedule of ventilation complies with this section when the annual average relative exposure during occupied periods is not no more than one, and the peak relative exposure shall not exceed five for any time step as unity as calculated in accordance with ASHRAE 62.2. [ASHRAE 62.2:4.5.2.1]

**E 605.1.7.2.2 Block Scheduling.** The schedule of ventilation complies with this section when if it is broken into blocks of time and each block individually has an average relative exposure during occupied periods that is not no more than one unity as calculated in ASHRAE 62.2. All blocks shall end with a relative exposure less than or equal to one. [ASHRAE 62.2:4.5.2.2]

**E 605.1.7.3 Real-Time Control.** A real-time ventilation controller complies with this section when it is designed to adjust the ventilation system based on real-time input to the ventilation calculations so that the average relative exposure during occupied periods is not no more than unity one, and the peak relative exposure shall not exceed five for any time
step as calculated in ASHRAE 62.2. The averaging period shall be not less than one day but not no more than one year and shall be based on simple, recursive or running average, but not extrapolation.

For the purposes of calculating average relative exposure, a dwelling unit shall be permitted to be treated as unoccupied during a time step only if it is unoccupied for the entire time step. [ASHRAE 62.2:4.5.3]

TABLE E 605.1.3.1
VENTILATION AIR REQUIREMENTS, (cubic foot per minute)
[ASHRAE 62.2:TABLE 4-4a 4-1a]

(portion of table not shown remains unchanged)

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN/CGSB 149.10-2019</td>
<td>Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method</td>
<td>Ventilation</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Appendix E is being revised to the latest edition of ASHRAE 62.2-2019 and Addendum x as published on March 2, 2020 to ASHRAE 62.2-2019.
Proposals

Item #: 289

UMC 2024  Section: Appendix E, Table 1701.2

SUBMITTER: IAPMO Staff - Update Extracts
ASHRAE 90.1 Extract Update

RECOMMENDATION:
Revise text

E 201.0 Definitions.

**Fan, Embedded.** A fan that is part of a manufactured assembly where the assembly includes functions other than air movement. [ASHRAE 90.1:3.2]

**Fan Array.** Multiple fans in parallel between two plenum sections in an air distribution system. [ASHRAE 90.1:3.2]

**Fan Nameplate Electrical Input Power.** The nominal electrical input power rating stamped on a fan assembly nameplate. [ASHRAE 90.1:3.2]

**Fan Energy Index (FEI).** The ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated per AMCA 208. [ASHRAE 90.1:3.2]

**Fan System Electrical Input Power.** The sum of the fan electrical power of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces and/or return it to the source or exhaust it to the outdoors. [ASHRAE 90.1:3.2]

**On-Site Renewable Energy.** Energy generated from renewable energy resources produced harvested at the building site. [ASHRAE 90.1:3.2]

**Site-Recovered Energy.** Waste energy recovered at the building site that is used to offset consumption of purchased fuel or electrical energy supplies. [ASHRAE 90.1:3.2]

**Renewable Energy Resources.** Energy from solar, wind, biomass or hydro, or extracted from hot fluid or steam heated within the earth. [ASHRAE 90.1:3.2]

E 503.1.3 Alterations to Heating, Ventilating, Air-Conditioning, and Refrigeration in Existing Buildings. New HVACR equipment as a direct replacement of existing HVACR equipment shall be in accordance with the following sections as applicable for the equipment being replaced:

(1) Section E 503.3 “Simplified Approach Option for HVAC Systems”
(2) Section E 503.4 “Equipment Efficiencies, Verification, and Labeling Requirements”
(3) Section E 503.4.6 “Zone Thermostatic Controls”
(4) Section E 503.4.6.2 “Setpoint Overlap Restriction”
(5) Section E 503.4.6.3 “Off-Hour Controls”
(6) Section E 503.4.6.4 “Ventilation System Controls”
(7) Section E 503.4.6.8 “Freeze Protection and Snow or Ice Melting Systems”
(8) Section E 503.4.6.9 “Ventilation Controls for High-Occupancy Areas”
(9) Section E 503.4.6.11 “Heated or Cooled Vestibules”
(10) Section E 503.4.8 “Walk-In Coolers and Walk-In Freezers”
(11) Section E 503.5.1 “Air Economizers, Design Capacity”
(12) Section E 503.5.3 “Integrated Economizer Control”
(13) Section E 503.5.4 “Economizer Heating System Impact”
(14) Section E 503.5.6.1.2 “Fan Efficiency”
(15) Section E 503.5.6.2 “Supply Fan Airflow Control”
(16) Section E 503.5.6.5 “Fractional Horsepower Fan Motors”
(17) Section E 503.5.7 “Boiler Turndown”
(18) Section E 503.5.7.2 “Chiller and Boiler Isolation”
E 503.4.8 Walk-In Coolers and Walk-In Freezers. Site-assembled or site-constructed walk-in coolers and walk-in freezers shall conform to the following requirements:

1. Shall be equipped with automatic door closers that firmly close walk-in doors that have been closed to within 1 inch of full closure.

Exception: Doors wider than 3 feet 9 inches or taller than 7 feet.

2. Doorways shall have strip doors (curtains), spring-hinged doors, or other method of minimizing infiltration when doors are open.

3. Walk-in coolers shall contain wall, ceiling, and door insulation of at least R-25 and at least R-32 for walk-in freezers.

Exception: Glazed portions of doors or structural members.

4. Walk-in freezers shall contain floor insulation of at least R-28.

5. Evaporator fan motors that are less than 1 hp and less than 460 V shall use electronically commutated motors (brushless direct-current motors) or three-phase motors.

6. Lights shall use light sources with an efficacy of 40 lm/W or more, including ballast losses (if any). Light sources with lower may be used in conjunction with a timer or device that turns off the lights within 15 minutes of when the walk-in cooler or walk-in freezer is not occupied by people.

7. Transparent reach-in doors for walk-in freezers, and windows in walk-in freezer doors, shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass or vacuum insulating glazing.

8. Transparent reach-in doors for walk-in coolers, and windows in walk-in cooler doors, shall be double-pane glass with heat-reflective treated glass and gas filled, or triple-pane glass, either filled with inert gas or with heat-reflective treated glass or vacuum insulating glazing.

9. Antisweat heaters without antisweat heater controls shall have a total door rail, glass, and frame heater power draw of not more than 7.1 W/ft² of door opening for walk-in freezers and 3.0 W/ft² of door opening for walk-in coolers.

10. Antisweat heater controls shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.

11. Condenser fan motors that are less than 1 hp shall use electronically commutated motors, permanent split-capacitor-type motors, or three-phase motors.

12. All walk-in freezers shall incorporate temperature-based defrost termination control with a time limit default. The defrost cycle shall terminate first on an upper temperature limit breach and second upon a time limit breach.

Exception: Walk-in coolers and walk-in freezers combined in a single enclosure greater than 3000 ft² (278 m²).

13. Doors in walk-in coolers and walk-in freezers shall meet the requirements of ASHRAE 90.1. Walk-in cooler and walk-in freezer refrigeration systems, except for walk-in process cooling refrigeration systems as defined in 10 CFR 431.302, shall meet the requirements of ASHRAE 90.1. [ASHRAE 90.1:6.4.5]

E 503.2 Compliance Path(s). Mechanical equipment and systems providing heating, cooling, ventilating, or refrigeration shall comply with Section E 503.2.1 and Section E 503.2.2.

Section E 503.0 shall be achieved in accordance with the requirements of Section E 503.1.1 through Section E 503.1.3.4, Section E 503.6, Section E 503.7, and one of the following:

1. Section E 503.3 and Section E 503.3.1
2. Section E 503.4
3. Section E 503.4 and Section E 503.8 [ASHRAE 90.1:6.2.1 6.2]

E 503.2.1 Requirements For All Compliance Paths. Mechanical equipment and systems shall comply with the following:

1. Section E 503.0, “General”
2. Section E 503.4, “Equipment Efficiencies, Verification, and Labeling Requirements”
3. Section E 503.6, “Submittals”

E 503.2.2 Additional Requirements. Mechanical equipment and systems shall comply with one of the following:

2. Section E 503.4, “Prescriptive Compliance Path”

Exception: When compliance is shown using Section E 503.2.2(1), compliance with Section E 503.4 is not required.

E 503.2.1 Projects Using Energy Cost Budget Method. Projects using the energy cost budget method in accordance with ASHRAE 90.1 shall comply with Section E 503.4, the mandatory provisions of this section, as a portion of that compliance path. [ASHRAE 90.1:6.2.2]

E 503.3.1 Criteria. The HVAC system shall comply with all of the following criteria:
(1) The system serves a single HVAC zone.
(2) The equipment shall comply with the variable flow requirements of Section E 503.5.6.2.
(3) Cooling (where any) shall be provided by a unitary packaged or split-system air conditioner that is either air-cooled or evaporatively cooled, with efficiency that is in accordance with the requirements shown in Table E 503.7.1(2) for heat pumps, or Table E 503.7.1(4) for packaged terminal and room air conditioners and heat pumps, a fuel-fired furnace that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(2) for heat pumps or Table E 503.7.1(4) for packaged terminal and room air conditioners and heat pumps, a fuel-fired furnace that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(5) for furnaces, duct furnaces, and unit heaters, an electric resistance heater, or a baseboard system connected to a boiler that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(6) for boilers.
(4) The system shall have an air economizer in accordance with Section E 503.5 and Section E 503.4.6.13.
(5) Heating (where any) shall be provided by a unitary packaged or split-system heat pump that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(2) for heat pumps or Table E 503.7.1(4) for packaged terminal and room air conditioners and heat pumps, a fuel-fired furnace that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(5) for furnaces, duct furnaces, and unit heaters, an electric resistance heater, or a baseboard system connected to a boiler that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(6) for boilers.
(6) The system shall comply with the exhaust air energy recovery requirements in accordance with Section E 503.5.10.
(7) The system shall be controlled by a manual changeover or dual setpoint thermostat.
(8) Where a heat pump equipped with auxiliary internal electric resistance heaters is installed, controls shall be provided that prevent supplemental heater operation where the heating load is capable of being met by the heat pump alone during both steady-state operation and setback recovery. Supplemental heater operation shall be permitted during outdoor coil defrost cycles. The heat pump shall be controlled in accordance with one of the following:
(a) A digital or electronic thermostat designed for heat pump use that energizes auxiliary heat where the heat pump has insufficient capacity to maintain setpoint or to warm up the space at a sufficient rate.
(b) A multistage space thermostat and an outdoor air thermostat wired to energize auxiliary heat on the last stage of the space thermostat and where outdoor air temperature is less than 40°F (4°C).

Exceptions: Heat Pumps that comply with the following:
(1) Have a minimum efficiency regulated by NAECA.
(2) In accordance with the requirements shown in Table E 503.7.1(2).
(3) Include all usage of internal electric resistance heating.

(9) The system controls shall not permit reheat or other form of simultaneous heating and cooling for humidity control.
(10) Systems serving spaces other than hotel or motel guest rooms, and other than those requiring continuous operation, which have both a cooling or heating capacity more than 15 000 Btu/h (4.4 kW) and a supply fan motor power more than 0.75 horsepower (hp) (0.56 kW), shall be provided with a time clock that is in accordance with the following:
(a) Can start and stop the system under different schedules for seven different day-types per week.
(b) Is capable of retaining programming and time setting during a loss of power for a period of not less than 10 hours.
(c) Includes an accessible manual override that allows temporary operation of the system for up to 2 hours.
(d) Is capable of and configured with temperature setback down to 55°F (13°C) during off hours.
(e) Is capable of and configured with temperature setup to 90°F (32°C) during off hours.
(11) Systems serving hotel/motel guest rooms shall comply with Section E 503.4.6.3.5.
(12) Except for piping within manufacturer’s units, HVAC piping shall be insulated in accordance with Table E 503.7.3(1) and Table E 503.7.3(2). Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation.
(13) Ductwork and plenums shall be insulated in accordance with Table E 503.7.2 and shall be sealed in accordance with Section E 503.4.7.2.
(14) Construction documents shall require a ducted system to be air balanced in accordance with industry-accepted procedures.
(15) Outdoor air intake and exhaust systems shall comply with Section E 503.4.6.4 through Section E 503.4.6.5.
(16) Where separate heating and cooling equipment serves the same temperature zone, thermostats shall be interlocked to prevent simultaneous heating and cooling.
(17) Systems with a design supply air capacity more than 10 000 ft³/min (4.7195 m³/s) shall have optimum start controls.
(18) The system shall comply with the demand control ventilation requirements of Section E 503.4.6.9. occupied-stanby controls in Section E 503.5.6.7, and the ventilation design requirements of Section E 503.5.6.6.
(19) The system shall comply with the door switch requirements of Section E 503.5.14. [ASHRAE 90.1:6.3.2]

E 503.5.6.7 Occupied-Standby Controls. Zones serving only rooms that are required to have automatic partial OFF or automatic full OFF lighting controls in accordance with ASHRAE 90.1, where the Chapter 4 or ASHRAE 62.1 occupancy category permits ventilation air to be reduced to zero when the space is in occupied-stanby mode, and when using the Ventilation Rate Procedure, shall meet the following within 5 minutes of all rooms in that zone entering occupied-stanby mode.
(1) Active heating set point shall be setback at least 1°F.
(2) Active cooling set point shall be setup at least 1°F.
(3) All airflow supplied to the zone shall be shut off whenever the space temperature is between the active heating and cooling set points.
Exception: Multiple zone systems without automatic zone flow control dampers. [ASHRAE 90.1:6.5.3.8]

E 503.4 Mandatory Provisions — Equipment Efficiencies, Verification, and Labeling Requirements. Equipment shown in Table E 503.7.1(1) through Table E 503.7.1(16) shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy the all stated requirements unless otherwise exempted by footnotes in the table. Equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum efficiency requirements for operation at minimum capacity or other than standard rating conditions. Equipment used to provide service water-heating functions as part of a combination system shall satisfy the all stated requirements for the appropriate space heating or cooling category.

Tables are as follows:
(1) Table E 503.7.1(1), “Electrically Operated Unitary Air Conditioners and Condensing Units-Minimum Efficiency Requirements”
(2) Table E 503.7.1 (2), “Electrically Operated Air-Cooled Unitary and Applied Heat Pumps-Minimum Efficiency Requirements”
(3) Table E 503.7.1 (3), “Water-Chilling Packages-Minimum Efficiency Requirements” (See Section E 503.4.1 for water-cooled centrifugal water-chilling packages that are designed to operate at nonstandard conditions.)
(4) Table E 503.7.1 (4), “Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps-Minimum Efficiency Requirements”
(5) Table E 503.7.1 (5), “Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters-Minimum Efficiency Requirements”
(6) Table E 503.7.1 (6), “Gas- and Oil-Fired Boilers-Minimum Efficiency Requirements”
(7) Table E 503.7.1 (7), “Performance Requirements for Heat-Rejection Equipment—Minimum Efficiency Requirements”
(8) Table E 503.7.1 (8), “Heat Transfer Equipment”
(9) Table E 503.7.1 (9), “Electrically Operated Variable-Refrigerant-Flow Air Conditioners-Minimum Efficiency Requirements”
(10) Table E 503.7.1 (10), “Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps-Minimum Efficiency Requirements”
(11) Table E 503.7.1 (11), “Air Conditioners and Condensing Units Serving Computer Rooms”
(12) Table E 503.7.1 (12), “Commercial Refrigerators, Commercial Freezers, and Freezers-Refrigeration and Freezers-Minimum Efficiency Requirements”
(13) Table E 503.7.1 (13), “Commercial Refrigeration-Minimum Efficiency Requirements”
(14) Table E 503.7.1 (14), “Vapor-Compression-Based Indoor Pool Dehumidifiers-Minimum Efficiency Requirements”
(17) Table E 503.7.1 (17), “Electrically Operated Water-Source Heat Pumps—Minimum Efficiency Requirements”
(19) Table E 503.7.1 (19), “Walk-In Cooler and Freezer Display Door Efficiency Requirements”
(20) Table E 503.7.1 (20), “Walk-In Cooler and Freezer Refrigeration System Efficiency Requirements”

All furnaces with input ratings of 225 000 Btu/h (66 kW) or more, including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input rating. Air conditioners primarily serving computer rooms and covered by ASHRAE 127 shall comply with the requirements in Table E 503.7.1(11). All other air conditioners shall meet the requirements in Table E 503.7.1(1). [ASHRAE 90.1:6.4.1.1]

E 503.4.1 Water-Cooled Centrifugal Chilling Packages. Equipment not designed for operation in accordance with AHRI 550/590 test conditions of 44.00°F (6.67°C) leaving and 54.00°F (12.22°C) entering chilled-fluid temperatures, and with 85.00°F (29.44°C) entering and 94.30°F (34.61°C) leaving condenser-fluid temperatures, shall have maximum full-load kW/ton (FL) and part-load rating requirements adjusted in accordance with Equation E 503.4.1(1) through Equation E 503.4.1(3):

\[
FL_{adj} = FL/K_{adj} \quad [\text{Equation E 503.4.1(1)}]
\]
\[
PLV_{adj} = IPLV/IP/K_{adj} \quad [\text{Equation E 503.4.1(2)}]
\]
\[
K_{adj} = A \times B \quad [\text{Equation E 503.4.1(3)}]
\]

Where:
\( FL \) = full-load kW/ton value from Table E 503.7.1(3)
\( FL_{adj} \) = maximum full-load kW/ton rating, adjusted for nonstandard conditions
\( IPLV/IP \) = IPLV/IP value from Table E 503.7.1(3)
PLV_{adj} = \text{maximum NPLV rating, adjusted for nonstandard conditions}

A = 0.000000014592 \times (LIFT)^4 - 0.0000346496 \times (LIFT)^3 + 0.00314196 \times (LIFT)^2 - 0.147199 \times (LIFT) + 3.93073

B = 0.0015 \times \text{LvgEvap} + 0.934

LIFT = \text{LvgCond} - \text{LvgEvap}

LvgCond = \text{Full-load condenser leaving fluid temperature (°F)}

LvgEvap = \text{Full-load evaporator leaving temperature (°F)}

The FL_{adj} and PLV_{adj} values shall only be applicable for centrifugal chillers meeting all of the following full-load design ranges:

1. 36.00°F (2.22°C) = \text{LvgEvap} = 60.00°F (15.56°C)
2. \text{LvgCond} = 115.00°F (46.11°C)
3. 20.00°F (-6.67°C) = \text{LIFT} = 80.00°F (26.67°C)

Manufacturers shall calculate the FL_{adj} and PLV_{adj} before determining whether to label the chiller in accordance with Section E 503.4.4. Chillers that are in accordance with ASHRAE 90.1 shall be labeled on chillers in accordance with the scope of ASHRAE 90.1.

Centrifugal chillers designed to operate outside of these ranges shall not be covered under this appendix.

Example: Path A, 600 ton (600 000 kg) centrifugal chiller Table E 503.7.1(3) efficiencies.

\begin{align*}
FL &= 0.5600 \text{ kW/ton} \\
IPLV/IP &= 0.5000 \text{ kW/ton} \\
LvgCond &= 91.16°F \\
LvgEvap &= 42.00°F \\
LIFT &= 91.16°F - 42.00°F = 49.16°F \\
A &= 0.000000014592 \times (49.16)^4 - 0.0000346496 \times (49.16)^3 + 0.00314196 \times (49.16)^2 - 0.147199 \times (49.16) + 3.93073 = 1.02331 \\
B &= 0.0015 \times 42.00 + 0.934 = 0.99700 \\
K_{adj} &= A \times B = 1.02024 \\
FL_{adj} &= 0.5600/1.02024 = 0.5489 \text{ kW/ton} \ [\text{ASHRAE 90.1:6.4.1.2.1}] \\
PLV_{adj} &= 0.5000/1.02024 = 0.4901 \text{ kW/ton} \ [\text{ASHRAE 90.1:6.4.1.2.1}] \\
\end{align*}

For SI units: 1 metric ton = 1000 kg, 1000 British thermal units per hour = 0.293 kW, 1 gallon per minute = 0.06 L/s, °C = (°F-32)/1.8

E 503.4.2 Equipment not Listed. Equipment not listed in the tables referenced in Section E 503.4 and Section E 503.4.1 shall be permitted to be used. [ASHRAE 90.1:6.4.1.3 6.4.1.4]

E 503.4.3 Verification of Equipment Efficiencies.

Equipment efficiency information supplied by manufacturers shall be verified in accordance with one of the following:

1. Equipment covered under EPACT shall be in accordance with U.S. Department of Energy certification requirements.
2. Where a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be listed in the certification program.
3. Where a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, but the product is not listed in the existing certification program, the ratings shall be verified by an independent laboratory test report.
4. Where no certification program exists for a covered product, the equipment efficiency ratings shall be supported by data furnished by the manufacturer.
5. Where components such as indoor or outdoor coils from different manufacturers are used, the system designer shall specify component efficiencies whose combined efficiency is in accordance with the minimum equipment efficiency requirements in Section E 503.4 through Section E 503.4.1.

(6) Requirements for plate-type liquid-to-liquid heat exchangers are listed in Table E 503.7.1(8). [ASHRAE 90.1:6.4.1.4]

E 503.4.9 Liquid-to-Liquid Heat Exchangers. Plate-type liquid-to-liquid heat exchangers shall be rated in accordance with AHRI 400. [ASHRAE 90.1:6.4.7]

E 503.4.4 Mechanical Equipment Labeling. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment is in accordance with the requirements of ASHRAE 90.1. [ASHRAE 90.1:6.4.1.5.1 6.4.1.6.1]

E 503.4.4.1 Packaged Terminal Air Conditioners. Nonstandard-size packaged terminal air conditioners and heat pumps with existing sleeves having an external wall opening of less than 16 inches (406 mm) high or less than 42 inches (1067 mm) wide and having a cross-sectional area less than 670 square inches (0.432 m$^2$) shall be factory labeled as follows:

Manufactured for nonstandard-size applications only: Not to be installed in new construction projects. [ASHRAE
E 503.4.6.4.1 Shutoff Damper Controls. Outdoor air intake and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. Ventilation outdoor air and exhaust or relief dampers shall be capable of and configured to automatically shut off during preoccupancy building warm-up, cooldown, and setback, except when ventilation supply of outdoor air reduces energy costs or when ventilation outdoor air shall be supplied to comply with the code requirements.

Exceptions:

(1) Back-draft Nonmotorized (gravity back draft) (nonmotorized) dampers shall be permitted for exhaust and relief in buildings less than three stories in height and for ventilation outdoor air intakes and exhaust and relief dampers in buildings of any height located in Climate Zones 0, 1, 2, and 3. Back-draft Nonmotorized dampers for ventilation outdoor air intakes shall be protected from direct exposure to wind.

(2) Dampers shall not be required in ventilation or exhaust systems serving unconditioned spaces.

(3) Dampers shall not be required in exhaust systems serving Type 1 kitchen exhaust hoods.

(4) Dampers are not required in systems intended to operate continuously. [ASHRAE 90.1:6.4.3.4.2]

E 503.4.6.4.2 Dampers Leakage. Where outdoor air supply, and exhaust or relief dampers are required in Section E 503.4.6.4, they shall have a maximum leakage rate in accordance with Table E 503.4.6.4.2 where tested in accordance with AMCA 500D. [ASHRAE 90.1:6.4.3.4.3]

E 503.4.6.7 Humidification and Dehumidification Control.
Humidity control shall prevent the use of fossil fuel or electricity to produce relative humidity above 30 percent in the warmest zone served by the humidification system and to reduce relative humidity below 60 percent in the coldest zone served by the dehumidification system.

Humidification and dehumidification control shall be in accordance with Section E 503.4.6.7.1 through E 503.4.6.7.3.

E 503.4.6.7.1 Dehumidification. Humidistatic controls shall not use mechanical cooling to reduce the humidity below the lower of a dew point of 55°F or relative humidity of 60 percent in the coldest zone served by the system.

Exceptions:

(1) Lower humidity shall be permitted when operating mechanical cooling for temperature control.

(2) Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the Authority Having Jurisdiction or required by accreditation standards, and where humidistatic controls are capable of and configured to maintain a dead band of at least 10 percent relative humidity where no active humidification or dehumidification takes place.

(3) Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5 percent relative humidity to comply with applicable codes or accreditation standards or as approved by the Authority Having Jurisdiction. [ASHRAE 90.1:6.4.3.6.1]

E 503.4.6.7.2 Humidification. Humidistatic controls shall not use fossil fuel or electricity to produce relative humidity above 30 percent in the warmest zone served by the system.

Exceptions:

(1) Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the Authority Having Jurisdiction or required by accreditation standards, and where humidistatic controls are capable of and configured to maintain a dead band of at least 10 percent relative humidity where no active humidification or dehumidification takes place.

(2) Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5 percent relative humidity to comply with applicable codes or accreditation standards or as approved by the Authority Having Jurisdiction. [ASHRAE 90.1:6.4.3.6.2]

E 503.4.6.7.3 Control Interlock. Where a zone is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided capable of and configured to prevent simultaneous operation of humidification and dehumidification equipment.

Exceptions:

(1) Zones served by desiccant systems, used with direct evaporative cooling in series.

(2) Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the Authority Having Jurisdiction or required by accreditation standards, and humidity where humidistatic controls are capable of and configured to maintain a dead band of at least 10 percent relative humidity where no active humidification or dehumidification takes place.

(3) Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5 percent relative humidity to comply with applicable codes or accreditation standards or as approved by the Authority Having Jurisdiction. [ASHRAE 90.1:6.4.3.6.3]

E 201.6 Humidistatic Controls. Automatic controls used to maintain humidity at a fixed or adjustable set point. [ASHRAE 90.1:3.2]
Insulation required by this section shall be installed in accordance with industry-accepted standards. These requirements shall not apply to HVAC equipment. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind, but not limited to the following:

1. Insulation exposed to weather shall be suitable for outdoor service (e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover). Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.

2. Insulation covering chilled-water piping, refrigerant suction piping, or cooling ducts located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant). All penetrations and joints of which shall be sealed. [ASHRAE 90.1:6.4.4.1.1]

**E 503.4.7.1.1 Duct and Plenum Insulation.** Supply and return ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Table E 503.7.2.

**Exceptions:**

1. Factory-installed plenums, casings, or ductwork furnished as a part of HVAC equipment tested and rated in accordance with Section E 503.4 through Section E 503.4.4.1.

2. Ducts or plenums located in heated spaces, semi-heated spaces, or cooled spaces.

3. For runouts less than 10 feet (3048 mm) in length to air terminals or air outlets, the rated R-value of insulation shall not be required to exceed R-3.5.

4. Backs of air outlets and outlet plenums exposed to unconditioned space or indirectly conditioned spaces with face areas exceeding 5 square feet (0.5 m$^2$) shall not be required to exceed R-2; those not exceeding 5 square feet (0.5 m$^2$) shall not be required to be insulated. [ASHRAE 90.1:6.4.4.1.2]

**E 503.4.7.1.3 Sensible Heating Panel Insulation.** Thermally ineffective panel surfaces of sensible heating panels, including U-bends and headers, shall be insulated with a minimum of R-3.5. Adjacent building envelope insulation counts toward this requirement. [ASHRAE 90.1:6.4.4.1.4]

**E 503.5 Prescriptive Compliance Path, Economizers.** Each cooling system shall include either an air economizer or fluid economizer in accordance with Section E 503.5.1 through Section E 503.5.4.1.

**Exceptions:** Economizers shall not be required for the following systems:

1. Individual fan-cooling units with a supply capacity less than the minimum listed in Table E 503.5(1).

2. Chilled-water cooling systems without a fan or that use induced airflow, where the total capacity of these systems is less than 1 000 000 Btu/h (293 kW) in Climate Zones 0, 1B, and 2 through 4; less than 1 400 000 Btu/h (410 kW) in Climate Zones 5 through 8; or any size in Climate Zone 1A.

3. Systems that include nonparticulate air treatment in accordance with ASHRAE 62.1.

4. In hospitals and ambulatory surgery centers, where more than 75 percent of the air designed to be supplied by the system is to spaces that are required to be humidified more than 35°F (2°C) dew-point temperature to comply with applicable codes or accreditation standards; in all other buildings, where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified more than 35°F (2°C) dew-point temperature to satisfy process application needs. This exception shall not apply to computer rooms.

5. Systems that include a condenser heat recovery system with a minimum capacity in accordance with Section E 503.5.10.1.2.

6. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table E 503.5(1).

7. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F (16°C).

8. Systems expected to operate less than 20 hours per week.

9. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.

10. For comfort cooling where the cooling efficiency is not less than the efficiency improvement requirements in accordance with Table E 503.5(2).

11. Systems primarily serving computer rooms where in accordance with one of the following:

   a. The total design cooling load of all computer rooms in the building is less than 3 000 000 Btu/h (879 kW) and the building in which they are located is not served by a centralized chilled water plant.

   b. The room total design cooling load is less than 600 000 Btu/h (176 kW) and the building in which they are located is served by a centralized chilled water plant.

   c. The local water authority does not permit cooling towers.

   d. Less than 600 000 Btu/h (176 kW) of computer room cooling equipment capacity is being added to an existing building.

12. Dedicated systems for computer rooms where a minimum of 75 percent of the design load serves one of the following:

   a. Spaces classified as an essential facility.
(b) Spaces having a design of Tier IV in accordance with TIA 942.
(c) Spaces classified as Critical Operations Power Systems (COPS) in accordance with NFPA 70.
(d) Spaces where core clearing and settlement services are performed such that their failure to settle pending financial transactions is capable of systemic risk in accordance with “The Interagency Paper on Sound Practices to Strengthen the Resilience of the US Financial System” (April 7, 2003). [ASHRAE 90.1:6.5.1]

**E 201.12 Process Application.** A manufacturing, industrial, or commercial procedure or activity where the primary purpose is other than conditioning spaces and maintaining comfort and amenities for the occupants of a building. [ASHRAE 90.1:3.2]

(renumber remaining sections)

**E 503.5.1.3 Dampers.** Return, exhaust, or exhaust or relief, and outdoor air dampers shall comply with the requirements of Section Table E 503.4.6.4.2. Return dampers shall meet the requirements of motorized exhaust or relief dampers in Table E 503.4.6.4.2.

**Exception:** Exhaust or relief and outdoor air intake dampers on systems intended to operate continuously. [ASHRAE 90.1:6.5.1.1.4]

**E 503.5.5 Simultaneous Heating and Cooling Limitation, Zone Controls.** Zone thermostatic controls shall prevent the following:

1. Reheating.
2. Recooling.
3. Mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems.
4. Other simultaneous operation of heating and cooling systems to the same zone.

**Exceptions:**

1. Zones for which the volume of air that is reheated, recooled, or mixed is less than the larger of the following:
   (a) Twenty percent of the zone design peak supply for systems without DDC. 30 percent of the zone design peak supply for systems with DDC and 30 percent for other systems.
   (b) The outdoor airflow required to meet the Simplified Procedure ventilation requirements of Chapter 4 or ASHRAE 62.1 for the zone, permitted to be the average airflow rate as allowed by Chapter 4 or ASHRAE 62.1.
2. Any higher rate that can be demonstrated, to the satisfaction of the Authority Having Jurisdiction, to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system.
3. The airflow rate required to be in accordance with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.
4. Zones with DDC that comply with the following:
   (a) The airflow rate in dead band between heating and cooling does not exceed the larger of the following:
      1. Twenty percent of the zone design peak supply rate.
      2. The outdoor airflow rate required to meet the Simplified Procedure ventilation requirements of Chapter 4 or ASHRAE 62.1 for the zone, permitted to be the average airflow rate as allowed by Chapter 4 or ASHRAE 62.1.
3. A higher rate that can be demonstrated, to the satisfaction of the Authority Having Jurisdiction, to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake.
4. The airflow rate required with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.
   (b) The airflow rate that is reheated, recooled, or mixed shall be less than 50 percent of the zone design peak supply rate.
   (c) The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint while the airflow is maintained at the dead band flow rate.
   (d) The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate.
3. Laboratory exhaust systems that comply with Section E 503.5.11.3.
4. Zones where at least 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from site-recovered energy (including condenser heat) or on-site solar renewable energy. [ASHRAE 90.1:6.5.2.1]

**E 503.5.5.3 Dehumidification.** Where humidity controls are provided, such controls shall prevent reheating, mixing of hot and cold airstreams, or other means of simultaneous heating and cooling of the same airstream.

**Exceptions:**

1. The system is capable of and configured to reduce supply air volume to 50 percent or less of the design airflow rate or the minimum outdoor air ventilation rate in accordance with Chapter 4 or ASHRAE 62.1 or other applicable federal,
E 503.5.6.1.1 Motor-Nameplate Horsepower Fan Motor Selection. Fan motor selection shall be in accordance with the following:

(1) For each fan less than 6 bhp (4.5 kW), the selected fan motor shall be no larger than the first available motor size with a nameplate rating greater than 1.5 times the bhp.

(2) The fan bhp shall be indicated on the design documents to allow for compliance verification by the Authority Having Jurisdiction. For each fan 6 bhp (4.5 kW) and larger, the selected fan motor shall be no larger than the first available motor with a nameplate rating greater than 1.3 times the bhp. The fan bhp must be indicated on the design documents to allow for compliance verification by the Authority Having Jurisdiction.

Exceptions:

(1) Motors equipped with electronic speed control devices to vary the fan airflow as a function of load. For fans less than 6 bhp (4.5 kW), where the first available motor larger than the bhp (kW) has a nameplate rating within 50 percent of the bhp (kW), the next larger motor size shall be permitted to be selected.

(2) For fans 6 bhp (4.5 kW) and larger, where the first available motor larger than the bhp (kW) has a nameplate rating within 30 percent of the bhp (kW), the next larger nameplate motor size shall be permitted to be selected.

(3) Systems that are in accordance with Section E 503.5.6.1, Option 1.

(3) Fans with motor nameplate horsepower of less than 1 hp (0.7 kW).

(4) Fans with motor nameplate horsepower a fan nameplate electrical input power of less than 1 hp (0.7 kW or less). [ASHRAE 90.1:6.5.3.1.2]

E 503.5.6.2 Fan Efficiency. Fans Each fan and fan array shall have a fan efficiency grade (FEG) of 67 or more, based on manufacturers' certified data in accordance with AMCA 205. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan energy index (FEI) of 1.00 or higher. Each fan and fan array used for a variable-air-volume system that meets the requirements of Section E 503.5.6.2 shall have an FEI of 0.95 or higher. The FEI for fan arrays shall be calculated in accordance with AMCA 208.

Exceptions:

(1) Individual Fans that are not embedded fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less that are not part of a group operated as the functional equivalent of a single fan less than 1.0 hp (0.7 kW) or with a fan nameplate electrical input power of less than 0.89 kW.

(2) Multiple-Embedded fans in series or parallel (e.g., and fan arrays) that have-with a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan or with a fan system electrical input power of 4.1 kW or less.

(3) Embedded Fans that are part of equipment listed under Section E 503.4.

(4) Embedded Fans included in equipment bearing a third-party-certified seal for air or energy performance of the equipment package.

(5) Powered wall/roof ventilators (PRV)-Ceiling fans.

(6) Fans used for moving gases at temperatures above 482°F (250 °C).

(7) Fans used for operation in explosive atmospheres.

(8) Reversible fans used for tunnel ventilation.

(9) Reversible fans used for tunnel ventilation.

(10) Fans outside the scope of AMCA 206-208.

E 503.5.6.3 Multiple-Zone VAV System Ventilation Optimization Control. Multiple-zone VAV systems with DDC of individual zone boxes reporting to a central control panel shall include means to automatically reduce outdoor air intake flow below design rates in response to changes in system ventilation efficiency in accordance with Section 404.0 or ASHRAE 62.1.
Exceptions:
(1) VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV systems, and VAV systems with fan-powered terminal units.
(2) Systems where total design exhaust airflow is more than 70 percent of total design outdoor air intake flow requirements. [ASHRAE 90.1:6.5.3.3]

E 503.5.6.4 Supply Air Temperature Reset Controls. Multiple zone HVAC systems shall include controls that are capable of and configured to automatically reset the supply air temperature in response to representative building loads, or to outdoor air temperature. The controls shall reset the supply air temperature to at least 25 percent of the difference between the design supply air temperature and the design room air temperature. Controls that adjust the reset based on zone humidity shall be permitted in Climate Zones 0B, 1B, 2B, 3B, 3C, and 4 through 8. HVAC zones that are expected to experience relatively constant loads, such as electronic equipment rooms, shall have maximum airflow designed for to accommodate the fully reset supply air temperature. HVAC zones that are expected to experience relatively constant loads typically include electronic equipment rooms and interior zones.

Exceptions:
(1) Systems in Climate Zones 0A, 1A, 2A, and 3A with less than 3000 cubic feet per minute (1.4 m$^3$/s) of design outdoor air.
(2) Systems in Climate Zone 2A with less than 10 000 cubic feet per minute (4.7 m$^3$/s) of design outdoor air.
(3) Systems in Climate Zones 0A, 1A, 2A, and 3A with at least 80 percent outdoor air and employing exhaust air energy recovery complying with Section E 503.5.10.
(4) Systems that prevent reheating, recooling, or mixing of heated and cooled supply air.
(5) Systems where not less than 75 percent of the energy for reheating (on an annual basis) is from site recovered energy or on-site renewable energy. [ASHRAE 90.1:6.5.3.5]

E 503.5.7 Hydronic System Design and Control. Hydronic system design and control shall be in accordance with Section E 503.5.7.1 and Section E 503.5.7.2.

E 503.5.7.1 Boiler Turndown. Boiler systems with design input of 1 000 000 Btu/h (293 kW) or more shall comply with the turndown ratio in accordance with Table E 503.5.7. The system turndown requirement shall use multiple single-input boilers, one or more modulating boilers, or a combination of single-input and modulating boilers.

Boilers shall comply with the minimum efficiency requirements in Table E 503.7.1(6). [ASHRAE 90.1:6.5.4.1]

E 503.5.7.3 Chilled- and Hot-Water Temperature Reset Controls. Chilled- and hot-water systems with a design capacity exceeding 300 000 Btu/h (88 kW) supplying chilled or heated water to comfort conditioning systems shall include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outdoor air temperature. Where DDC is used to control valves, the set point shall be reset based on valve positions until one valve is nearly wide open or setpoint limits of the system equipment or application have been reached.

Exceptions:
(1) Where chilled-water supply is already cold, such as chilled water supplied from a district cooling or thermal energy storage system, such that blending would be required to achieve the reset chilled-water supply temperature.
(2) Where a specific temperature is required for a process application.
(3) Water temperature reset is not required where valve position is used to comply with Section E 503.5.7. [ASHRAE 90.1:6.5.4.4]

E 503.5.7.4 Hydronic (Water Loop) Heat Pump and Water-Cooled Unitary Air Conditioners. Hydronic heat pumps and water-cooled unitary air-conditioners shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

Exception: Units employing water-fluid economizers. [ASHRAE 90.1:6.5.4.5.1]

E 503.5.10 Energy Recovery. Energy recovery shall be in accordance with Section E 503.5.10.1, through Section E 503.5.10.3.

E 503.5.10.1 Exhaust Air Energy Recovery. Exhaust air energy recovery shall be in accordance with Section E 503.5.10.1.1 through Section E 503.5.10.1.2.

E 503.5.10.1.1 Exhaust Air Energy Recovery for Nontransient Dwelling Units. Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems. For nontransient dwelling units, energy recovery systems shall result in an enthalpy recovery ratio of at least 50 percent at cooling design condition and at least 60 percent at heating design condition. The energy recovery system shall provide the required enthalpy recovery ratio at both heating and cooling design conditions, unless one mode is not required for the climate zone by the exceptions below.

Exceptions:
(1) Nontransient dwelling units in Climate Zone 3C.
E 503.5.10.1.2 Exhaust Air Energy Recovery for Spaces Other than Nontransient Dwelling Units. Each fan system serving spaces other than nontransient dwelling units shall have an energy recovery system where the design supply fan airflow rate exceeds the value listed in Table E 503.5.10(1) and Table E 503.5.10(2), based on the climate zone and percentage of outdoor air at design airflow conditions. Table E 503.5.10(1) shall be used for all ventilation systems that operate less than 8000 hours per year and Table E 503.5.10(2) shall be used for all ventilation systems that operate 8000 or more hours per year.

Exception: For spaces other than nontransient dwelling units, energy recovery systems required by this section shall result in an enthalpy recovery ratio of not less than 50 percent. A fifty percent recovery system shall provide the required enthalpy recovery ratio shall mean a change in the enthalpy of the outdoor air supply equal to 50 percent of the difference between the outdoor air and entering exhaust air enthalpies at both heating and cooling design conditions, unless one mode is not required for the climate zone by the exceptions below. Provision shall be provided to bypass or control the energy recovery system to permit air economizer operation in accordance with Section E 503.5.1.

Exceptions:

(1) Laboratory systems that are in accordance with Section E 503.5.11.3.
(2) Systems serving spaces that are not cooled and that are heated to less than 60°F (16°C).
(3) Heating energy recovery where more than 60 percent of the outdoor air heating energy is provided from site-recovered energy or on-site solar renewable energy.
(4) Heating energy enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1, and 2.
(5) Cooling energy recovery in climate zones 3C, 4C, 5B, 5C, 6B, 7, and 8.
(6) Where the sum of the airflow rates exhausted and relieved within 20 feet (6096 mm) of each other is less than 75 percent of the design outdoor airflow rate, excluding exhaust air that is;
(a) used for another energy recovery system,
(b) not allowed by ASHRAE 170 for use in energy recovery systems with leakage potential, or
(c) of Class 4 as defined in Chapter 2 or ASHRAE 62.1.

(7) Systems heating energy recovery for systems in Climate Zones 0 through 4 requiring dehumidification during heating mode that employ energy recovery in series with the cooling coil and have a minimum SERR of 0.40.
(8) Systems expected to operate less than 20 hours per week at the outdoor air percentage in accordance with Table E 503.5.10(1).

(9) Indoor pool dehumidifiers meeting Section E 503.5.10.4. [ASHRAE 90.1:6.5.6.4 6.5.6.1.2]

E 503.5.10.3 Heat Recovery for Space Conditioning. Where heating water is used for space heating, a condenser heat recovery system shall be installed, provided all of the following are true:

(1) The building is an acute inpatient hospital, where the building or portion of a building is used on a 24-hour basis for the inpatient medical, obstetric, or surgical care for patients.
(2) The total design chilled-water capacity for the acute inpatient hospital, either air cooled or water cooled, required at cooling design conditions exceeds 3 600 000 Btu/h of cooling.
(3) Simultaneous heating and cooling occurs above 60°F (16°C) outdoor air temperature. The required heat recovery system shall have a cooling capacity that is at least 7 percent of the total design chilled-water capacity of the acute inpatient hospital at peak design conditions.

[ASHRAE 90.1:6.5.6.3]

E 503.5.10.4 Indoor Pool Dehumidifier Energy Recovery. An indoor pool dehumidifier serving a natatorium with a heated indoor pool over 500 ft² (46.45 m²) in size shall include one of the following:

(1) An exhaust air sensible energy recovery system with a sensible energy recovery ratio of at least 50 percent.
(2) A condenser heat recovery system capable of and configured to use 100 percent of the heat generated through dehumidification to heat the pool water when there is a pool water heating load.
(3) An exhaust air energy recovery system that results in an enthalpy recovery ratio of at least 50 percent. [ASHRAE 90.1:6.5.6.4]

E 503.5.10.1 E 503.5.10.2 Heat Recovery for Service Water Heating. Heat recovery shall comply with Section E 503.5.10.1.1 and Section E 503.5.10.1.2.

E 503.5.10.1.1 E 503.5.10.2.1 Condenser Heat Recovery Systems. Condenser heat recovery systems shall be installed for the heating or preheating of service hot water where all of the following conditions exist:

(1) The facility operates 24 hours a day.
(2) The total installed heat rejection capacity of the water-cooled system is more than 6 000 000 Btu/h (1757 kW) of heat rejection.
(3) The design service water heating load is more than 1 000 000 Btu/h (293 kW). [ASHRAE 90.1:6.5.6.2.1]

E 503.5.10.1.2 E 503.5.10.2.2 Capacity. The required heat recovery system shall have the capacity to provide the smaller of:

(1) Sixty percent of the peak heat-rejection load at design conditions or
(2) Preheat of the peak service hot-water draw to 85°F (29°C).

Exceptions:
(1) Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.
(2) Facilities that provide 60 percent of their service water heating from on-site solar renewable energy or site-recovered energy or from other sources. [ASHRAE 90.1:6.5.6.2.2]

E 503.5.12 Radiant Heating Systems. Radiant heating systems shall be in accordance with Section E 503.5.12.1 through Section E 503.5.12.2.

E 503.5.12.1 Heating Unenclosed Spaces. Radiant heating shall be used when heating is required for unenclosed spaces.

Exception: Loading docks equipped with air curtains. [ASHRAE 90.1:6.5.8.1] E 503.5.12.2 Heating Enclosed Spaces. (remaining text unchanged)

E 503.6.1 Construction Details. Compliance documents shall show all the pertinent data and features of the building, equipment, and systems in sufficient detail to permit a determination of compliance by the building official and to indicate compliance with the requirements of this appendix. [ASHRAE 90.1:4.2.2.1]

E 503.6.3.1 Required Information. Construction documents shall require that an operating manual and maintenance manual be provided to the building owner. The manuals shall include, at a minimum, the following:
(1) Submittal data stating equipment rating and selected options for each piece of equipment requiring maintenance.
(2) Operation manuals and maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.
(3) Names and addresses of not less than one qualified service agency.
(4) A complete narrative of how each system is intended to operate.

The Authority Having Jurisdiction shall only check to ensure that the construction documents require this information to be transmitted to the owner and should not expect copies of any of the materials. [ASHRAE 90.1:6.7.2.3.2]

E 503.6.3.2 Lighting Manuals. Construction documents shall require for all lighting equipment and lighting controls that an operating manual and maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance. These manuals shall include, at a minimum, the following:
(1) Submittal data indicating all selected options for each piece of lighting equipment, including but not limited to lamps, ballasts, drivers, and lighting controls.
(2) Operation and maintenance manuals for each piece of lighting equipment and lighting controls with routine maintenance clearly identified including, as a minimum, a recommended relamping or cleaning program and a schedule for inspecting and recalibrating all lighting controls.
(3) A complete narrative of how each lighting control system is intended to operate including recommended settings. [ASHRAE 90.1:6.7.2.3.2]

E 503.6.5.1 Drawings. Construction documents shall require that, within 90 days after the date of system acceptance, record drawings of the actual installation documents be provided to the building owner or the designated representative of the building owner. Record drawings include, as a minimum, the general configuration of the duct and pipe distribution system including sizes, and the terminal air or water design flow rates. [ASHRAE 90.1:6.7.2.1]

E 503.6.5.2 Manuals. Construction documents shall require that an operating manual and a maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance. These manuals shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:
(1) Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
(2) Operation manuals and maintenance manuals for each piece of equipment and system requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
(3) Names and addresses of not less than one service agency.
(4) HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
(5) A complete narrative of how each system is intended to operate, including suggested setpoints. [ASHRAE 90.1:6.7.2.6.7.3.2]

E 503.6.5.3 System Balancing. Construction documents shall require that HVAC systems be balanced in accordance with generally accepted engineering standards. Construction documents shall require that a written balance report be provided to the building owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5000 square feet (464.52 m²). [ASHRAE 90.1:6.7.2.3.4.6.7.3.3.1]

E 503.6.5.3.1 Air System Balancing. Air systems shall be balanced in a manner to first minimize throttling losses. Then, for fans with fan system power greater than 1 hp (0.7 kW), fan speed shall be adjusted to meet design flow conditions. [ASHRAE 90.1:6.7.2.3.2.6.7.3.3.2]
E 503.6.5.4 System Commissioning. HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 square feet (4645.15 m²) conditioned area, except warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems shall be provided by the designer in plans and specifications. [ASHRAE 90.1:6.7.7.2.4]

E 503.8 Alternative Compliance Path, Computer Room Systems. HVAC systems only serving the heating, cooling, or ventilation-ventilating needs of a computer room with IT equipment load greater than 13.4 hp (10 kW) shall be in accordance with Section E 503.1, Section E 503.4, Section E 503.6.1 or Section E 503.8.2, Section E 503.8.3, Section E 502.7 through Section E 502.7.2, and Section E 503.7 ASHRAE 90.4. [ASHRAE 90.1:6.6.1]

E 503.8.1 Computer Room (PUE₁). The computer room PUE₁ shall be not more than the values listed in Table E 503.8.1. Hourly simulation of the proposed design, for purposes of calculating PUE₁, shall be in accordance with ASHRAE 90.1.
Exception: The compliance path shall not be permitted for a proposed computer room design utilizing a combined heat and power system. [ASHRAE 90.1:6.6.1.1]

E 503.8.2 Computer Room (PUE₀). The computer room PUE₀ is less than or equal to the values listed in Table E 503.8.1, shall be the highest value determined at outdoor cooling design temperatures, and shall be limited to systems only using electricity for an energy source. PUE₀ shall be calculated for two conditions:
1. One hundred percent design IT equipment energy
2. Fifty percent design IT equipment energy. [ASHRAE 90.1:6.6.1.2]

E 503.8.3 Documentation. Documentation on the following components shall be provided, including a breakdown of energy consumption or demand:
1. IT equipment
2. Power distribution losses external to the IT equipment
3. HVAC systems
4. Lighting [ASHRAE 90.1:6.6.1.3]

<table>
<thead>
<tr>
<th>TABLE E 503.4.6.4.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAXIMUM DAMPER LEAKAGE¹, ² (cubic foot per minute per square foot) at 1.0 in.-w.g inch water gauge</td>
</tr>
<tr>
<td>[ASHRAE 90.1: TABLE 6.4.3.4.3]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>VENTILATION-OUTDOOR AIR INTAKE (CFM/ft²)</th>
<th>EXHAUST/RELIEF (CFM/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONMOTORIZED¹</td>
<td>MOTORIZED</td>
</tr>
<tr>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any height</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any height</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>4, 5bB, 5eC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less-Fewer than 3-three stories</td>
<td>not-allowed-²⁴</td>
<td>10</td>
</tr>
<tr>
<td>³Three or more stories</td>
<td>not-allowed-²⁴</td>
<td>10</td>
</tr>
<tr>
<td>5aA, 6, 7, 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less-Fewer than 3-three stories</td>
<td>not-allowed-²⁴</td>
<td>4</td>
</tr>
<tr>
<td>³Three or more stories</td>
<td>not-allowed-²⁴</td>
<td>4</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.00047 m³/s, 1 square foot = 0.0929 m², 1 inch water gauge = 0.249 kPa

¹ Dampers smaller than 24 inches (610 mm) in either dimension shall be permitted to have leakage of 40 ft³/min per square foot [0.203 (m³/s)/m²].
² Dampers smaller than 12 inches (305 mm) in height, width, or diameter need not be tested but shall be of the same design and construction as the smallest tested damper meeting the listed leakage rate requirement.
³ Nonmotorized dampers smaller than 24 inches (610 mm) in height, width, or diameter shall be permitted to have a leakage rate of 40 CFM/ft² [0.203 (m³/s)/m²].
⁴ Where permitted by Section E 503.4.6.4.1, exception 2.

Notes:
1 When tested in accordance with AMCA 500D.
2 When tested in accordance with AMCA 500D.
3 When tested in accordance with AMCA 500D.
4 Where permitted by Section E 503.4.6.4.1, exception 2.
**TABLE E 503.5.1.2**  
HIGH-LIMIT SHUTOFF CONTROL SETTINGS FOR AIR ECONOMIZERS

[ASHRAE 90.1: TABLE 6.5.1.1.3]

<table>
<thead>
<tr>
<th>CONTROL TYPE</th>
<th>ALLOWED ONLY IN CLIMATE ZONE AT LISTED SETPOINT</th>
<th>REQUIRED HIGH LIMIT (ECONOMIZER OFF WHERE):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed dry-bulb temperature</td>
<td>0B, 1B, 2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B, 7, 8</td>
<td>( T_{\text{OA}}&gt; 75^\circ \text{F} ) Outdoor air temperature exceeds 75°F</td>
</tr>
<tr>
<td></td>
<td>5A, 6A</td>
<td>( T_{\text{OA}}&gt; 70^\circ \text{F} ) Outdoor air temperature exceeds 70°F</td>
</tr>
<tr>
<td></td>
<td>0A, 1A, 2A, 3A, 4A</td>
<td>( T_{\text{OA}}&gt; 65^\circ \text{F} ) Outdoor air temperature exceeds 65°F</td>
</tr>
<tr>
<td>Differential dry-bulb</td>
<td>0B, 1B, 2B, 3B, 3C, 4B, 4C, 5A, 5B, 5C, 6B, 7, 8</td>
<td>( T_{\text{OA}}&gt; T_{\text{RA}} ) Outdoor air temperature exceeds return air temperature</td>
</tr>
<tr>
<td>temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed enthalpy with fixed</td>
<td>All</td>
<td>( h_{\text{OA}}&gt; 28 \text{ Btu/lb} ) or ( T_{\text{OA}}&gt; 75^\circ \text{F} ) Outdoor air enthalpy exceeds 28 Btu/lb of dry air1 or outdoor air temperature exceeds 75°F</td>
</tr>
<tr>
<td>dry-bulb temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential enthalpy with</td>
<td>All</td>
<td>( h_{\text{OA}}&gt; h_{\text{RA}} ) or ( T_{\text{OA}}&gt; 75^\circ \text{F} ) Outdoor air enthalpy exceeds return air enthalpy or outdoor air temperature exceeds 75°F</td>
</tr>
<tr>
<td>fixed dry-bulb temperature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units: °C = (°F-32)/1.8, 1 British thermal unit per pound = 2326 J/kg

**Notes:**

1. At altitudes substantially different than sea level, the fixed enthalpy limit shall be set to the enthalpy value at 75°F (24°C) and 50 percent relative humidity. As an example, at approximately 6000 feet (1829 m) elevation, the fixed enthalpy limit shall be approximately 30.7 Btu/lb (71 408 J/kg).
2. Devices with selectable rather than adjustable setpoints shall be capable of being set to within 2°F (1°C) and 2 Btu/lb (4649 J/kg) of the setpoint listed.

**TABLE E 503.5.2**  
WATER-FLUID ECONOMIZER SIZING DRY-BULB AND WET-BULB REQUIREMENTS FOR COMPUTER ROOMS*

[ASHRAE 90.1: TABLE 6.5.1.2.1]

(portions of table not shown remain unchanged)

**TABLE E 503.5.6.1(1)**  
FAN POWER LIMITATION*

[ASHRAE 90.1: TABLE 6.5.3.1-1]

<table>
<thead>
<tr>
<th>LIMIT</th>
<th>CONSTANT VOLUME</th>
<th>VARIABLE VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: Fan system motor nameplate (hp)</td>
<td>Allowable motor nameplate (hp)</td>
<td>( hp = \text{CFMS} \times 0.0011 )</td>
</tr>
<tr>
<td>Option 2: Fan system (bhp)</td>
<td>Allowable fan system (bhp)</td>
<td>( bhp = \text{CFMS} \times 0.00094 + A )</td>
</tr>
</tbody>
</table>

For SI units: 1 horsepower = 0.746 kW, 1 cubic foot per minute = 0.00047 m³/s

*Where:

- \( \text{CFMS} \) = the maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute (m³/s)
- \( hp \) = the maximum combined motor nameplate horsepower (kW)
- \( bhp \) = the maximum combined fan-brake horsepower (kW)
- \( A \) = sum of \((PD \times CFMD)/4131\)
- \( PD \) = each applicable pressure drop adjustment from Table E 503.5.6.1(2) in inch water column (kPa)
- \( CFMD \) = the design airflow through each applicable device from Table E 503.5.6.1(2) in cubic feet per minute (m³/s)
TABLE E 503.5.6.1(2)
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT
[ASHRAE 90.1: TABLE 6.5.3.1-2]

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>ADJUSTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms</td>
<td>0.5 in. <strong>w.e.</strong> of water. (2.15 in. <strong>w.e.</strong> of water for laboratory and vivarium systems)</td>
</tr>
<tr>
<td>Return, and/or exhaust, or both airflow control devices</td>
<td>0.5 in. <strong>w.e.</strong> of water</td>
</tr>
<tr>
<td>Exhaust filters, scrubbers, or other exhaust treatment</td>
<td>The pressure drop of device calculated at fan system design condition</td>
</tr>
<tr>
<td>Particulate Filtration Credit: MERV 9 through 12</td>
<td>0.5 in. <strong>w.e.</strong> of water</td>
</tr>
<tr>
<td>Particulate Filtration Credit: MERV 13 through 15</td>
<td>0.9 in. <strong>w.e.</strong> of water</td>
</tr>
<tr>
<td>Particulate Filtration Credit: MERV 16 and greater, and electronically enhanced filters</td>
<td>Pressure drop calculated at 2x clean filter pressure drop at fan system design condition</td>
</tr>
<tr>
<td>Carbon and other gas-phase air cleaners</td>
<td>Clean filter pressure drop at fan system design condition</td>
</tr>
<tr>
<td>Biosafety cabinet</td>
<td>Pressure drop of device at fan system design condition</td>
</tr>
<tr>
<td>Energy recovery device, other than coil runaround loop</td>
<td>For each airstream [(2.2 x e<strong>R</strong>enthalpy <strong>R</strong>covery <strong>R</strong>atio) - 0.5] in. <strong>w.e.</strong> of water</td>
</tr>
<tr>
<td>Coil runaround loop</td>
<td>0.6 in. <strong>w.e.</strong> of water, for each airstream</td>
</tr>
<tr>
<td>Evaporative humidifier- or/and cooler in series with another cooling coil</td>
<td>Pressure drop of device at fan system design condition</td>
</tr>
<tr>
<td>Sound attenuation section (fans serving spaces with design back- ground noise goals below NC35)</td>
<td>0.15 in. <strong>w.e.</strong> of water</td>
</tr>
<tr>
<td>Exhaust system serving fume hoods</td>
<td>0.35 in. <strong>w.e.</strong> of water</td>
</tr>
<tr>
<td>Laboratory and vivarium exhaust systems in high-rise buildings</td>
<td>0.25 in. <strong>w.e.</strong> of water /per 100 feet of vertical duct exceeding 75 ft</td>
</tr>
</tbody>
</table>

DEDUCTIONS

| Systems without central cooling device                                | −0.6 in. **w.e.** of water                      |
| Systems without central heating device                               | −0.3 in. **w.e.** of water                      |
| Systems with central electric resistance heat                        | −0.2 in. **w.e.** of water                      |

For SI units: 1 inch water column = 0.249 kPa, 1 foot = 304.8 mm

TABLE E 503.5.6.5(1)
MINIMUM AVERAGE FULL-LOAD EFFICIENCY FOR POLYPHASE SMALL ELECTRIC MOTORS*
[ASHRAE 90.1: TABLE 10.8-3]

<table>
<thead>
<tr>
<th>FULL-LOAD EFFICIENCY, %</th>
<th>OPEN MOTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER OF POLES</td>
<td>2</td>
</tr>
<tr>
<td>SYNCHRONOUS SPEED (RPM rpm)</td>
<td>3600</td>
</tr>
<tr>
<td>MOTOR HORSEPOWER SIZE (hp)</td>
<td>EFFICIENCY,%</td>
</tr>
<tr>
<td>0.25</td>
<td>65.6</td>
</tr>
<tr>
<td>0.33</td>
<td>69.5</td>
</tr>
<tr>
<td>0.50</td>
<td>73.4</td>
</tr>
<tr>
<td>0.75</td>
<td>76.8</td>
</tr>
<tr>
<td>1</td>
<td>77.0</td>
</tr>
<tr>
<td>1.5</td>
<td>84.0</td>
</tr>
<tr>
<td>2</td>
<td>85.5</td>
</tr>
<tr>
<td>3</td>
<td>85.5</td>
</tr>
</tbody>
</table>

*AVERAGE full-load efficiencies shall be established in accordance with 10 CFR 431.
TABLE E 503.5.6.5(2)
MINIMUM AVERAGE FULL-LOAD EFFICIENCY FOR CAPACITOR-START CAPACITOR-RUN AND CAPACITOR-START INDUCTION-RUN SMALL ELECTRIC MOTORS*
[ASHRAE 90.1: TABLE 10.8-4]

<table>
<thead>
<tr>
<th>NUMBER OF POLES</th>
<th>FULL-LOAD EFFICIENCY, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OPEN MOTORS</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>SYNCHRONOUS SPEED (RPM rpm)</td>
<td>3600</td>
</tr>
<tr>
<td>MOTOR HORSEPOWER SIZE (hp)</td>
<td>4</td>
</tr>
<tr>
<td>EFFICIENCY, %</td>
<td>6</td>
</tr>
<tr>
<td>0.25</td>
<td>66.6</td>
</tr>
<tr>
<td>0.33</td>
<td>70.5</td>
</tr>
<tr>
<td>0.50</td>
<td>72.4</td>
</tr>
<tr>
<td>0.75</td>
<td>76.2</td>
</tr>
<tr>
<td>1</td>
<td>80.4</td>
</tr>
<tr>
<td>1.5</td>
<td>81.5</td>
</tr>
<tr>
<td>2</td>
<td>82.9</td>
</tr>
<tr>
<td>3</td>
<td>84.1</td>
</tr>
<tr>
<td>4</td>
<td>68.5</td>
</tr>
<tr>
<td>4</td>
<td>72.4</td>
</tr>
<tr>
<td>4</td>
<td>76.2</td>
</tr>
<tr>
<td>4</td>
<td>81.8</td>
</tr>
<tr>
<td>4</td>
<td>82.6</td>
</tr>
<tr>
<td>4</td>
<td>83.8</td>
</tr>
<tr>
<td>4</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>62.2</td>
</tr>
<tr>
<td></td>
<td>66.6</td>
</tr>
<tr>
<td></td>
<td>76.2</td>
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<tr>
<td></td>
<td>80.2</td>
</tr>
<tr>
<td></td>
<td>81.1</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Average full-load efficiencies shall be established in accordance with 10 CFR 431.

TABLE E 503.5.10(1)
EXHAUST AIR ENERGY RECOVERY REQUIREMENTS FOR VENTILATION SYSTEMS OPERATING LESS THAN 8000 HOURS PER YEAR*
[ASHRAE 90.1: TABLE 6.5.6.1-1 6.5.6.1.2-1]

(portions of table not shown remain unchanged)

TABLE E 503.5.10(2)
EXHAUST AIR ENERGY RECOVERY REQUIREMENTS FOR VENTILATION SYSTEMS OPERATING NOT LESS GREATER THAN OR EQUAL TO 8000 HOURS PER YEAR*
[ASHRAE 90.1: TABLE 6.5.6.1-2 6.5.6.1.2-2]

(portions of table not shown remain unchanged)

TABLE E 503.8.1
POWER USAGE EFFECTIVENESS (PUE) MAXIMUM
[ASHRAE 90.1: TABLE 6.6.1]

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>PUE²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0A</td>
<td>1.64</td>
</tr>
<tr>
<td>0B</td>
<td>1.62</td>
</tr>
<tr>
<td>1A</td>
<td>1.61</td>
</tr>
<tr>
<td>1B</td>
<td>1.59</td>
</tr>
<tr>
<td>2A</td>
<td>1.49</td>
</tr>
<tr>
<td>2B</td>
<td>1.45</td>
</tr>
<tr>
<td>3A</td>
<td>1.41</td>
</tr>
<tr>
<td>3B</td>
<td>1.42</td>
</tr>
<tr>
<td>3C</td>
<td>1.39</td>
</tr>
<tr>
<td>4A</td>
<td>1.36</td>
</tr>
<tr>
<td>4B</td>
<td>1.38</td>
</tr>
<tr>
<td>4C</td>
<td>1.38</td>
</tr>
<tr>
<td>5A</td>
<td>1.36</td>
</tr>
</tbody>
</table>
PUE0 and PUE1 shall not include energy for battery charging.

**TABLE E 503.7.1(1)**

ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS—MINIMUM EFFICIENCY REQUIREMENTS

[ASHRAE 90.1: TABLE 6.8.1-1]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air conditioners, air cooled</td>
<td>&lt;65 000 Btu/h2</td>
<td>All</td>
<td>Split system, three phase <strong>and</strong> applications outside U.S. single phase²</td>
<td>13.0 SEER before 1/1/2023 13.4 SEER² after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td>Through the wall</td>
<td>&lt;=30 000 Btu/h2</td>
<td>All</td>
<td>Split system, three phase <strong>and</strong> applications outside U.S. single phase²</td>
<td>12.0 SEER before 1/1/2023 11.7 SEER² after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td>Small duct, high velocity, air cooled</td>
<td>&lt;65 000 Btu/h2</td>
<td>All</td>
<td>Split system, three phase <strong>and</strong> applications outside U.S. single phase²</td>
<td>11.0 SEER before 1/1/2023 12.0 SEER² after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td>Air conditioners, air cooled</td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>Split system and single package</td>
<td>11.2 EER before 1/1/2023 12.9 IEER after 1/1/2023</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td>&gt;=135 000 Btu/h and &lt;240 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td></td>
<td>11.0 EER before 1/1/2023 12.4 IEER after 1/1/2023</td>
<td></td>
</tr>
</tbody>
</table>

* PUE0 and PUE1 shall not include energy for battery charging.
<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air conditioners, evaporatively cooled</td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>Split system and single package</td>
<td>12.1 EER 12.3 IEER</td>
<td>AHRI 210/240</td>
</tr>
<tr>
<td></td>
<td>&gt;/=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All</td>
<td>12.1 EER 13.9 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=135 000 Btu/h and &lt;240 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All</td>
<td>12.5 EER 13.9 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=240 000 Btu/h and &lt;760 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All</td>
<td>12.2 EER 13.6 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=760 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All</td>
<td>12.2 EER 13.5 IEER</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE E 503.7.1(2)

**ELECTRICALLY OPERATED AIR-COOLED UNITARY AND APPLIED HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-2]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled (cooling mode)</td>
<td>&lt;65 000 Btu/h&lt;sup&gt;2&lt;/sup&gt;</td>
<td>All</td>
<td>Split system, three phase and applications outside U.S. single phase&lt;sup&gt;2&lt;/sup&gt;</td>
<td>14.0 SEER before 1/1/2023 14.3 SEER&lt;sup&gt;2&lt;/sup&gt; after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023 AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td>Through the wall Space constrained, air cooled (cooling mode)</td>
<td>&lt;=30 000 Btu/h&lt;sup&gt;2&lt;/sup&gt;</td>
<td>All</td>
<td>Split system, three phase and applications outside</td>
<td>12.0 SEER before 1/1/2023 11.7 SEER&lt;sup&gt;2&lt;/sup&gt; after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023 AHRI 210/240-2023 after 1/1/2023</td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW

Notes:
1. ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2. Single-phase, **U.S.** air-cooled air conditioners less than 65 000 Btu/h (19 kW) are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430. SEER and SEER<sup>2</sup> values for single-phase products are set by the U.S. Department of Energy.
<table>
<thead>
<tr>
<th>Category</th>
<th>Capacity Range</th>
<th>Type</th>
<th>SEER/I.EER Before 1/1/2023</th>
<th>SEER/I.EER After 1/1/2023</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U.S. single phase</strong></td>
<td></td>
<td>Single package, three phase and applications outside U.S. single phase²</td>
<td>12.0 SEER before 1/1/2023 11.7 SEER² after 1/1/2023</td>
<td>2023 after 1/1/2023</td>
</tr>
<tr>
<td><strong>Small duct, high velocity, air cooled</strong></td>
<td>&lt;65,000 Btu/h</td>
<td>All</td>
<td>11.0 SEER before 1/1/2023 12.0 SEER after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023 AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electric resistance (or none)</td>
<td>11.0 EER before 1/1/2023 12.2 I.EER 14.1 I.EER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>All other</td>
<td>10.8 EER before 1/1/2023 12.0 I.EER 13.9 I.EER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Split system and single package</td>
<td>10.6 EER before 1/1/2023 11.6 I.EER 13.5 I.EER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>All other</td>
<td>10.4 EER before 1/1/2023 11.4 I.EER 13.3 I.EER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electric resistance (or none)</td>
<td>9.5 EER before 1/1/2023 10.6 I.EER 12.5 I.EER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>All other</td>
<td>9.3 EER before 1/1/2023 10.4 I.EER 12.3 I.EER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td><strong>Water to air, water loop</strong></td>
<td>&lt;47,000 Btu/h</td>
<td>All</td>
<td>12.2 EER before 1/1/2023 12.0 SEER² after 1/1/2023</td>
<td>ISO-13256-1</td>
</tr>
<tr>
<td></td>
<td>=47,000 Btu/h and &lt;65,000 Btu/h</td>
<td></td>
<td>13.0 EER before 1/1/2023 12.0 SEER² after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td>System Type</td>
<td>Capacity</td>
<td>Temperature</td>
<td>EER</td>
<td>Standard</td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
<td>-------------</td>
<td>-----</td>
<td>----------</td>
</tr>
<tr>
<td>Water to air, groundwater (cooling mode)</td>
<td>≤65,000 Btu/h and &lt;135,000 Btu/h</td>
<td>59°F entering water</td>
<td>13.0</td>
<td>ISO 13256-1</td>
</tr>
<tr>
<td>Water to water, water loop (cooling mode)</td>
<td>≤135,000 Btu/h</td>
<td>86°F entering water</td>
<td>10.6</td>
<td>ISO 13256-2</td>
</tr>
<tr>
<td>Water to water, groundwater (cooling mode)</td>
<td>≤135,000 Btu/h</td>
<td>59°F entering water</td>
<td>16.3</td>
<td>ISO 13256-2</td>
</tr>
<tr>
<td>Brine to water, ground loop (cooling mode)</td>
<td>≤135,000 Btu/h</td>
<td>77°F entering water</td>
<td>12.1</td>
<td>ISO 13256-2</td>
</tr>
<tr>
<td>Air cooled (heating mode)</td>
<td>≤65,000 Btu/h (^2)</td>
<td>Split system, three phase and applications outside U.S. single phase(^2)</td>
<td>8.2 HSPF before 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td>Through the wall Space constrained, air cooled (heating mode)</td>
<td>≤30,000 Btu/h (^2)</td>
<td>Split system, three phase and applications outside U.S. single phase(^2)</td>
<td>7.4 HSPF before 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td>Small duct high velocity, air cooled (heating mode)</td>
<td>≤65,000 Btu/h (^2)</td>
<td>Split system, three phase and applications outside U.S. single phase(^2)</td>
<td>6.8 HSPF before 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY</td>
<td>HEATING SECTION TYPE</td>
<td>SUBCATEGORY OR RATING CONDITION</td>
<td>MINIMUM EFFICIENCY</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td>----------------------</td>
<td>---------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Air cooled (heating mode)</td>
<td>&gt;/=65 000 Btu/hc and &lt;135 000 Btu/h (cooling capacity)</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.3 COPH before 1/1/2023 3.40 COPH before 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>17°F db/15°F wb outdoor air</td>
<td>2.25 COPH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=135 000 Btu/h (cooling capacity) and &lt;240 000 Btu/h</td>
<td></td>
<td>3.20 COPH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>17°F db/15°F wb outdoor air</td>
<td>2.05 COPH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=240 000 Btu/h (cooling capacity)</td>
<td></td>
<td>3.20 COPH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>17°F db/15°F wb outdoor air</td>
<td>2.05 COPH</td>
<td></td>
</tr>
<tr>
<td>Water to air, water loop (heating mode)</td>
<td>&lt;135 000 Btu/h (cooling capacity)</td>
<td>68°F entering water</td>
<td>4.3 COPH</td>
<td>ISO-13256-1</td>
</tr>
<tr>
<td>Water to air, groundwater (heating mode)</td>
<td>&lt;135 000 Btu/h (cooling capacity)</td>
<td>60°F entering water</td>
<td>3.7 COPH</td>
<td>ISO-13256-1</td>
</tr>
<tr>
<td>Brine to air, ground loop (heating mode)</td>
<td>&lt;135 000 Btu/h (cooling capacity)</td>
<td>32°F entering fluid</td>
<td>3.2 COPH</td>
<td>ISO-13256-1</td>
</tr>
<tr>
<td>Water to water, water loop (heating mode)</td>
<td>&lt;135 000 Btu/h (cooling capacity)</td>
<td>68°F entering water</td>
<td>3.7 COPH</td>
<td>ISO-13256-2</td>
</tr>
<tr>
<td>Water to water, groundwater (heating mode)</td>
<td>&lt;135 000 Btu/h (cooling capacity)</td>
<td>60°F entering water</td>
<td>3.1 COPH</td>
<td>ISO-13256-2</td>
</tr>
<tr>
<td>Brine to water, ground loop (heating mode)</td>
<td>&lt;135 000 Btu/h (cooling capacity)</td>
<td>32°F entering fluid</td>
<td>2.5 COPH</td>
<td>ISO-13256-2</td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW, °C = (°F-32)/1.8

Notes:
1 ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
Single-phase, **U.S. air-cooled heat pumps less than 65,000 Btu/h (19 kW)** are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430. SEER, SEER2, and HSPF values for single-phase products are set by the U.S. Department of Energy.

### Table E 503.7.1(4)

**Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps - Minimum Efficiency Requirements**

[ASHRAE 90.1: Table 6.8.1-4]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTAC (cooling mode) standard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>11.9 EER (before 1/1/2015)</td>
<td>AHRI 310/380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15,000 Btu/h</td>
<td></td>
<td>14.0 – (0.300 x Cap/1000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15,000 Btu/h</td>
<td></td>
<td>9.5 EER</td>
<td></td>
</tr>
<tr>
<td>PTAC (cooling mode) nonstandard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>9.4 EER</td>
<td>AHRI 310/380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15,000 Btu/h</td>
<td></td>
<td>10.9 – (0.213 x Cap/1000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15,000 Btu/h</td>
<td></td>
<td>7.7 EER</td>
<td></td>
</tr>
<tr>
<td>PTHP (cooling mode) standard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>11.9 EER</td>
<td>AHRI 310/380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15,000 Btu/h</td>
<td></td>
<td>14.0 – (0.300 x Cap/1000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15,000 Btu/h</td>
<td></td>
<td>9.5 EER</td>
<td></td>
</tr>
<tr>
<td>PTHP (cooling mode) nonstandard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>9.3 EER</td>
<td>AHRI 310/380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15,000 Btu/h</td>
<td></td>
<td>10.8 – (0.213 x Cap/1000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15,000 Btu/h</td>
<td></td>
<td>7.6 EER</td>
<td></td>
</tr>
<tr>
<td>PTHP (heating mode) standard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.3 COPH</td>
<td>AHRI 310/380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15,000 Btu/h</td>
<td></td>
<td>3.7 – (0.052 x Cap/1000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15,000 Btu/h</td>
<td></td>
<td>2.90 COPH</td>
<td></td>
</tr>
<tr>
<td>PTHP (heating mode) nonstandard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>47°F db/43°F wb outdoor air</td>
<td>2.7 COPH</td>
<td>AHRI 310/380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15,000 Btu/h</td>
<td></td>
<td>2.9 – (0.026 x Cap/1000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15,000 Btu/h</td>
<td></td>
<td>2.5 COPH</td>
<td></td>
</tr>
<tr>
<td>SPVAC (cooling mode) single and three phase</td>
<td>&lt;65,000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>10.0 EER</td>
<td>AHRI 390</td>
</tr>
<tr>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;=135,000 Btu/h</td>
<td></td>
<td>10.0 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=135,000 Btu/h and &lt;240,000 Btu/h</td>
<td></td>
<td>10.0 EER</td>
<td></td>
</tr>
<tr>
<td>SPVHP (cooling mode)</td>
<td>&lt;65,000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>10.0 EER</td>
<td>AHRI 390</td>
</tr>
<tr>
<td></td>
<td>&gt;=65,000 Btu/h and</td>
<td></td>
<td>10.0 EER</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE E 503.7.1(4) (continued)
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE-PACKAGE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS, AND ROOM AIR CONDITIONER HEAT PUMPS - MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-4]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY 4</th>
<th>TEST PROCEDURE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room air conditioners without louvered sides</td>
<td>&lt;8000-6000 Btu/h</td>
<td></td>
<td>9.9 10.0 CEER</td>
<td>AHAM RAC-1</td>
</tr>
<tr>
<td></td>
<td>&gt;/=6000 Btu/h and &lt;8000 Btu/h</td>
<td></td>
<td>9.9 10.0 CEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=8000 Btu/h and &lt;20 000 Btu/h</td>
<td></td>
<td>9.6 10.6 CEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=20 000 Btu/h</td>
<td></td>
<td>9.5 CEER</td>
<td></td>
</tr>
<tr>
<td>Room air conditioners heat pumps with reversed cycle, with</td>
<td>&lt;20 000 Btu/h</td>
<td></td>
<td>9.9 9.8 CEER</td>
<td>AHAM RAC-1</td>
</tr>
<tr>
<td></td>
<td>&gt;/=20 000 Btu/h</td>
<td></td>
<td>8.5 9.3 CEER</td>
<td></td>
</tr>
</tbody>
</table>

### Room air conditioners

#### Table entries:
- **<135 000 Btu/h**
  - **outdoor air:** 3.0 COPH
  - **47°F db/43°F wb**
  - **3.0 COPH**
- **>/=135 000 Btu/h and <240 000 Btu/h**
  - **outdoor air:** 10.0 EER
- **>/=240 000 Btu/h**
  - **outdoor air:** 3.0 COPH
- **>/=65 000 Btu/h and <135 000 Btu/h**
  - **47°F db/43°F wb**
  - **3.0 COPH**

### Room air conditioners with reverse cycle for applications outside U.S.

#### Table entries:
- **<6000 Btu/h**
  - **9.7 10.0 CSEER**
- **>/=6000 Btu/h and <8000 Btu/h**
  - **9.7 10.0 CSEER**
- **>/=8000 Btu/h and <14 000 Btu/h**
  - **9.6 10.6 CEER**
- **>/=14 000 Btu/h and <20 000 Btu/h**
  - **9.6 10.6 CEER**
- **>/=20 000 Btu/h and <28 000 Btu/h**
  - **8.5 9.4 CEER**
- **>/=28 000 Btu/h**
  - **9.0 CEER**

### SPVAC (cooling mode), nonweatherized space-constrained

#### Table entries:
- **=30 000 Btu/h**
  - **9.2 EER**
- **>/=30 000 Btu/h and <36 000 Btu/h**
  - **9.0 EER**
- **>/=36 000 Btu/h**
  - **8.5 9.4 CEER**

### SPVHP (heating mode), nonweatherized space-constrained

#### Table entries:
- **=30 000 Btu/h**
  - **3.0 COPH**
- **>/=30 000 Btu/h and <36 000 Btu/h**
  - **3.0 COPH**
- **>/=36 000 Btu/h**
  - **8.5 9.4 CEER**

### SPVHP (cooling mode), nonweatherized space-constrained

#### Table entries:
- **=30 000 Btu/h**
  - **9.2 EER**
- **>/=30 000 Btu/h and <36 000 Btu/h**
  - **9.0 EER**
- **>/=36 000 Btu/h**
  - **8.5 9.4 CEER**

### Room air conditioners with reverse cycle with louvered sides for applications outside U.S.

#### Table entries:
- **<6000 Btu/h**
  - **9.7 11.0 CSEER**
- **>/=6000 Btu/h and <8000 Btu/h**
  - **9.7 11.0 CSEER**
- **>/=8000 Btu/h and <14 000 Btu/h**
  - **9.8 10.9 CEER**
- **>/=14 000 Btu/h and <20 000 Btu/h**
  - **9.7 10.7 CEER**
- **>/=20 000 Btu/h and <28 000 Btu/h**
  - **8.5 9.4 CEER**
- **>/=28 000 Btu/h**
  - **9.0 CEER**
louvered sides for applications outside U.S.

| Room air conditioners, heat pumps with reverse cycle without louvered sides for applications outside U.S. | <14 000 Btu/h | 8.5 9.3 CEER | AHAM RAC-1 |
| Room air conditioners, casement only for applications outside U.S. | All capacities | 8.7 9.5 CEER | AHAM RAC-1 |
| Room air conditioners, casement slider for applications outside U.S. | All capacities | 9.5 10.4 CEER | AHAM RAC-1 |

For SI units: 1000 British thermal units per hour = 0.293 kW, °C = (°F-32)/1.8

Notes:
1 ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2 Nonstandard size units must be factory labeled as follows: “MANUFACTURED FOR NONSTANDARD SIZE APPLICATIONS ONLY, NOT TO BE INSTALLED IN NEW STANDARD PROJECTS.” Nonstandard size efficiencies apply only to units being installed in existing sleeves having an external wall opening of less than 16 inch (406 mm) high or less than 42 inch (1067 mm) wide and having a cross-sectional area less than 670 square inches (0.432 m²).
3 “Cap” means the rated cooling capacity of the product in Btu/h (kW). If the unit’s capacity is less than 7000 Btu/h (2.05 kW), use 7000 Btu/h (2.05 kW) in the calculation. Where the unit’s capacity is more than 15 000 Btu/h (4.4 kW), use 15 000 Btu/h (4.4 kW) in the calculation.
4 The cooling-mode wet bulb temperature requirement only applies for units that reject condensate to the condenser coil.
5 Room air conditioners are regulated as consumer products by 10 CFR 430. For U.S. applications of room air conditioners, refer to Informative Appendix F, Table F-3, for the USDOE minimum efficiency requirements for U.S. applications.

**TABLE E 503.7.1(5)**

WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES, AND UNIT HEATERS - MINIMUM EFFICIENCY REQUIREMENTS

| EQUIPMENT TYPE | SIZE CATEGORY (INPUT) | SUBCATEGORY OR RATING CONDITION | MINIMUM EFFICIENCY | TEST PROCEDURE
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-air furnace, gas fired for application outside the U.S.</td>
<td>&lt;225 000 Btu/h</td>
<td>Maximum capacity</td>
<td>78% AFUE or 80% EF</td>
<td>DOE-Appendix N of 10 CFR Part 430 or Section 2.39, Thermal Efficiency, CSA Z21.47</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>80% AFUE (nonweatherized) or 81% AFUE (weatherized) or 80% EF</td>
<td></td>
</tr>
<tr>
<td>System Type</td>
<td>Capacity Range</td>
<td>Rating Requirements</td>
<td>Section/Standard</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Warm-air furnace, oil fired for application outside the U.S.</td>
<td>$\geq 225,000$ Btu/h</td>
<td>80% $E_t^{2,4}$ before 1/1/2023, 81% $E_t^{4}$ after 1/1/2023</td>
<td>Section 2.39, Thermal Efficiency, CSA Z21.47</td>
<td></td>
</tr>
<tr>
<td>Warm-air furnace, oil fired</td>
<td>$&lt; 225,000$ Btu/h</td>
<td>Maximum capacity $^3$, 83% AFUE (nonweatherized) or 78% AFUE (weatherized) or 80% $E_t^{2,4}$</td>
<td>Appendix N of 10 CFR 430 or Section 42, Combustion, UL 727</td>
<td></td>
</tr>
<tr>
<td>Electric furnaces for applications outside the U.S.</td>
<td>$&lt; 225,000$ Btu/h</td>
<td>All $^7$, 96% AFUE</td>
<td>Appendix N of 10 CFR 430</td>
<td></td>
</tr>
<tr>
<td>Warm-air duct furnaces, gas fired</td>
<td>All capacities</td>
<td>Maximum capacity $^3$, 80% $E_c^{5}$</td>
<td>Section 2.10, Efficiency, CSA Z83.8</td>
<td></td>
</tr>
<tr>
<td>Warm-air unit heaters, gas fired</td>
<td>All capacities</td>
<td>Maximum capacity $^3$, 80% $E_c^{5,6}$</td>
<td>Section 2.10, Efficiency, CSA Z83.8</td>
<td></td>
</tr>
<tr>
<td>Warm-air unit heaters, oil fired</td>
<td>All capacities</td>
<td>Maximum capacity $^3$, 80% $E_c^{5,6}$</td>
<td>Section 40, Combustion, UL 731</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW

**Notes:**
1. ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2. Combination units (i.e., furnaces contained within the same cabinet as an air conditioner) not covered by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430 [(i.e., three-phase power or with cooling capacity greater than or equal to 65,000 Btu/h (19 kW)] may comply with either rating. All other units greater than 225,000 Btu/h (66 kW) sold in the U.S. must meet the AFUE standards for consumer products and test using USDOE’s AFUE test procedure at 10 CFR 430, Subpart B, Appendix N.
3. Compliance of multiple firing rate units shall be at the maximum firing rate.
4. $E_t$ = thermal efficiency. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
5. $E_c$ = combustion efficiency (100 percent less flue losses). See test procedure for detailed discussion.
6. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.
7. For U.S. applications of federal covered greater than 225,000 Btu/h (66 kW) products, see Informative Appendix F, Table F-4 of ASHRAE 90.1.
### Table E 503.7.1(6)
**GAS- AND OIL-FIRED BOILERS - MINIMUM EFFICIENCY REQUIREMENTS**

**[ASHRAE 90.1: TABLE 6.8.1-6]**

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>MINIMUM EFFICIENCY</th>
<th>EFFICIENCY AS OF 3/2/2020</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers, hot water</td>
<td>Gas fired(^6)</td>
<td>&lt;300,000 Btu/h, for applications outside U.S.(^9)</td>
<td>82% AFUE</td>
<td>82% AFUE</td>
<td><strong>Appendix N of 10 CFR Part 430</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;300,000 Btu/h and ≤2,500,000 Btu/h</td>
<td>80% Et(^3)</td>
<td>80% Et(^3)</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2,500,000 Btu/h(^1); 4</td>
<td>82% Ec(^2)</td>
<td>82% Ec(^2)</td>
<td></td>
</tr>
<tr>
<td>Boilers, hot water</td>
<td>Oil fired(^5)</td>
<td>&lt;300,000 Btu/h, for applications outside U.S.(^9)</td>
<td>84% AFUE</td>
<td>84% AFUE</td>
<td><strong>Appendix N of 10 CFR Part 430</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;300,000 Btu/h and ≤2,500,000 Btu/h</td>
<td>82% Et(^2)</td>
<td>82% Et(^2)</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2,500,000 Btu/h(^1); 4</td>
<td>84% Ec(^2)</td>
<td>84% Ec(^2)</td>
<td></td>
</tr>
<tr>
<td>Boilers, steam</td>
<td>Gas fired</td>
<td>&lt;300,000 Btu/h, for applications outside U.S.(^9)</td>
<td>80% AFUE</td>
<td>80% AFUE</td>
<td><strong>Appendix N of 10 CFR Part 430</strong></td>
</tr>
<tr>
<td></td>
<td>Gas fired— all, except natural draft</td>
<td>&gt;300,000 Btu/h and ≤2,500,000 Btu/h</td>
<td>79% Et(^3)</td>
<td>79% Et(^3)</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2,500,000 Btu/h(^1); 4</td>
<td>79% Et(^3)</td>
<td>79% Et(^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gas fired— natural draft</td>
<td>&gt;300,000 Btu/h and ≤2,500,000 Btu/h</td>
<td>77% Et(^3)</td>
<td>79% Et(^3)</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2,500,000 Btu/h(^1); 4</td>
<td>77% Et(^3)</td>
<td>79% Et(^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil fired(^5)</td>
<td>&lt;300,000 Btu/h, for applications outside U.S.(^9)</td>
<td>82% AFUE</td>
<td>82% AFUE</td>
<td><strong>Appendix N of 10 CFR Part 430</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;300,000 Btu/h and ≤2,500,000 Btu/h</td>
<td>81% Et(^3)</td>
<td>81% Et(^3)</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2,500,000 Btu/h(^1); 4</td>
<td>81% Et(^3)</td>
<td>81% Et(^3)</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW

**Notes:**

1. These requirements apply to boilers with rated input of 8,000,000 Btu/h (2343 kW) or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.
2. \(Ec\) = combustion efficiency (100 percent less flue losses). See reference document for detailed information.
3. $E_t = \text{thermal efficiency. See reference document for detailed information.}$
4. Maximum capacity—minimum and maximum ratings as provided for and allowed by the unit’s controls.
5. Includes oil-fired (residual).
6. Boilers shall not be equipped with a constant burning pilot light.
7. A boiler not equipped with a tankless domestic water-heating coil shall be equipped with an automatic means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.
8. For new construction, refer to Section E 503.4 for additional system compliance requirements.
9. See Informative Appendix F, Table F-4 of ASHRAE 90.1, for U.S. minimum efficiencies for residential products covered by USDOE requirements for U.S. applications.

### TABLE E 503.7.1(7)

**PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT—MINIMUM EFFICIENCY REQUIREMENTS**

**[ASHRAE 90.1: TABLE 6.8.1-7]**

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>TOTAL SYSTEM HEAT-REJECTION CAPACITY AT RATED CONDITIONS</th>
<th>SUBCATEGORY OR RATING CONDITION$^8$</th>
<th>PERFORMANCE REQUIRED$^{1,2,3,6,7}$</th>
<th>TEST PROCEDURE$^{4,5}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propeller or axial fan open- circuit cooling towers</td>
<td>All</td>
<td>$95^\circ\text{F entering water}$ $85^\circ\text{F leaving water}$ $75^\circ\text{F entering wb}$</td>
<td>$\geq 40.2 \text{ gpm/hp}$</td>
<td>CTI ATC-105 and CTI STD-201 RS</td>
</tr>
<tr>
<td>Centrifugal fan open-circuit cooling towers</td>
<td>All</td>
<td>$95^\circ\text{F entering water}$ $85^\circ\text{F leaving water}$ $75^\circ\text{F entering wb}$</td>
<td>$\geq 20.0 \text{ gpm/hp}$</td>
<td>CTI ATC-105 and CTI STD-201 RS</td>
</tr>
<tr>
<td>Propeller or axial fan closed- circuit cooling towers</td>
<td>All</td>
<td>$102^\circ\text{F entering water}$ $90^\circ\text{F leaving water}$ $75^\circ\text{F entering wb}$</td>
<td>$\geq 16.1 \text{ gpm/hp}$</td>
<td>CTI ATC-105S and CTI STD-201 RS</td>
</tr>
<tr>
<td>Centrifugal closed-circuit cooling towers</td>
<td>All</td>
<td>$102^\circ\text{F entering water}$ $90^\circ\text{F leaving water}$ $75^\circ\text{F entering wb}$</td>
<td>$\geq 7.0 \text{ gpm/hp}$</td>
<td>CTI ATC-105S and CTI STD-201 RS</td>
</tr>
<tr>
<td>Propeller or axial fan dry coolers (air-cooled fluid coolers)</td>
<td>All</td>
<td>$115^\circ\text{F entering water}$ $105^\circ\text{F leaving water}$ $95^\circ\text{F entering wb}$</td>
<td>$\geq 4.5 \text{ gpm/hp}$</td>
<td>CTI ATC-105DS</td>
</tr>
<tr>
<td>Propeller or axial fan evaporative condensers</td>
<td>All</td>
<td>R-507A R-448A test fluid $165^\circ\text{F entering gas temperature}$ $105^\circ\text{F condensing temperature}$ $75^\circ\text{F entering wb}$</td>
<td>$\geq 157\ 000 \ 160\ 000$ $\text{Btu/h·hp}$</td>
<td>CTI ATC-106</td>
</tr>
<tr>
<td>Propeller or axial fan evaporative condensers</td>
<td>All</td>
<td>Ammonia test fluid $140^\circ\text{F entering gas temperature}$ $96.3^\circ\text{F condensing temperature}$ $75^\circ\text{F entering wb}$</td>
<td>$\geq 134\ 000 \text{ Btu/h·hp}$</td>
<td>CTI ATC-106</td>
</tr>
<tr>
<td>Centrifugal fan evaporative condensers</td>
<td>All</td>
<td>R-507A R-448A test fluid $165^\circ\text{F entering gas temperature}$ $105^\circ\text{F condensing temperature}$ $75^\circ\text{F entering wb}$</td>
<td>$\geq 135\ 000 \ 137\ 000$ $\text{Btu/h·hp}$</td>
<td>CTI ATC-106</td>
</tr>
<tr>
<td>Centrifugal fan evaporative condensers</td>
<td>All</td>
<td>Ammonia test fluid $140^\circ\text{F entering gas temperature}$ $96.3^\circ\text{F}$</td>
<td>$\geq 110\ 000 \text{ Btu/h·hp}$</td>
<td>CTI ATC-106</td>
</tr>
</tbody>
</table>
Air cooled condensers

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Subcategory</th>
<th>Minimum Efficiency</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid-to-liquid heat exchangers</td>
<td>Plate type</td>
<td>NR</td>
<td>AHRI 400</td>
</tr>
</tbody>
</table>

**Notes:**

1. For purposes of this table, open-circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table E 503.7.1(7) divided by the fan motor nameplate power.

2. For purposes of this table, closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the thermal rating condition listed in Table E 503.7.1(7) divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

3. For purposes of this table, dry-cooler performance is defined as the process water flow rating of the unit at the thermal rating condition listed in this table divided by the total fan motor nameplate power of the unit, and air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the total fan motor nameplate power of the unit.

4. ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

5. The efficiencies and test procedures for both open- and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections. The certification requirements do not apply to field-erected cooling towers.

6. All cooling towers shall comply with the minimum efficiency listed in the table for that specific type of tower with the capacity effect of any project-specific accessories and/or options included in the capacity of the cooling tower.

7. For purposes of this table, evaporative condenser performance is defined as the heat rejected at the specified rating condition in the table, divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.

8. Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A-448A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A-448A must meet the minimum efficiency requirements listed above with R-507A-448A as the test fluid. For ammonia, the condensing temperature is defined as the saturation temperature corresponding to the refrigerant pressure at the condenser entrance. For R-448A, which is a zeotropic refrigerant, the condensing temperature is defined as the arithmetic average of the dew point and the bubble point temperatures corresponding to the refrigerant pressure at the condenser entrance.
### TABLE E 503.7.1(10) 503.7.1(9)
ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AND APPLIED HEAT PUMPS - MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-10 6.8.1-9]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRF air cooled (cooling mode)</td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system</td>
<td>13.0 SEER</td>
</tr>
<tr>
<td></td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>VRF multisplit system</td>
<td>11.0 EER (as of 1/1/2017)</td>
</tr>
<tr>
<td></td>
<td>&gt;=135 000 Btu/h and &lt;240 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>VRF multisplit system</td>
<td>10.4 EER (as of 1/1/2017)</td>
</tr>
<tr>
<td></td>
<td>&gt;=240 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>VRF multisplit system</td>
<td>9.3 EER (as of 1/1/2017)</td>
</tr>
<tr>
<td>VRF water source (cooling mode)</td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit systems 86°F entering water</td>
<td>12.0 EER (as of 1/1/2017)</td>
</tr>
<tr>
<td></td>
<td>VRF multisplit</td>
<td>11.8 EER</td>
<td>AHRI 1230</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW
<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRF groundwater source (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system with heat recovery 59°F entering water</td>
<td>16.2 EER</td>
<td>AHRI 1230</td>
</tr>
<tr>
<td></td>
<td>&gt;/=135 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system with heat recovery 59°F entering water</td>
<td>16.0 EER</td>
<td></td>
</tr>
<tr>
<td>VRF ground source (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system with heat recovery 77°F entering water</td>
<td>13.4 EER</td>
<td>AHRI 1230</td>
</tr>
<tr>
<td></td>
<td>&gt;/=135 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system with heat recovery 77°F entering water</td>
<td>13.2 EER</td>
<td></td>
</tr>
<tr>
<td>VRF Air cooled (heating mode)</td>
<td>&lt;65 000 Btu/h (cooling capacity)</td>
<td>—</td>
<td>VRF Multi-split system</td>
<td>7.7 HSPF</td>
<td>AHRI 1230</td>
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<tr>
<td></td>
<td>&gt;/=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>—</td>
<td>VRF Multisplit system 47°F db/43°F wb outdoor air</td>
<td>3.3 COPH</td>
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</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>NET-SENSIBLE COOLING CAPACITY</td>
<td>STANDARD MODEL</td>
<td>RETURN AIR DRY-BULB TEMPERATURE/DEW-POINT TEMPERATURE</td>
<td>MINIMUM-SENSIBLE COPe</td>
<td>TEST PROCEDURE</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------</td>
<td>----------------</td>
<td>----------------------------------------------</td>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Air-cooled</td>
<td>&lt;65,000 Btu/h</td>
<td>Downflow-unit</td>
<td>75°F/52°F/85°F/52°F/95°F/52°F</td>
<td>2.30</td>
<td>AHRI 1360</td>
</tr>
<tr>
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<td>Upflow-unit-ducted</td>
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<td>Upflow-unit-nonducted</td>
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<td>2.45</td>
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<td></td>
<td>=65,000 Btu/h and</td>
<td>Downflow-unit</td>
<td>75°F/52°F/85°F/52°F/95°F/52°F</td>
<td>2.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;240,000 Btu/h</td>
<td>Upflow-unit-ducted</td>
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<td>2.05</td>
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<tr>
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<td></td>
<td>Upflow-unit-nonducted</td>
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<td>1.99</td>
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<td>Horizontal-flow-unit</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>=240,000 Btu/h</td>
<td>Downflow-unit</td>
<td>75°F/52°F/85°F/52°F/95°F/52°F</td>
<td>2.00</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW, °C=(°F-32)/1.8
<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>NET-SENSIBLE COOLING CAPACITY</th>
<th>STANDARD MODEL</th>
<th>MINIMUM NET-SENSIBLE COPc</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycol-cooled</td>
<td>≤65,000 Btu/h</td>
<td>Downflow unit</td>
<td>2.30</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upflow-unit-d</td>
<td>2.10</td>
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<td></td>
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<td>Horizontal-fl</td>
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<td>≥65,000 Btu/h and</td>
<td>Downflow unit</td>
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<td></td>
<td>&lt;240,000 Btu/h</td>
<td>Upflow-unit-d</td>
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<td>1.85</td>
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<td>2.15</td>
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<td>≥240,000 Btu/h</td>
<td>Downflow unit</td>
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<td>nonducted</td>
<td>2.00</td>
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<td>Downflow unit</td>
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<td>Upflow-unit-d</td>
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<tr>
<td></td>
<td></td>
<td>nonducted</td>
<td>2.05</td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>&gt;240,000 Btu/h</td>
<td>Downflow unit</td>
<td>2.15</td>
<td>AHRI 1360</td>
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<tr>
<td></td>
<td></td>
<td>Upflow-unit-d</td>
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<td>nonducted</td>
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TABLE E 503.7.1(11) (continued)
AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-11]
<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Standard Model</th>
<th>Net Sensible Cooling Capacity</th>
<th>Minimum Net Sensible COP</th>
<th>Rating Conditions Return air (dry bulb/dew point)</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled</td>
<td>Downflow</td>
<td>&lt;80 000 Btu/h</td>
<td>2.70</td>
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<tr>
<td></td>
<td></td>
<td>&gt;/=80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=295 000 Btu/h</td>
<td>2.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—ducted</td>
<td>&lt;80 000 Btu/h</td>
<td>2.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.55</td>
<td></td>
<td>AHRI 1360</td>
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<tr>
<td></td>
<td></td>
<td>&gt;/=295 000 Btu/h</td>
<td>2.33</td>
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<tr>
<td></td>
<td>Upflow—nonducted</td>
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<td>2.16</td>
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<tr>
<td></td>
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<td>&gt;/=65 000 Btu/h and &lt;240 000 Btu/h</td>
<td>2.04</td>
<td>75°F/52°F (Class 1)</td>
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<tr>
<td></td>
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<td>&gt;/=240 000 Btu/h</td>
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<tr>
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<td>Horizontal</td>
<td>&lt;65 000 Btu/h</td>
<td>2.65</td>
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<tr>
<td></td>
<td></td>
<td>&gt;/=65 000 Btu/h and &lt;240 000 Btu/h</td>
<td>2.55</td>
<td>95°F/52°F (Class 3)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=240 000 Btu/h</td>
<td>2.47</td>
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<td></td>
</tr>
<tr>
<td>Air cooled with fluid economizer</td>
<td>Downflow</td>
<td>&lt;80 000 Btu/h</td>
<td>2.70</td>
<td></td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=295 000 Btu/h</td>
<td>2.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—ducted</td>
<td>&lt;80 000 Btu/h</td>
<td>2.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=295 000 Btu/h</td>
<td>2.33</td>
<td></td>
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</table>
### TABLE E 503.7.1(10)

**FLOOR-MOUNTED AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS—MINIMUM EFFICIENCY REQUIREMENTS (CONTINUED)**

[ASHRAE 90.1: TABLE 6.8.1-10]

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Standard Model</th>
<th>Net Sensible Cooling Capacity</th>
<th>Minimum Net Sensible COP</th>
<th>Rating Conditions</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water cooled</td>
<td>Downflow</td>
<td>&lt;80,000 Btu/h</td>
<td>2.82</td>
<td>85°F/52°F (Class 1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—ducted</td>
<td>&lt;80,000 Btu/h</td>
<td>2.79</td>
<td></td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—nonducted</td>
<td>&lt;65,000 Btu/h</td>
<td>2.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.32</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Horizontal</td>
<td>&lt;65,000 Btu/h</td>
<td>2.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.68</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.60</td>
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<tr>
<td>Water cooled with fluid economizer</td>
<td>Downflow</td>
<td>&lt;80,000 Btu/h</td>
<td>2.77</td>
<td>85°F/52°F (Class 1)</td>
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</tr>
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<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.68</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
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<td></td>
<td>Upflow—ducted</td>
<td>&lt;80,000 Btu/h</td>
<td>2.74</td>
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<td>AHRI 1360</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—nonducted</td>
<td>&lt;65,000 Btu/h</td>
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<td></td>
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</tr>
<tr>
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<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
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<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.12</td>
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<td></td>
<td>Horizontal</td>
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<td>2.71</td>
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<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.60</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.54</td>
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### TABLE E 503.7.1(10)
FLOOR-MOUNTED AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS—MINIMUM EFFICIENCY REQUIREMENTS (CONTINUED)

[ASHRAE 90.1: TABLE 6.8.1-10]

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Standard Model</th>
<th>Net Sensible Cooling Capacity</th>
<th>Minimum Net Sensible COP</th>
<th>Rating Conditions Return air (dry bulb/dew point)</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycol cooled</td>
<td>Downflow</td>
<td>&lt;80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.56</td>
<td>85°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td>Glycol cooled</td>
<td>Downflow</td>
<td>&gt;=80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol cooled</td>
<td>Downflow</td>
<td>&gt;=295 000 Btu/h</td>
<td>2.21</td>
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<td>Glycol cooled</td>
<td>Upflow, ducted</td>
<td>&lt;80 000 Btu/h</td>
<td>2.53</td>
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<tr>
<td>Glycol cooled</td>
<td>Upflow, ducted</td>
<td>&gt;=80 000 Btu/h and &lt;295 000 Btu/h</td>
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<td>Glycol cooled</td>
<td>Upflow, ducted</td>
<td>&gt;=295 000 Btu/h</td>
<td>2.18</td>
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<td>Upflow, nonducted</td>
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<td>Glycol cooled</td>
<td>Upflow, nonducted</td>
<td>&gt;=65 000 Btu/h and &lt;240 000 Btu/h</td>
<td>1.90</td>
<td>75°F/52°F (Class 1)</td>
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<td>Glycol cooled</td>
<td>Upflow, nonducted</td>
<td>&gt;=240 000 Btu/h</td>
<td>1.81</td>
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<td>Glycol cooled</td>
<td>Horizontal</td>
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</tr>
<tr>
<td>Glycol cooled</td>
<td>Horizontal</td>
<td>&gt;=80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.19</td>
<td>85°F/52°F (Class 1)</td>
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</tr>
<tr>
<td>Glycol cooled</td>
<td>Horizontal</td>
<td>&gt;=295 000 Btu/h</td>
<td>2.15</td>
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<td></td>
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<tr>
<td>Glycol cooled with fluid economizer</td>
<td>Glycol cooled with fluid economizer</td>
<td>&lt;80 000 Btu/h and &lt;295 000 Btu/h</td>
<td>2.19</td>
<td>85°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td>Glycol cooled with fluid economizer</td>
<td>Glycol cooled with fluid economizer</td>
<td>&gt;=295 000 Btu/h</td>
<td>2.15</td>
<td>85°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
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<tr>
<td>Glycol cooled with fluid economizer</td>
<td>Glycol cooled with fluid economizer</td>
<td>&lt;65 000 Btu/h</td>
<td>2.48</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td>Glycol cooled with fluid economizer</td>
<td>Glycol cooled with fluid economizer</td>
<td>&gt;=65 000 Btu/h and &lt;240 000 Btu/h</td>
<td>1.82</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td>Glycol cooled with fluid economizer</td>
<td>Glycol cooled with fluid economizer</td>
<td>&gt;=240 000 Btu/h</td>
<td>1.73</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
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### TABLE E 503.7.1(12)
COMMERCIAL REFRIGERATOR AND FREEZERS—MINIMUM EFFICIENCY REQUIREMENTS

[ASHRAE 90.1: TABLE 6.8.1-12]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>APPLICATION</th>
<th>ENERGY USE LIMITS, KWH/DAY*</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerator with solid doors</td>
<td>Holding temperature</td>
<td>0.10 x V + 2.04</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Refrigerator with transparent doors</td>
<td>Holding temperature</td>
<td>0.12 x V + 3.34</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Freezers with solid doors</td>
<td>Holding temperature</td>
<td>0.40 x V + 1.38</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Freezers with transparent doors</td>
<td>Holding temperature</td>
<td>0.75 x V + 4.40</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Refrigerators/freezers with solid doors</td>
<td>Holding temperature</td>
<td>the greater of 0.12 x V + 3.34 or 0.70</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Commercial refrigerators</td>
<td>Pulldown</td>
<td>0.126 x V + 3.54</td>
<td>AHRI 1200</td>
</tr>
</tbody>
</table>
For SI units: 1000 British thermal units per hour per day = 0.293 kW/day
*V = the chiller or frozen compartment volume (ft³) as defined in Association of Home Appliance Manufacturers.

**TABLE E 503.7.1(11)**
COMMERCIAL REFRIGERATORS, COMMERCIAL FREEZERS, AND REFRIGERATION—MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: Table 6.8.1-11]

<table>
<thead>
<tr>
<th>EQUIPMENT CATEGORY</th>
<th>CONDENSING UNIT CONFIGURATION</th>
<th>EQUIPMENT FAMILY</th>
<th>RATING TEMP., °F</th>
<th>OPERATING TEMP., °F</th>
<th>EQUIPMENT CLASSIFICATION</th>
<th>MAXIMUM DAILY ENERGY CONSUMPTION, KWH/DAY</th>
<th>TEST STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Condensing Commercial refrigerators and commercial freezers</td>
<td>Remote (RC)</td>
<td>Vertical open (VOP)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VOP.RC.M</td>
<td>0.64 × TDA + 4.07</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>VOP.RC.L</td>
<td>2.20 × TDA + 6.85</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Semivertical open (SVO)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>SVO.RC.M</td>
<td>0.66 × TDA + 3.18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>SVO.RC.L</td>
<td>2.20 × TDA + 6.85</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal open (HZO)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>HZO.RC.M</td>
<td>0.35 × TDA + 2.88</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>HZO.RC.L</td>
<td>0.55 × TDA + 6.88</td>
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<tr>
<td></td>
<td></td>
<td>Vertical closed transparent (VCT)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VCT.RC.M</td>
<td>0.15 × TDA + 1.95</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>VCT.RC.L</td>
<td>0.49 × TDA + 2.61</td>
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<tr>
<td></td>
<td></td>
<td>Horizontal closed Transparent (HCT)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>HCT.RC.M</td>
<td>0.16 × TDA + 0.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>HCT.RC.L</td>
<td>0.34 × TDA + 0.26</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Vertical closed solid (VCS)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VCS.RC.M</td>
<td>0.10 × TDA + 0.26</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>VCS.RC.L</td>
<td>0.21 × TDA + 0.54</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal closed solid (HCS)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>HCS.RC.M</td>
<td>0.10 × TDA + 0.26</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>HCS.RC.L</td>
<td>0.21 × TDA + 0.54</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Service over counter (SOC)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>SOC.RC.M</td>
<td>0.44 × TDA + 0.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>SOC.RC.L</td>
<td>0.93 × TDA + 0.22</td>
<td></td>
</tr>
<tr>
<td>Self-contained Commercial refrigerators and commercial freezers with and without doors</td>
<td>Self-contained (SC)</td>
<td>Vertical open (VOP)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VOP.SC.M</td>
<td>1.69 × TDA + 4.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>VOP.SC.L</td>
<td>4.25 × TDA + 11.82</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Semivertical open (SVO)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>SVO.SC.M</td>
<td>1.70 × TDA + 4.59</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>SVO.SC.L</td>
<td>4.26 × TDA + 11.51</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal open (HZO)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>HZO.SC.M</td>
<td>0.72 × TDA + 5.55</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>HZO.RC.L</td>
<td>1.90 × TDA + 7.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical closed transparent (VCT)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VCT.SC.M</td>
<td>0.10 × TDA + 0.86</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>VCT.SC.L</td>
<td>0.29 × TDA + 2.95</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VCS.SC.M</td>
<td>0.05 × TDA + 1.36</td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT CATEGORY</td>
<td>CONDENSING UNIT CONFIGURATION</td>
<td>EQUIPMENT FAMILY</td>
<td>RATING TEMP., °F</td>
<td>OPERATING TEMP., °F</td>
<td>EQUIPMENT CLASSIFICATION</td>
<td>MAXIMUM DAILY ENERGY CONSUMPTION, KWH/DAY</td>
<td>TEST STANDARD</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>--------------------------</td>
<td>------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Commercial ice-cream freezers</td>
<td>Remote (RC)</td>
<td>Vertical Open (VOP)</td>
<td>–15 (I)</td>
<td>&lt;–5</td>
<td>VOP.RC.I</td>
<td>2.79 × TDA + 8.70</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Semivertical Open (SVO)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal Open (HZO)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical Closed Transparent (VCT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal Closed Transparent (HCT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical Closed Solid (VCS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal Closed Solid (HCS)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Service Over Counter (SOC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-contained (SC)</td>
<td>Pull-down (PD)</td>
<td>38 (M)</td>
<td>&gt;=32</td>
<td>PD.SC.M</td>
<td>0.11 × V + 0.81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-contained</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE E 503.7.1(11)
COMMERCIAL REFRIGERATORS, COMMERCIAL FREEZERS, AND REFRIGERATION—MINIMUM EFFICIENCY REQUIREMENTS (Continued)
[ASHRAE 90.1: TABLE 6.8.1-11]
1. The meaning of the letters in this column is indicated in the columns to the left.
2. “Ice-cream freezer” is defined in 10 CFR 431.62 as a commercial freezer that is designed to operate at or below –5°F and that the manufacturer designs, markets, or intends for the storing, displaying, or dispensing of ice cream.
3. Equipment class designations consist of a combination (in sequential order separated by periods (AAA).(BB).(C)) of the following:
   a. (AAA)—An equipment family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical closed transparent doors, VCS = vertical closed solid doors, HCT = horizontal closed transparent doors, HCS = horizontal closed solid doors, and SOC = service over counter);
   b. (BB)—An operating mode code (RC = remote condensing and SC = self-contained); and
   c. (C)—A rating temperature code (M = medium temperature [38°F], L = low temperature [0°F], or I = ice cream temperature [–15°F]). For example, “VOP.RC.M” refers to the “vertical open, remote condensing, medium temperature” equipment class.
4. V is the volume of the case (ft³) as measured in AHRI 1200, Appendix C.
5. TDA is the total display area of the case (ft²) as measured in AHRI 1200, Appendix D.

### Table E 503.7.1(13)
COMMERCIAL REFRIGERATION – MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-13]

<table>
<thead>
<tr>
<th>EQUIPMENT CLASS</th>
<th>FAMILY CODE</th>
<th>OPERATING MODE</th>
<th>RATING TEMPERATURE</th>
<th>ENERGY USE LIMITS2,3 KWH/DAY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOP.RC.M</td>
<td>Vertical-open</td>
<td>Remote-condensing</td>
<td>Medium-temperature</td>
<td>0.82 × TDA + 4.07</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>SVO.RC.M</td>
<td>Semiverstical-open</td>
<td>Remote-condensing</td>
<td>Medium-temperature</td>
<td>0.83 × TDA + 3.18</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HZO.RC.M</td>
<td>Horizontal-open</td>
<td>Remote-condensing</td>
<td>Medium-temperature</td>
<td>0.35 × TDA + 2.88</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VOP.RC.L</td>
<td>Vertical-open</td>
<td>Remote-condensing</td>
<td>Low-temperature</td>
<td>2.27 × TDA + 6.85</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HZO.RC.L</td>
<td>Horizontal-open</td>
<td>Remote-condensing</td>
<td>Low-temperature</td>
<td>0.57 × TDA + 6.88</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Condensing Type</td>
<td>Temperature</td>
<td>Equation</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>-----------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>VCT.RC.M</td>
<td>Vertical transparent door</td>
<td>Remote-condensing</td>
<td>Medium</td>
<td>$0.22 \times TDA + 1.95$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VCT.RC.L</td>
<td>Vertical transparent door</td>
<td>Remote-condensing</td>
<td>Low</td>
<td>$0.56 \times TDA + 2.64$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>SOC.RC.M</td>
<td>Service over counter</td>
<td>Remote-condensing</td>
<td>Medium</td>
<td>$0.61 \times TDA + 0.41$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VOP.SC.M</td>
<td>Vertical-open</td>
<td>Self-contained</td>
<td>Medium</td>
<td>$1.74 \times TDA + 4.74$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>SVO.SC.M</td>
<td>Semivertical-open</td>
<td>Self-contained</td>
<td>Medium</td>
<td>$1.73 \times TDA + 4.59$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HZO.SC.M</td>
<td>Horizontal-open</td>
<td>Self-contained</td>
<td>Medium</td>
<td>$0.77 \times TDA + 5.55$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HZO.SC.L</td>
<td>Horizontal-open</td>
<td>Self-contained</td>
<td>Low</td>
<td>$1.92 \times TDA + 7.08$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VCT.SC.I</td>
<td>Vertical-transparent door</td>
<td>Self-contained</td>
<td>Ice cream</td>
<td>$0.67 \times TDA + 3.29$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VCS.SC.I</td>
<td>Vertical-solid-door</td>
<td>Self-contained</td>
<td>Ice cream</td>
<td>$0.38 \times V + 0.88$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCT.SC.I</td>
<td>Horizontal-transparent door</td>
<td>Self-contained</td>
<td>Ice cream</td>
<td>$0.56 \times TDA + 0.43$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>SVO.RC.L</td>
<td>Semivertical-open</td>
<td>Remote-condensing</td>
<td>Low</td>
<td>$2.27 \times TDA + 6.85$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VOP.RC.I</td>
<td>Vertical-open</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$2.89 \times TDA + 8.7$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>SVO.RC.I</td>
<td>Semivertical-open</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$2.89 \times TDA + 8.7$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HZO.RC.I</td>
<td>Horizontal-open</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$0.72 \times TDA + 8.74$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VCT.RC.I</td>
<td>Vertical-transparent door</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$0.66 \times TDA + 3.05$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCT.RC.M</td>
<td>Horizontal-transparent door</td>
<td>Remote-condensing</td>
<td>Medium</td>
<td>$0.16 \times TDA + 0.13$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCT.RC.L</td>
<td>Horizontal-transparent door</td>
<td>Remote-condensing</td>
<td>Low</td>
<td>$0.34 \times TDA + 0.26$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCT.RC.I</td>
<td>Horizontal-transparent door</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$0.4 \times TDA + 0.31$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VCS.RC.M</td>
<td>Vertical-solid-door</td>
<td>Remote-condensing</td>
<td>Medium</td>
<td>$0.11 \times V + 0.26$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VCS.RC.L</td>
<td>Vertical-solid-door</td>
<td>Remote-condensing</td>
<td>Low</td>
<td>$0.23 \times V + 0.54$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>VCS.RC.I</td>
<td>Vertical-solid-door</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$0.27 \times V + 0.63$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCS.RC.M</td>
<td>Horizontal-solid-door</td>
<td>Remote-condensing</td>
<td>Medium</td>
<td>$0.11 \times V + 0.26$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCS.RC.L</td>
<td>Horizontal-solid-door</td>
<td>Remote-condensing</td>
<td>Low</td>
<td>$0.23 \times V + 0.54$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCS.RC.I</td>
<td>Horizontal-solid-door</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$0.27 \times V + 0.63$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>HCS.RC.I</td>
<td>Horizontal-solid-door</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$0.27 \times V + 0.63$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>SOC.RC.L</td>
<td>Service-over-counter</td>
<td>Remote-condensing</td>
<td>Low</td>
<td>$1.08 \times TDA + 0.22$</td>
<td>AHRI-1200</td>
</tr>
<tr>
<td>SOC.RC.I</td>
<td>Service-over</td>
<td>Remote-condensing</td>
<td>Ice cream</td>
<td>$1.26 \times TDA + 0.26$</td>
<td>AHRI-1200</td>
</tr>
</tbody>
</table>
### TABLE E 503.7.1(14) 503.7.1(12)
**VAPOR COMPRESSION-BASED INDOOR POOL DEHUMIDIFIERS – MINIMUM EFFICIENCY REQUIREMENTS**
[ASHRAE 90.1: TABLE 6.8.1-14 6.8.1-12]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single package indoor* (with or without economizer)</td>
<td>Rating Conditions: A or C</td>
<td>3.5 MRE</td>
<td>AHRI 910</td>
</tr>
<tr>
<td>Single package indoor water-cooled (with or without economizer)</td>
<td>Rating Conditions: A, B, or C</td>
<td>3.5 MRE</td>
<td>3.5 MRE</td>
</tr>
<tr>
<td>Single package indoor air-cooled (with or without economizer)</td>
<td>Rating Conditions: A, B, or C</td>
<td>3.5 MRE</td>
<td>3.5 MRE</td>
</tr>
<tr>
<td>Split system indoor air-cooled (with or without economizer)</td>
<td>Rating Conditions: A, B, or C</td>
<td>3.5 MRE</td>
<td>3.5 MRE</td>
</tr>
</tbody>
</table>

*Units without air-cooled condenser

### TABLE E 503.7.1(14) 503.7.1(13)
**ELECTRICALLY OPERATED DX-DOAS UNITS, SINGLE-PACKAGE AND REMOTE CONDENSER,**
**WITHOUT ENERGY RECOVERY – MINIMUM EFFICIENCY REQUIREMENTS**

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SUBCATEGORY OR CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled (dehumidification mode)</td>
<td>–</td>
<td>4.0 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Equipment Type</td>
<td>Subcategory or Rating Condition</td>
<td>Minimum Efficiency</td>
<td>Test Procedure</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------</td>
<td>--------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Air source heat pumps (dehumidification mode)</td>
<td>–</td>
<td>4.0 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Water cooled (dehumidification mode)</td>
<td>Cooling tower condenser water</td>
<td>4.9 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Chilled Water</td>
<td>6.0 ISMRE</td>
<td></td>
</tr>
<tr>
<td>Air source heat pump (heating mode)</td>
<td>–</td>
<td>2.7 ISCOP</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Water source heat pump (dehumidification mode)</td>
<td>Ground source, closed loop</td>
<td>4.8 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Ground-water source</td>
<td>5.0 ISMRE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water source</td>
<td>4.0 ISMRE</td>
<td></td>
</tr>
<tr>
<td>Water source heat pump (heating mode)</td>
<td>Ground source, closed loop</td>
<td>2.0 ISCOP</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Ground-water source</td>
<td>3.2 ISCOP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water source</td>
<td>3.5 ISCOP</td>
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</tr>
</tbody>
</table>

### TABLE E 503.7.1(15) ELECTRICALLY OPERATED WATER-SOURCE HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Size Category</th>
<th>Heating Section Type</th>
<th>Subcategory or Rating Condition</th>
<th>Minimum Efficiency</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-to-air, water loop (cooling mode)</td>
<td>&lt;17,000 Btu/h</td>
<td>All</td>
<td>86°F entering water</td>
<td>12.2 EER</td>
<td>ISO 13256-1</td>
</tr>
<tr>
<td></td>
<td>&gt;=17,000 Btu/h and &lt;65,000 Btu/h</td>
<td></td>
<td></td>
<td>13.0 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;135,000 Btu/h</td>
<td></td>
<td></td>
<td>13.0 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;135,000 Btu/h</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY, ton</td>
<td>COOLING-ONLY OPERATION</td>
<td>HEATING OPERATION</td>
<td>HEAT RECOVERY CHILLER FULL-LOAD EFFICIENCY (COPHR², WW)</td>
<td>TEST PROCEDURE</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------</td>
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<td>------------------</td>
<td>--------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COOLING EFFICIENCY¹</td>
<td>HEATING SOURCE EFFICIENCY (COPH², WW)</td>
<td>LEAVING HEATING WATER TEMPERATURE</td>
<td>LEAVING HEATING WATER TEMPERATURE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AIR SOURCE EER (FL/IPLV), Btu/W·h</td>
<td>TEMPERATURE OR OAT (db/wb), °F</td>
<td>HEATING SOURCE CONDITIONS (ENTERING/LEAVING WATER) OR OAT (db/wb), °F</td>
<td>LOW</td>
</tr>
<tr>
<td>Air source</td>
<td>All sizes</td>
<td>&lt;135 000 Btu/h</td>
<td>59°F entering water</td>
<td>18.0 EER</td>
<td>105°F</td>
</tr>
<tr>
<td>Water source</td>
<td>electrically</td>
<td>&lt;135 000 Btu/h</td>
<td>59°F entering water</td>
<td>18.0 EER</td>
<td>105°F</td>
</tr>
<tr>
<td></td>
<td>operated</td>
<td>&lt;135 000 Btu/h</td>
<td>59°F entering water</td>
<td>18.0 EER</td>
<td>105°F</td>
</tr>
<tr>
<td></td>
<td>positive</td>
<td>&lt;135 000 Btu/h</td>
<td>59°F entering water</td>
<td>18.0 EER</td>
<td>105°F</td>
</tr>
</tbody>
</table>

1. Section 12 of ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

2. Single-phase, U.S. air-cooled heat pumps less than 19 kW are regulated as consumer products by 10 CFR 430. SCOPc, SCOP2c, SCOPH and SCOP2H values for single-phase products are set by the USDOE. See Informative Appendix F for the USDOE minimum.

TABLE E 503.7.1(16)
HEAT-PUMP AND HEAT RECOVERY CHILLER PACKAGES—MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-16]
<table>
<thead>
<tr>
<th>WATER SOURCE ELECTRICALLY OPERATED CENTRIFUGAL</th>
<th>COOLING-ONLY RATING CONDITIONS</th>
<th>HEATING FULL-LOAD RATING CONDITIONS</th>
<th>COP</th>
<th>TYPE</th>
<th>NET SENSIBLE COOLING CAPACITY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;150</td>
<td>FL</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
<td>Air cooled with free air discharge condenser</td>
<td>Ducted</td>
<td>&lt;29 000 Btu/h</td>
</tr>
<tr>
<td>&gt;150 and &lt;300</td>
<td>FL</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
<td>Air cooled with free air discharge condenser</td>
<td>Nonducted</td>
<td>&lt;29 000 Btu/h and &lt;65 000 Btu/h</td>
</tr>
<tr>
<td>&gt;=300 and &lt;600</td>
<td>FL</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
<td>Air cooled with free air discharge condenser</td>
<td>Ducted</td>
<td>&gt;29 000 Btu/h and &lt;65 000 Btu/h</td>
</tr>
<tr>
<td>&gt;=600</td>
<td>FL</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
<td>Air cooled with free air discharge condenser</td>
<td>Nonducted</td>
<td>&gt;65 000 Btu/h</td>
</tr>
</tbody>
</table>

1. Cooling-only rating conditions are standard rating conditions defined in AHRI 550/590, Table 1.
2. Heating full-load rating conditions are at rating conditions defined in AHRI 550/590, Table 1.
3. For water-cooled heat recovery chillers that have capabilities for heat rejection to a heat recovery condenser and a tower condenser, the COP applies to operation at full load with 100 percent heat recovery (no tower rejection). Units that only have capabilities for partial heat recovery shall meet the requirements of Table E 503.7.1(3).
4. Outdoor air entering dry-bulb (db) temperature and wet-bulb (wb) temperature.
5. Source-water entering and leaving water temperature.
<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>STANDARD MODEL</th>
<th>NET SENSIBLE COOLING CAPACITY</th>
<th>MINIMUM NET SENSIBLE COP</th>
<th>RATING CONDITIONS RETURN AIR (DRY BULB/DEW POINT)</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water cooled with fluid economizer</td>
<td>Ducted</td>
<td>&lt;29 000 Btu/h</td>
<td>2.33</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td>Ducted</td>
<td>&gt;/=29 000 Btu/h and &lt;65 000 Btu/h</td>
<td>2.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=65 000 Btu/h</td>
<td>1.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonducted</td>
<td>&lt;29 000 Btu/h</td>
<td>2.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ducted</td>
<td>&gt;/=29 000 Btu/h and &lt;65 000 Btu/h</td>
<td>2.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=65 000 Btu/h</td>
<td>1.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol cooled</td>
<td>Ducted</td>
<td>&lt;29 000 Btu/h</td>
<td>1.97</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td>Ducted</td>
<td>&gt;/=29 000 Btu/h and &lt;65 000 Btu/h</td>
<td>1.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=65 000 Btu/h</td>
<td>1.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonducted</td>
<td>&lt;29 000 Btu/h</td>
<td>2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ducted</td>
<td>&gt;/=29 000 Btu/h and &lt;65 000 Btu/h</td>
<td>1.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Glycol cooled with fluid economizer

<table>
<thead>
<tr>
<th>Ducted</th>
<th>&lt;65,000 Btu/h</th>
<th>1.81</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;=65,000 Btu/h</td>
<td>1.92</td>
</tr>
<tr>
<td></td>
<td>&lt;29,000 Btu/h</td>
<td>1.92</td>
</tr>
<tr>
<td></td>
<td>&gt;=29,000 Btu/h</td>
<td>1.88</td>
</tr>
<tr>
<td></td>
<td>&lt;65,000 Btu/h</td>
<td>1.73</td>
</tr>
<tr>
<td></td>
<td>&gt;=65,000 Btu/h</td>
<td>1.73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nonducted</th>
<th>&lt;29,000 Btu/h</th>
<th>1.95</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;=29,000 Btu/h</td>
<td>1.93</td>
</tr>
<tr>
<td></td>
<td>&lt;65,000 Btu/h</td>
<td>1.76</td>
</tr>
</tbody>
</table>

**TABLE E 503.7.1(18)**

**WALK-IN COOLER AND FREEZER DISPLAY DOOR EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-18]

<table>
<thead>
<tr>
<th>CLASS DESCRIPTOR</th>
<th>CLASS</th>
<th>MAXIMUM ENERGY CONSUMPTION, kWh/day*</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display door, medium temperature</td>
<td>DD, M</td>
<td>0.04 × A_{dd} + 0.41</td>
<td>10 CFR 431</td>
</tr>
<tr>
<td>Display door, low temperature</td>
<td>DD, L</td>
<td>0.15 × A_{dd} + 0.29</td>
<td>10 CFR 431</td>
</tr>
</tbody>
</table>

* A_{dd} is the surface area (ft²) of the display door.

**TABLE E 503.7.1(19)**

**WALK-IN COOLER AND FREEZER NONDISPLAY DOOR EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-19]

<table>
<thead>
<tr>
<th>CLASS DESCRIPTOR</th>
<th>CLASS</th>
<th>MAXIMUM ENERGY CONSUMPTION, kWh/day*</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passage door, medium temperature</td>
<td>PD, M</td>
<td>0.05 × A_{nd} + 1.7</td>
<td>10 CFR 431</td>
</tr>
<tr>
<td>Passage door, low temperature</td>
<td>PD, L</td>
<td>0.14 × A_{nd} + 4.8</td>
<td>10 CFR 431</td>
</tr>
<tr>
<td>Freight door, medium temperature</td>
<td>FD, L</td>
<td>0.04 × A_{nd} + 1.9</td>
<td>10 CFR 431</td>
</tr>
<tr>
<td>Freight door, low temperature</td>
<td>FD, L</td>
<td>0.12 × A_{nd} + 5.6</td>
<td>10 CFR 431</td>
</tr>
</tbody>
</table>

* A_{nd} is the surface area (ft²) of the non-display door.

**TABLE E 503.7.1(20)**

**WALK-IN COOLER AND FREEZER REFRIGERATION SYSTEM EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-20]

<table>
<thead>
<tr>
<th>CLASS DESCRIPTOR</th>
<th>CLASS</th>
<th>MINIMUM ANNUAL WALK-IN ENERGY FACTOR AWEF, Btu/W·h*</th>
<th>TEST PROCEDURE</th>
<th>COMPLIANCE DATE: EQUIPMENT MANUFACTURED STARTING ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedicated condensing, medium temperature, indoor system</td>
<td>DC.M.I</td>
<td>5.61</td>
<td>AHRI 1250</td>
<td>June 5, 2017</td>
</tr>
<tr>
<td>Dedicated condensing, medium temperature, outdoor system</td>
<td>DC.M.O</td>
<td>7.60</td>
<td>AHRI 1250</td>
<td>June 5, 2017</td>
</tr>
<tr>
<td>Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) &lt; 6500 Btu/h</td>
<td>DC.L.I</td>
<td>9.091 × 10−5 × q_{net} + 1.81</td>
<td>AHRI 1250</td>
<td>July 10, 2020</td>
</tr>
<tr>
<td>Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) &gt;= 6500 Btu/h</td>
<td>DC.L.I</td>
<td>2.40</td>
<td>AHRI 1250</td>
<td>July 10, 2020</td>
</tr>
<tr>
<td>Dedicated condensing, low temperature, outdoor system, net capacity (q_{net}) &lt; 6500 Btu/h</td>
<td>DC.L.O</td>
<td>6.522 × 10−5 × q_{net} + 2.73</td>
<td>AHRI 1250</td>
<td>July 10, 2020</td>
</tr>
<tr>
<td>Dedicated condensing, low</td>
<td>DC.L.O</td>
<td>3.15</td>
<td>AHRI 1250</td>
<td>July 10, 2020</td>
</tr>
</tbody>
</table>
Proposals

Item #: 290

UMC 2024 Section: 210.0, E 201.0

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

E 201.0 Definitions.

Packaged Terminal Air Conditioner (PTAC). A self-contained unit used to heat or cool a conditioned space with a combination of heating and cooling components, assemblies, or sections and typically installed through an external wall.

Packaged Terminal Heat Pump (PTHP): A self-contained refrigerating system similar to a packaged terminal air conditioner (PTAC) that uses reverse cycle refrigeration to provide heat to a conditioned space.

210.0 – H –
Heat Pump. A refrigeration system that extracts heat from one substance and transfers it to another portion of the same substance or to a second substance at a higher temperature for a beneficial purpose.

SUBSTANTIATION:
Definitions for “Packaged Terminal Air Conditioner” and “Packaged Terminal Heat Pump” are recommended. Packaged Terminal Air Conditioners (PTACs) and Packaged Terminal Heat Pumps (PTHPs) provide both heating and cooling from one unit and are commonly installed in commercial and institutional spaces such as hotel rooms, senior living facilities, hospital rooms, apartment complexes, etc. PTACs utilize electric resistance heat, while PTHPs utilize heat pump heating along with back-up electric resistance heat. When a PTHP is heating in heat pump mode, the coolant reverses with the use of a reversing valve. Minimum efficiency requirements for PTACs and PTHPs are found in Table E 503.7.1(4) of the 2021 UMC.
Proposals

Item #: 291
UMC 2024  Section: E 201.0

SUBMITTER: Bruce A Pfeiffer
Retired - City of Topeka

RECOMMENDATION:
Add new text

E 201.0 Definitions.

**Storm Water.** Natural precipitation, including rain, snow and ice melt, that discharges across land surfaces, including manmade surfaces, or through other conveyances to one or more waterways and has not been put to beneficial use.

(below shown for reference only)

E 604.0 Indoor Moisture Control.
E 604.1 Rainwater Control. Roof drainage systems shall discharge to a place of disposal in accordance with the plumbing code. Storm water shall be directed away from the building.

SUBSTANTIATION:
A definition of stormwater is needed to clarify that stormwater includes runoff water from concrete surfaces, some of which may include pollutants. This would require pretreatment of the stormwater prior to use as a non-potable water source.
Proposals

Item #: 292
UMC 2024  Section: E 201.0

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

E 201.0 Definitions.

**Thermal Energy.** The amount of sensible heat energy stored within a material or fluid. The product of the mass, specific thermal capacity and temperature increase/decrease of the material or fluid. Also known as sensible heat energy.

SUBSTANTIATION:
A definition is needed in the UMC for the term “Thermal Energy,” which is used in Appendix E. The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.
Proposals

Item #: 293
UMC 2024  Section: E 201.0

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

E 201.0 Definitions.

Thermal Storage. A tank or vessel used in a solar thermal, hydronic, or geothermal system, in which thermal energy is stored.

SUBSTANTIATION:
The term “Thermal Storage” is used in Appendix E and requires a definition for clarity. The change correlates with the USHGC. This is necessary to ensure correlation between the codes.
Proposals

Item #: 294
UMC 2024  Section: E 201.0

SUBMITTER: Cary Smith
           Sound Geothermal Corporation

RECOMMENDATION:
Add new text

E 201.0 Definitions.

**Total Dissolved Solids (TDS).** A measure (by electrical conductivity) of the amount of soluble matter that is present in the water.

SUBSTANTIATION:
UMC Section E 403.4.3 references the term “Total Dissolved Solids (TDS),” however there is no definition. A definition is needed for clarity. The code change correlates with the USHGC. This is necessary to ensure correlation between the codes.
Proposals

Item #: 295
UMC 2024  Section: E 402.1

SUBMITTER: Julius Ballanco, P.E.
            JB Engineering and Code Consulting, P.C.
            Rep. Chair, UMC Legionella Task Group

RECOMMENDATION:
Revise text

E 402.0 Meters.
E 402.1 Required. A water meter shall be required for buildings connected to a public water system, including municipally supplied reclaimed (recycled) water. In other than single-family houses, multi-family structures not exceeding three stories above grade, and modular houses, a separate meter or submeter shall be installed in the following locations:
(1) The makeup water supply to cooling towers, evaporative condensers, and fluid coolers, and domestic hot water systems.
(2) through (4) (remaining text unchanged)

SUBSTANTIATION:
This code change was submitted and discussed during the UMC Legionella Task Group and the decision was made by the Task Group to submit as a separate code change so as to focus on the scope of the Task Group in the new Appendix H (Impact of Water Temperature on The Potential for Legionella Growth).
Proposals

Item #: 296

UMC 2024  Section: 218.0, Table 1701.2, E 503.3.1, E 503.4.6.5, E 503.5.6.6

SUBMITTER: Emily Toto
ASHRAE

RECOMMENDATION:
Revise text

218.0   – P –

Parking Garage Section. A part of a parking garage where airflow is restricted from other parts of the garage by solid walls.

E 503.4.6.5 Enclosed Parking Garage Ventilation Systems. Enclosed parking garage ventilation systems shall automatically detect contaminant levels and stage fans or modulate fan airflow rates to 50 percent or less of design capacity, provided acceptable contaminant levels are maintained.

Parking garage ventilation systems shall meet all of the following:
(1) Separate ventilation systems and control systems shall be provided for each parking garage section.
(2) Control systems for each parking garage section shall automatically detect and control contaminant levels and shall be capable of and configured to reduce fan airflow to 20 percent or less of design capacity.
(3) The ventilation system for each parking garage section shall have controls and devices that result in fan motor demand of no more than 30 percent of design wattage at 50 percent of the design airflow.

Exceptions:
(1) Garages less than 30,000 square feet (2787.09 m²) with ventilation systems that do not utilize mechanical cooling or mechanical heating.
(2) Garages that have a garage area to ventilation system motor nameplate horsepower ratio that exceeds 1500 square feet per horsepower (ft²/hp) (186.8 m²/kW) and do not utilize mechanical cooling or mechanical heating.
(3) Where not permitted by the Authority Having Jurisdiction.

Garage ventilation systems serving a single parking garage section having a total ventilation system motor nameplate horsepower [kilowatts] not exceeding 5 hp [3.7 kW] at fan system design conditions and where the parking garage section has no mechanical cooling or mechanical heating. [ASHRAE 90.1:6.4.3.4.5]

E 503.5.6.6 Low Power Fans. Fans that are not covered by Section E 503.5.6.5 and having a fan nameplate electrical input power of less than 180 W or having a motor nameplate horsepower less than 1/12 HP (62.1 W) shall meet the fan efficacy requirements specified in ASHRAE 90.1. [ASHRAE 90.1:6.5.3.7]

E 503.5.6.6 E 503.5.6.7 Ventilation Design. The required minimum outdoor air rate is the larger of the minimum outdoor air rate or the minimum exhaust air rate required by Chapter 4, ASHRAE 62.1, ASHRAE 62.2, ASHRAE 170, or applicable codes or accreditation standards. Outdoor air ventilation systems shall comply with one of the following:
(1) Design minimum outdoor air provided shall not exceed 135 percent of the required minimum outdoor air rate. 
(2) Dampers, ductwork, and controls shall be provided that allow the system to supply no more than the required minimum outdoor air rate with a single setpoint adjustment.
(3) The system includes exhaust air energy recovery complying with Section E 503.5.10. [ASHRAE 90.1:6.5.3.7]

E 503.3.1 Criteria. The HVAC system shall comply with the following criteria:
(1) through (17) (remaining text unchanged)
(18) The system shall comply with the demand control ventilation requirements of Section E 503.4.6.9 and the ventilation design requirements of Section E-503.5.6.6 E 503.5.6.7.
### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI/AMCA 210-2016/ASHRAE 51-2016</td>
<td>Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating</td>
<td>Low Power Fans</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** ANSI/AMCA 210/ASHRAE 51 and ANSI/ASHRAE/IES 90.1 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

The changes to Section E 503.4.6.5 including the new definition for parking garage section are based on addendum d to ASHRAE 90.1-2019 for parking garage ventilation. This proposal increases stringency for these systems, with additional requirements for pollutant sensors and fan variable speed drives that SSPC 90.1 has determined to be cost effective.

The changes to Section E 503.5.6.6 align the UMC with the latest requirements in published addendum a to ASHRAE 90.1-2019 for low-power ventilation fans. The proposal also establishes ASHRAE Standard 62.2 as the reference for determining the minimum ventilation rates for non-transient dwelling units, in accordance with the scope of ASHRAE Standards 62.2 and 62.1.
E 603.0 Pollutant Control.

E 603.1 Indoor Air Quality During Construction. (remaining text unchanged)

E 603.1.3 Covering of Duct Openings and Protection of Mechanical Equipment During Construction. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal, or other methods acceptable to the enforcing agency Authority Having Jurisdiction to reduce the amount of dust or debris that collects in the system.

SUBSTANTIATION:
The term “enforcing agency” is not defined in the code. The term “Authority Having Jurisdiction” should be used as it is defined in the code and consistent with other requirements within the code.
E 608.0 Low VOC Solvent Cement and Primer.

E 608.1.1 Solvent Cement. Solvent cement, including one-step solvent cement, shall have a volatile organic compound (VOC) content of less than or equal to 65 ounces per gallon (oz/gal) (487 g/L) for CPVC cement, 68 oz/gal (509 g/L) for PVC cement, and 43 oz/gal (322 g/L) for ABS cement, as determined by the South Coast Air Quality Management District’s Laboratory Methods of Analysis for Enforcement Samples, Method 316A. Solvent cement shall comply with ASTM F493 for CPVC or CPVC/AL/CPVC joints, or ASTM D2564 for PVC joints.

E 608.1.2 Primer. Primer shall have a volatile organic compound (VOC) content of less than or equal to 73 oz/gal (546 g/L), as determined by the South Coast Air Quality Management District’s Laboratory Methods of Analysis for Enforcement Samples, Method 316A. Primer shall comply with ASTM F656 for CPVC, CPVC/AL/CPVC, or PVC.

Note: ASTM D2564, ASTM F493, and ASTM F656 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 608.1.1 applies to solvent cement, including one-step solvent cement. The applicable standards for solvent cements are ASTM D2235 for ABS joints, ASTM F493 for CPVC joints, or ASTM D2564 for PVC joints. This change makes it clear that solvent cements must comply with these criteria.
APPENDIX F

GEOTHERMAL ENERGY SYSTEMS AND DISTRICT AMBIENT TEMPERATURE LOOPS

Part I – General.

F 101.0 General.
F 101.1 Applicability. Part I of this appendix shall apply to all geothermal energy systems such as, but not limited to, building systems coupled with a ground-heat exchanger, submerged heat exchanger using water-based fluid as a heat transfer medium, or groundwater (well). The regulations of this appendix shall govern the construction, location and installation of geothermal energy systems.

Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section F 104.4 and Chapter 12.

Part I through Part V of this appendix shall apply to geothermal energy systems and district thermal systems that circulate ground-ambient-temperature water to be used in end-use buildings as a thermal source or sink via water source heat pump or reversing chiller. The systems shall operate to permit independent and bi-directional heating and cooling for comfort and water heating such as, but not limited to, building systems coupled with ground ambient district loops, a ground-heat exchanger, submerged heat exchanger using water-based fluid as a heat transfer medium, or groundwater (well), or such local resources to the advantage of the district. Central district auxiliary components shall add or reject heat to benefit district ability to reduce both power consumption and demand combined with energy sharing. The regulations of this appendix shall govern the construction, location and installation of ground temperature thermal distribution districts from 100 percent geothermal energy system to multiple hybrid district systems.

F 101.1.1 Prior to Construction. Documents for permits shall be submitted prior to the construction of a building system, ground-heat exchanger, submerged heat exchanger, or water well. Permits shall be issued by the Authority Having Jurisdiction.

F 101.1.2 Equipment, Accessories, Components, and Materials. The mechanical equipment, accessories, components, and materials used shall be of the type and rating approved for the specific use.

F 101.1.3 Indoor Piping. Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section F 104.4 and Chapter 12.

F 102.0 Definitions.

Ambient Temperature Loop (ATL). A closed loop piping system with central pumping that includes various heat sources and heat sinks to hold the loop fluid near the long-term average ambient air temperature. The sources/sinks can be passive (e.g., a ground loop, a body of water, sewer effluent) or active (e.g., a cooling tower) and further can include opportunistic, or unique locally available waste or byproduct heat sources (e.g., data center, industrial process). The closed loop piping system typically controls or engages these sources/sinks to maintain the loop temperature to meet the seasonal requirements as well as specific building needs.

SUBSTANTIATION:

Section F 101.1 has been updated to clarify that Part I applies to all geothermal energy systems. The included paragraph expands the applicability of Part I to all ambient temperature loop systems and further describes the nature of the ambient temperature central systems. The paragraph further details that the ambient loop may consist of multiple sources and sinks as well as other district geothermal distribution systems. Finally, the Indoor piping
clause has been relocated to Section F 101.1 sub paragraphs for continuity and separation of other applicable components.

In addition, since the revision to F 101.1 includes district ambient temperature loop, the title of the Appendix F has been revised to address such system. With the addition of Geothermal district energy systems, the name of the section will reflect the inclusion of code language for ambient temperature loops and district systems.

Lastly, the definition for "ambient temperature loop (ATL)" was added to define such system. An ATL system is a closed loop piping system that includes various heat sources and heat sinks. There are installations for such systems and should be defined in Appendix F.
Proposals

Item #: 300

UMC 2024 Section: F 501.0 - F 501.2

SUBMITTER: Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Add new text

Part V – District Ambient Temperature Loop (ATL) Geothermal

F 501.0 Ambient Temperature Loop (ATL) Distributed Energy Systems.

F 501.1 General. An Ambient Temperature Loop (ATL) distributed energy system shall be installed in accordance with Section F 501.2 through Section F 501.6.2 and Section F 502.0. ATL systems shall comply with Part I through Part IV of this appendix, as applicable.

F501.1.1 Fourth Generation (4G) System Configuration. A fourth-generation system configuration shall be a district geothermal energy system distributing hot water, cold water, or both to the conditioned space or building for a specific use. Where a geothermal energy source is used, such system shall comply with Part I through Part IV of this appendix, Chapter 11, and Chapter 12.

F 501.1.2 Fifth generation (5G) System Configurations. An advanced Ambient Temperature Loop (ATL) System or fifth generation (5G) ATL system shall also be capable of interacting with the electric utility system as well as other utility systems and systems components. The system components shall include, but not limited to, the following:

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

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

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

F 501.2 Permitting. Permits required for the installation and application of an ATL distributed energy system shall be obtained as required by the Authority Having Jurisdiction.

F 102.0 Definitions.

Ambient Temperature Loop (ATL). A closed loop piping system with central pumping that includes various heat sources and heat sinks to hold the loop fluid near the long-term average ambient air temperature. The sources/sinks can be passive (e.g., a ground loop, a body of water, sewer effluent) or active (e.g., a cooling tower) and further can include, opportunistic, or unique locally available waste or byproduct heat sources (e.g., data center, industrial process). The closed loop piping system typically controls or engages these sources/sinks to maintain the loop temperature to meet the seasonal requirements as well as specific building needs.

Fifth Generation (5G) System Configurations. An advanced ambient temperature (ATL) system that distributes near-ambient-temperature water among and between end-use buildings that are equipped with water-source heat pumps or other water-source HVAC equipment. Such systems stand in contrast to fourth generation (4G) systems that distribute hot water or chilled water to buildings to serve facility loads.

Fourth Generation (4G) System Configurations. A district geothermal energy system that distributes hot water and cold water for direct use in the conditioned space.
SUBSTANTIATION:
This section is being added in response to the attention drawn to ambient temperature loop district systems in many state due to carbon reduction plans and non-combustion alternatives. Ambient Temperature loops are high efficiency systems that recover wasted energy that is normally rejected to the atmosphere. The current language in Appendix F does not address these systems. The provisions in proposed Section F 501.0 through Section F 501.3 will address the general requirements for fourth generation systems and fifth generation systems; along with permitting requirements.

The definitions for "fourth generation (4G) system configuration" and "fifth generation (5G) system configuration" are included as such systems are not currently defined in the code. The definition for "ambient temperature loop (ATL)" was also added to define such system. ATL systems is a closed loop piping system that includes various heat sources and heat sinks.
Proposals

Item #: 301

UMC 2024  Section: F 501.3 - F 501.5, Table 1701.2

SUBMITTER: Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Add new text

F 501.3 Ambient Loop Temperature Range. The operating loop temperature range of an ambient temperature loop (ATL) system shall be not less than the freeze point of the circulating fluid and not more than the maximum temperature as required by the manufacturer’s installation instructions for the attached heat pump equipment in accordance with Section F 501.3.1 and Section F 501.3.2. The ATL system shall use treated water as the heat transfer medium.

F 501.3.1 ATL Operating Temperature. For equipment listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, the controlled temperature range of the ambient closed loop shall be not less than 7°F (4°C) above the freeze point of the transport fluid and 10°F (6°C) below the (collective) heat pump lowest maximum inlet supply temperature as recommended by the manufacturer’s instructions.

Exception. Equipment that is not listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, The controlled temperature range of the ambient closed loop shall be in accordance with F 501.4 for minimum and maximum temperatures.

F 501.3.2 ATL Operating Temperature Range for Mixed Equipment Certifications. The source inlet temperature range of any attached equipment shall govern the design operating temperature range. Such equipment shall be identified in the design documentation. In any case the most restrictive minimum and maximum inlet supply temperatures, as recommended by the manufacturer’s instructions, shall determine the System Operating temperature range.

F 501.4 Shutoff Valve. An automatic shutoff valve shall be provided for each individual building or facility transferring energy to or from an ATL distribution system. The automatic shutoff valve shall automatically shutoff upon operating command.

F 501.4.1 Shutoff Valve Operation. The operation of the automatic shutoff valve shall be in accordance with the system operating procedures. Where the operation of a shutoff valve was due to an emergency response, an auxiliary hearing or cooling methodology shall be provided in accordance with Section F 502.1.2.

F 501.5 Bypass. The ATL distributed energy system shall be provided with bypass path(s) to reroute the circulating fluid when necessary.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
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<th>APPLICATION</th>
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</thead>
</table>

(TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

(portions of table not shown remain unchanged)
SUBSTANTIATION:
Section F 501.3 through Section F 501.5 further address the characteristics and required components of an ATL system that include system safety and appropriate minimum emergency or operational temperatures. The section also recognizes that there may be equipment attached to the loop with unique operation limits and that this will govern the temperature limits for standard operation of the ATL.
Proposals

Item #: 302

UMC 2024 Section: F 501.6 - F 501.6.3

SUBMITTER: Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Add new text

F 501.6 Metering. Where meters are required by the system design, meter(s) shall be located as specified by the manufacturer on each consumptive or supply source and the range of the metering shall be appropriate to the thermal properties and flow rate(s) of the transport fluid.

F 501.6.1 Sub-Metering System Specification. The entire energy measurement system shall be provided with a sum-metering system. The metering system shall be calibrated and shall consist of a flow meter, temperature sensors, temperature thermowells, or other required mechanical installation metering. The sub-meter traceable calibration shall comply with the National Institute of Standards Technology (NIST) traceable calibration program or in accordance with the Authority Having Jurisdiction and shall be provided with an ATL distributed energy system.

F 501.6.2 BTU/Thermal Meters. Where used, the Btu/thermal meter shall be bidirectional and shall provide the following information via digital or analog display:
1. LCD, and via serial network communications.
2. Total energy.
3. Energy rate.
4. Total flow.
5. Flow rate.
7. Return temperature.

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

F 501.6.3 Flow Meter. Where used, the flow meter shall be provided with the following information via digital or analog display:
1. LCD, and via serial network communications.
2. Instantaneous fluid rate.

SUBSTANTIATION:
Section F 501.6 through Section F 501.6.3 are intended to require energy movement data with sufficient accuracy to both measure system performance and individual asset performance. The respective metering methods also provide the basis for a use or energy transfer custody platform. In addition, this section is recognizing that there are multiple ways to effectively measure energy transfer.
Proposals

Item #: 303
UMC 2024  Section: F 502.0 - F 502.1.2, Table 1701.2

SUBMITTER: Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Add new text

**F 502.0 ATL Distributed Energy Systems Design Requirements.**

**F 502.1 Thermal Resources.** The ambient temperature loop shall be permitted to connect to a thermal resource(s). Such resources may be an alternative energy source and sink, such as but not limited to solar photovoltaic (PV), solar thermal, combined heat power (CHP), and phase change thermal storage. These systems shall be installed and comply with the respective system requirements. ATL distributed energy systems coupled with solar thermal systems shall comply with the Uniform Solar, Hydronics and Geothermal Code (USHGC) or equivalent. ATL systems coupled with a solar PV system shall comply with the USHGC or NFPA 70, or equivalent. These systems shall optimize the use of the equipment and energy based on the system design intent.

**F 502.1.1 System Performance.** The System Coefficient of Performance (SCOP) of the system shall take the net COP of each individual members in the district. The SCOP shall be provided by the designer and included in the system design documents.

**F 502.1.2 Emergency Response.** An auxiliary heating or cooling methodology shall be provided with the ATL controls and shall be adequate to provide temporary service in the absence of an ATL energy transfer. Emergency source/sink measures such as but not limited to control subroutines that move energy between spaces in the building, use of locally connected ground source assets, combined heat and power (CHP), conventional equipment, other renewables systems may be used.

**F 102.0 Definitions.**

**Thermal Resources.** A source for a heating and a sink for a cooling. There are two types of sources:

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

**System Coefficient of Performance (SCOP).** A ratio of the total system energy moved divided by the total system purchased energy.

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TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
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</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
By definition, the ATL will use multiple types of sources and sinks and multiple heat transfer devices. This section is intended to demonstrate both different assets that are commonly used in conjunction with the ATL to meet specific system needs and the requirement to ensure that temporary service reductions or losses must be anticipated in the
A standard metric, system coefficient of performance (SCOP) must be used to evaluate the ATL design intent performance to include transport energy and wasted energy recovered. Sources and sinks are usually spread across the ATL system, GeoMicrodistrict, or thermal highway and provisions should be made to handle temporary reduction or loss of service utilizing assets currently connected to the ATL. Section F 502.1 is not intended to include a redundant system but rather to address use of existing or attached thermal resources.

Further, definitions to “thermal resource” and “system coefficient of performance (SCOP)” are being added as they are addressed in the proposed language and will assist the user as they are currently not defined, and the Authority Having Jurisdiction in enforcing these systems.
Proposals

Item #: 304

UMC 2024 Section: F 102.0, F 502.2 - F 502.2.3

SUBMITTER: Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Add new text

F 502.2 District Load Profiles. The district load profile of an ambient temperature loop (ATL) distributed energy system shall be identified and shall be included in the basis-of-design (BOD).

F 502.2.1 System Asset Identification. System assets shall be listed and included in the system design. The system asset shall include, but not be limited to, the following:
1. Building type and quantity.
2. Natural or constructed sources and sinks such as ground water, boreholes, etc.
3. Other renewable assets.
5. Potable and non-potable water or fluid sources.
6. Conventional assets such as boilers and cooling towers.
7. Other GeoMicroDistrict or thermal highway.

F 502.2.2 Driver Building. The driver building profile shall be identified in an ATL distributed energy system and shall be reported in the design documents.

F 502.2.3 Diversity Factor. The diversity factor and/or anticipated wasted energy recovery component of the GeoMicroDistrict shall be identified by the designer and this information shall be included in the drawings and specifications.

F 102.0 Definitions.

Driver Building. One or more building(s) or facility(s) that determined the upper and lower temperature limits of hot fluid or cold fluid delivery system.

GeoMicroDistrict. A collection of building and facilities on an independently pumped ambient temperature loop (ATL) that supplies or receives energy. An independent segment served by a thermal highway.

Thermal Highway. A collection one or more GeoMicroDistricts that acts as an energy transport system and supplies or accepts energy from multiple GeoMicroDistricts, individual buildings, or other sources. Also known as convective circulation circuit.

SUBSTANTIATION:
Along with System Coefficient of Performance (SCOP), there are several additional unique characteristics and components that must be identified in the ATL design documents. These components must be identified to accurately communicate design intent. In addition, identification of system assets, the driver building(s) and diversity factor (e.g. wasted energy recovery) are imperative for the building management system-code-development, and the validation/commissioning process and long term operations management as well as later system expansion.

Furthermore, the definitions for "driver building," "GeoMicroDistrict," and "thermal highway" are being added as they are addressed in the proposed language and will assist with the enforcement of the section.
Proposals

Item #: 305
UMC 2024  Section: F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

F 102.0 Definitions.

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

SUBSTANTIATION:
Boreholes are created during geothermal system installations and have provisions within Section F 201.3 (Borehole Piping and Tubing). Boreholes are also mentioned throughout Appendix F (Geothermal Energy Systems), and for this reason, such terminology is an appropriate addition to the Appendix F definitions. The terminology provided depicts what a borehole is, how it is created, and defines its purpose. This also correlates with the action taken by the USHGC Technical Committee.
Proposals

Item #: 306

UMC 2024  Section: F 102.0

SUBMITTER:  Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 102.0 Definitions.

**Geothermal Energy System; Closed-Loop System.**
(1) A hydronic system where the fluid is enclosed in piping that is not vented to the atmosphere. The system at any point, is typically under pressure that is greater than the ambient pressure.
(2) In a geothermal system, a liquid-source heat pump system using a continuous, sealed, underground, or submerged heat exchanger through which a heat-transfer fluid passes to and returns from a heat pump. The system at any point, is typically under pressure that is greater than the ambient pressure.

SUBSTANTIATION:
The definition of closed-loop system is being modified as the current definition may be true in some HVAC circulating systems, but I am not sure that “not vented to the atmosphere” is a clear and definitive characteristic of all HVAC closed-loop systems. The differentiation is typically that the fluid is or is NOT under “ambient” pressure. The change clarifies that there are 2 different applications for a closed-loop system. In definition (1), we account for things like drain down systems or recirculating through a storage vessel. The storage system may or may not be directly vented to the atmosphere and is typically held at ambient pressure. In definition (2), we use the “specific technology” application of the term.
Proposals

Item #: 307
UMC 2024  Section: F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

F 102.0 Definitions.

**Geoexchange.** See Geothermal Energy System.

SUBSTANTIATION:
Geoexchange is another term used for Geothermal Energy System, therefore, the term is being added to the Appendix F definitions. This also correlates with the action taken by the USHGC Technical Committee.
Proposals

Item #: 308
UMC 2024 Section: E 201.0, F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

E 201.0 Definitions.

E 201.4 Geothermal. Renewable energy generated by deep-earth.

F 102.0 Definitions.

Geothermal. Renewable energy generated by deep-earth conduction.

SUBSTANTIATION:
The definition of “Geothermal” in Appendix E (Sustainable Practices) must be relocated to Appendix F (Geothermal Energy Systems) as geothermal provisions are no longer located in Appendix E. Geothermal requirements have been relocated to Appendix F. In addition, there are both solar and deep earth influences on GX systems.
Proposals

Item #: 309
UMC 2024  Section: F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 102.0 Definitions.

Geothermal Energy System; Open-Loop System.
(1) A hydronic system where the fluid is enclosed in piping that is vented to the atmosphere, or is replaced, all or in part, during every circulation of the system.
(2) In a geothermal system, a liquid-source heat-pump system, inclusive of heat pump systems, that uses ground water or surface water to extract or reject heat.

SUBSTANTIATION:
The definition of open-loop system is being modified as the current definition may be true in some HVAC circulating systems, but I am not sure that “vented to the atmosphere” is a clear and definitive characteristic of all HVAC open-loop systems. The differentiation is typically that the fluid is or is NOT under “ambient” pressure. Even an open system can be continuously recirculated if it is circulated through a vented tank but the vent may be normally closed. The change clarifies that there are 2 different applications for an open-loop system. In definition (1), we account for things like drain down systems or recirculating through a storage vessel. The storage system may or may not be directly vented to the atmosphere and is typically held at ambient pressure. In definition (2), we use the “specific technology” application of the term.
Item #: 310
UMC 2024 Section: F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

F 102.0 Definitions.

**pH.** The log of the reciprocal of the hydrogen ion concentration of a solution, and a measure of the acidity or alkalinity of the water. It is determined by the concentration of hydrogen ions in a specific volume of water.

SUBSTANTIATION:
UMC Section F 301.2 references the term "pH," however there is no definition. A definition is needed for clarity. The code change correlates with the USHGC. This is necessary to ensure correlation between the codes.
Proposals

Item #: 311
UMC 2024 Section: Table F 104.2, Table 1701.2

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

TABLE F 104.2
PLASTIC GROUND SOURCE LOOP PIPING

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
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<tbody>
<tr>
<td>Cross-linked polyethylene (PEX)</td>
<td>ASTM F876, CSA B137.5, <a href="#">CSA B137.5</a>, CSA C448, NSF 358-3</td>
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</table>

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TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>CSA B137.5-2020</td>
<td>Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications</td>
<td>Piping</td>
</tr>
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</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
This change is being made to further enhance Table F 104.2 by providing an additional applicable material standard for plastic ground source loop piping to be used in geothermal systems. This also correlates with the action taken by the USHGC Technical Committee.
Proposals

Item #: 312
UMC 2024  Section: Table F 104.2, Table F 104.3

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

### TABLE F 104.2
PLASTIC GROUND SOURCE LOOP PIPING

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<tr>
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<tbody>
<tr>
<td>Cross-linked polyethylene (PEX)</td>
<td>ASTM F876, CSA B137.5, CSA/IGSHPA C448, NSF 358-3</td>
</tr>
<tr>
<td>High Density Polyethylene (HDPE)</td>
<td>ASTM D2737, ASTMD 3035, ASTM F714, AWWA C901, CSA B137.1, CSA/IGSHPA C448, NSF 358-1</td>
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<tr>
<td>Polypropylene (PP)</td>
<td>ASTM F2623, ASTM F2769, CSA B137.18, CSA/IGSHPA C448, NSF 358-4</td>
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<tr>
<td>Polyethylene Raised Temperature (PE-RT)</td>
<td></td>
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</table>

### TABLE F 104.3
GROUND SOURCE LOOP PIPE FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
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<tbody>
<tr>
<td>High Density Polyethylene (HDPE)</td>
<td>ASTM D2683, ASTM D3261, ASTM F1055, CSA B137.1, CSA/IGSHPA C448, NSF 358-1</td>
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<tr>
<td>Polypropylene (PP)</td>
<td>ASTM F2389, CSA B137.11, NSF 358-2</td>
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<tr>
<td>Polyethylene Raised Temperature (PE-RT)</td>
<td></td>
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</table>

(below shown for reference only)

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
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<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA/IGSHPA C448-2016</td>
<td>Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)
Note: CSA/IGSHPA C448 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
This code change adds IGSHPA to the CSA C448 standard as it is a harmonized standard. Table 1701.2 already shows the standard correctly. This also correlates with the action taken by the USHGC Technical Committee.
Proposals

Item #: 313
UMC 2024 Section: Table F 104.3, Table 1701.2

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

TABLE F 104.3
GROUND SOURCE LOOP PIPE FITTINGS

<table>
<thead>
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<th>MATERIAL</th>
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<tr>
<td>ASTM F3347-2020a</td>
<td>Metal Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
</tr>
<tr>
<td>ASTM F3348-2020b</td>
<td>Plastic Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
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</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
This change is being made to further enhance Table F 104.3 by providing additional applicable material standards for ground source loop pipe fittings to be used in geothermal systems. This also correlates with the action taken by the USHGC Technical Committee.
Item #: 314
UMC 2024  Section: Table F 104.3, Table 1701.2

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

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### TABLE F 104.3

<table>
<thead>
<tr>
<th>MATERIAL</th>
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<tbody>
<tr>
<td>Polyethylene Raised Temperature (PE-RT)</td>
<td>ASTM D3261, ASTM F1055, ASTM F1807, ASTM F2080, ASTM F2159, ASTM F2769, ASTM F3347, ASTM F3348, CSA B137.18, CSA C448; NSF 358-4</td>
</tr>
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(portion of table not shown remain unchanged)

### TABLE 1701.2

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<td>Fittings</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASTM standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Proposals

Item #: 315

UMC 2024  Section: F 106.2

SUBMITTER: Cary Smith  
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 106.0 Valves.

F 106.2 Heat Exchangers. Shutoff valves shall be installed on the supply and return side of a heat exchanger, except

Exception: Where the heat exchanger is integral with a boiler or is a component of a manufacturer’s boiler and heat
exchanger packaged unit, and is capable of being isolated from the hydronic system by the supply and return valves.

SUBSTANTIATION:
The proposed change to Section F 106.2 removes the lengthy, run on sentence and makes it clear that there is an
exception within the section. This also correlates with the action taken by the USHGC Technical Committee.
Proposals

Item #: 316
UMC 2024  Section: F 107.1, Table F 107.1, Table 1701.2

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 107.0 Specific System Components Design.
F 107.1 General. Heat pumps shall be in compliance with Table F 107.1, as applicable. Heat pumps shall also be listed and labeled in accordance with UL 1995 or UL 60335-2-40. Ground coupled and water source heat pumps shall be certified listed in accordance with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. DX heat pumps shall be certified listed in accordance with ASHRAE 194. All heat pump equipment used in DX systems shall comply with AHRI 870. Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

| TABLE F 107.1 |
| HEAT PUMPS |
| TYPE OF HEAT PUMP | STANDARDS |
| Water-to-Air | AHRI/ASHRAE/ISO 13256-1 |
| Water-to-Water | AHRI/ASHRAE/ISO 13256-2 |

| TABLE 1701.2 |
| STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES |

| DOCUMENT NUMBER | DOCUMENT TITLE | APPLICATION |

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Standards are being added to Section F 107.1 to address water source heat pumps. The standards provide detailed test methods, performance requirements and marking provisions for water-source heat pumps. AHRI/ASHRAE/ISO 13256-1 addresses water-to-water and brine-to-water heat pumps. AHRI/ASHRAE/ISO 13256-2 addresses water-to-air and brine-to-air heat pumps. AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2 have been used in the industry since 1998 and have been reaffirmed two times without substantive changes to the requirements.
Proposals

Item #: 317
UMC 2024 Section: F 108.18.8, Table 1701.2

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 108.0 Installation Practices.

F 108.18 Trenches, Excavation, and Backfill. (remaining text unchanged)

F 108.18.8 Tracer and Warning Markings. Means shall be provided for underground detection or utility location of the buried pipe system. This shall include, but is not limited to, metallic detectable tape, with a thickness of not less than 11/64 of an inch (4.4 mm) and a width of 6 inches (152 mm), or non-metallic warning tape used in conjunction with tracer wire that is listed and labeled in accordance with UL 2989.

Tracer and This warning markings shall be permanent, conspicuous and resistant to the environmental conditions and shall be placed within 1 foot to 2 feet (305 mm to 610 mm) on top of the horizontal piping of the heat exchanger installation.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 2989-2016</td>
<td>Outline of Investigation for Tracer Wire</td>
<td>Tracer Wire</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Tracer wire that is listed and labeled in accordance with UL 2989 has undergone specific testing to determine its suitability for use underground as a detectable tracer wire. The tests include:
• Physical Properties of Insulation
• Mechanical Water Absorption
• Cold-Bend Test
• Crushing Resistance
• Impact Resistance
• Unwinding of Low Temperature
• Dielectric-Voltage Withstand

Including the use of listed tracer wire in conjunction with a non-metallic warning tape in Section F 108.18.8 provides an alternative to metallic detectable warning tape. UL currently has 15 manufacturers that have tracer wire listed to UL 2989. This also correlates with the action taken by the USHGC Technical Committee.
Item #: 318

UMC 2024  Section: F 108.7

SUBMITTER: Cary Smith  
Sound Geothermal Corporation

RECOMMENDATION: 
Revise text

F 108.0 Installation Practices.

F 108.7 Ground-Heat Exchanger Installation Practices. A ground-heat exchanger system shall be installed as follows:
(1) through (6) (remain unchanged)
(7) Wells and boreholes shall be sealed in accordance with the Authority Having Jurisdiction. Where grout is required, it shall be applied in a single continuous operation from the bottom of the borehole by pumping through a tremie pipe.

SUBSTANTIATION:
Section F 108.7 (7) is being revised as sealing is a batch process and it is not always in a single continuous operation. Therefore, the term is being removed to allow for such process. The process can be either single, continuous, or multi-batch.
Proposals

Item #: 319

UMC 2024  Section: F 110.1, F 201.6, F 201.6.2, F 401.4

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 110.0 Decommissioning and Abandonment.
F 110.1 General. Decommissioning of geothermal systems shall comply with CSA/IGSHPA C448. Prior to the abandonment or decommissioning of geothermal systems, the owner shall obtain the necessary permits from the Authority Having Jurisdiction.

F 201.0 General.
F 201.6 Vertical Bores. Vertical bores shall be drilled to a depth to provide complete insertion of the u-bend pipe to its specified depth. The borehole diameter shall be sized for the installation and placement of the heat exchange u-bend and the tremie used to place the grouting material. CSA/IGSHPA C448 shall be used for vertical loop depth and borehole diameter sizing guidance. The u-bend joint and pipe shall be visually inspected for integrity in accordance with the manufacturer’s installation instructions. The u-bend joint and pipe shall be pressurized to not less than 100 psi (689 kPa), not to exceed the pressure rating of the pipe at the test temperature, for 1 hour to check for leaks before insertion into the borehole.

F 201.6.2 U-Bends and Headers. Headers, u-bends and ground loop pipes shall be pressure-tested in accordance with CSA/IGSHPA C448, or as required by the Authority Having Jurisdiction. Before testing, heat fusion joints shall be cooled to ambient temperature. Mechanical joints shall be completely assembled. Flushing and purging to remove air and debris shall be completed before testing. The assembly shall be filled with water (or water/antifreeze solution) and purged at a minimum flow rate of 2 feet per second (0.6 m/s) to remove air, but not more than the maximum flow velocity recommended by the pipe and fittings manufacturer to remove debris.

F 401.0 Direct Exchange (DX) Systems.
F 401.4 DX System Testing. For direct exchange (DX) systems, each u-bend shall be tested and proved tight with an inert gas at not less than 315 psi (2172 kPa) and maintained for 15 minutes without pressure drop. The pressure reading after tremie grouting of the boreholes shall be maintained in the ground-heat exchanger for not less than 2 hours, in accordance with CSA/IGSHPA C448.

(below shown for reference only)

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA/IGSHPA C448-2016</td>
<td>Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
This code change adds IGSHPA to the CSA C448 standard as it is a harmonized standard. Table 1701.2 already shows the standard correctly. This also correlates with the action taken by the USHGC Technical Committee.
Proposals

Item #: 320
UMC 2024  Section: F 401.4

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 401.0 Direct Exchange (DX) Systems.

F 401.4 DX System Testing. For direct exchange (DX) systems, each refrigerant u-bend shall be tested and proved tight with an inert gas at not less than 315 psi (2172 kPa) and maintained for 15 minutes without pressure drop. The pressure reading after tremie grouting of the boreholes shall be maintained in the ground-heat exchanger for not less than 2 hours, in accordance with CSA C448.

SUBSTANTIATION:
This change adds the term “refrigerant” to clarify which u-bend is being referred to. This also correlates with the action taken by the USHGC Technical Committee.
APPENDIX F Chapter 17

GEOTHERMAL ENERGY SYSTEMS

(renumber remaining chapters)

SUBSTANTIATION:
Geothermal energy systems are commonly used. Therefore, requirements for these systems should be in the body of the UMC and not in the appendix. Appendices are only enforceable if adopted. Currently, there is no geothermal code in the U.S. Therefore, relocating Appendix F to Chapter 17 will aid users of the UMC and the Authority Having Jurisdiction in enforcing the installation requirement of geothermal energy systems.
APPENDIX G
SIZING OF VENTING SYSTEMS AND OUTDOOR COMBUSTION
AND VENTILATION OPENING DESIGN
(The content of this Appendix is based on Annex F and Annex I of NFPA 54)

G 101.0 General.

G 101.1 Applicability. This appendix provides general guidelines for sizing venting systems serving appliances equipped with draft hoods, Category I appliances, and appliances listed for use with Type B vents.

G 101.2 Examples Using Single Appliance Venting Tables. See Figure G 101.2(1) through Figure G 101.2(14).

[NFPA 54:F.1]
G 101.3 Example 1: Single Draft Hood-Equipped Appliance. An installer has a 120 000 British thermal units per hour (Btu/h) (35 kW) input appliance with a 5 inch (127 mm) diameter draft hood outlet that needs to be vented into a 10 foot (3048 mm) high Type B vent system. What size vent should be used assuming: (1) a 5 foot (1524 mm) lateral single-wall metal vent connector is used with two 90 degree (1.57 rad) elbows or (2) a 5 foot (1524 mm) lateral single-wall metal vent connector is used with three 90 degree (1.57 rad) elbows in the vent system? (See Figure G 101.3)
Solution:
Table 803.1.2(2) should be used to solve this problem because single-wall metal vent connectors are being used with a Type B vent, as follows:

(1) Read down the first column in Table 803.1.2(2) until the row associated with a 10 foot (3048 mm) height and 5 foot (1524 mm) lateral is found. Read across this row until a vent capacity greater than 120 000 Btu/h (35 kW) is located in the shaded columns labeled NAT Max for draft hood-equipped appliances. In this case, a 5 inch (127 mm) diameter vent has a capacity of 122 000 Btu/h (35.7 kW) and can be used for this application.

(2) If three 90 degree (1.57 rad) elbows are used in the vent system, the maximum vent capacity listed in the tables must be reduced by 10 percent. This implies that the 5 inch (127 mm) diameter vent has an adjusted capacity of only 110 000 Btu/h (32 kW). In this case, the vent system must be increased to 6 inches (152 mm) in diameter. See the following calculations:

\[
122 000 \text{ Btu/h (35.7 kW)} \times 0.90 = 110 000 \text{ Btu/h (32 kW)} \text{ for 5 inch (127 mm) vent}
\]

From Table 803.1.2(2), select 6 inches (152 mm) vent.

\[
186 000 \text{ Btu/h (54.5 kW)} \times 0.90 = 167 000 \text{ Btu/h (49 kW)}
\]

This figure is greater than the required 120 000 Btu/h (35 kW). Therefore, use a 6 inch (152 mm) vent and connector where three elbows are used. [NFPA 54:F.1.1]

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**G 101.4 Example 2: Single Fan-Assisted Appliance.** An installer has an 80 000 Btu/h (23.4 kW) input fan-assisted appliance that must be installed using 10 feet (3048 mm) of lateral connector attached to a 30 foot (9144 mm) high Type B vent. Two 90-degree (1.57 rad) elbows are needed for the installation. Can a single-wall metal vent connector be used for this application? (See Figure G 101.4)

Solution:
Table 803.1.2(2) refers to the use of single-wall metal vent connectors with Type B vent. In the first column find the row associated with a 30 foot (9144 mm) height and a 10 foot (3048 mm) lateral. Read across this row, looking at the FAN Min and FAN Max columns, to find that a 3 inch (76 mm) diameter single-wall metal vent connector is not recommended. Moving to the next larger size single-wall connector [4 inch (102 mm)] we find that a 4 inch (102 mm) diameter single-wall metal connector has a recommended minimum vent capacity of 91 000 Btu/h (26.7 kW) and a recommended maximum vent capacity of 144 000 Btu/h (42 kW). The 80 000 Btu/h (23.4 kW) fan-assisted appliance is outside this range, so the conclusion is that a single-wall metal vent connector cannot be used to vent this appliance using 10 feet (3048 mm) of lateral for the connector. However, if the 80,000 Btu/h (23.4 kW) input appliance could be moved to within 5 feet (1524 mm) of the vertical vent, a 4 inch (102 mm) single-wall metal connector could be used to vent the appliance. Table 803.1.2(2) shows the acceptable range of vent capacities for a 4 inch (102 mm) vent with 5 feet (1524 mm) of lateral to be between 72 000 Btu/h (21.1 kW) and 157 000 Btu/h (46 kW).

If the appliance cannot be moved closer to the vertical vent, a Type B vent could be used as the connector material. In this case, Table 803.1.2(1) shows that, for a 30 foot (9144 mm) high vent with 10 feet (3048 mm) of lateral, the acceptable range of vent capacities for a 4 inch (102 mm) diameter vent attached to a fan-assisted appliance is between 37 000 Btu/h (10.8 kW) and 150 000 Btu/h (44 kW). [NFPA 54:F.1.2]
**G 101.5 Example 3: Interpolating Between Table Values.** An installer has an 80 000 Btu/h (23.4 kW) input appliance with a 4 inch (102 mm) diameter draft hood outlet that needs to be vented into a 12 foot (3658 mm) high Type B vent. The vent connector has a 5 foot (1524 mm) lateral length and is also Type B. Can this appliance be vented using a 4 inch (102 mm) diameter vent?

Solution:
Table 803.1.2(1) is used in the case of an all Type B Vent system. However, Table 803.1.2(1) does not have an entry for a height of 12 feet (3658 mm), and interpolation must be used. Read down the 4 inch (102 mm) diameter NAT Max column to the row associated with 10 foot (3048 mm) height and 5 foot (1524 mm) lateral to find the capacity value of 77 000 Btu/h (22.6 kW). Read further down to the 15 foot (4572 mm) height, 5 foot (1524 mm) lateral row to find the capacity value of 87 000 Btu/h (25.5 kW). The difference between the 15 foot (4572 mm) height capacity value and the 10 foot (3048 mm) height capacity value is 10 000 Btu/h (3 kW). The capacity for a vent system with a 12 foot (3658 mm) height is equal to the capacity for a 10 foot (3048 mm) height plus two-fifths of the difference between the 10 foot (3048 mm) and 15 foot (4572 mm) height values, or 77 000 Btu/h (22.6 kW) + \( \frac{2}{5} \times 10 000 \) Btu/h (3 kW) = 81 000 Btu/h (23.7 kW). Therefore, a 4 inch (102 mm) diameter vent can be used in the installation. [NFPA 54: F.1.3]

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**G 102.0 Examples Using Common Venting Tables.**

**G 102.1 Example 4: Common Venting Two Draft Hood-Equipped Appliances.** A 35 000 Btu/h (10.3 kW) water heater is to be common vented with a 150 000 Btu/h (44 kW) furnace, using a common vent with a total height of 30 feet (9144 mm). The connector rise is 2 feet (610 mm) for the water heater with a horizontal length of 4 feet (1219 mm). The connector rise for the furnace is 3 feet (914 mm) with a horizontal length of 8 feet (2438 mm). Assume single-wall metal connectors will be used with Type B vent. What size connectors and combined vent should be used in this installation? (See Figure G 102.1)

Solution:
Table 803.2(2) should be used to size single-wall metal vent connectors attached to Type B vertical vents. In the vent connector capacity portion of Table 803.2(2), find the row associated with a 30 foot (9144 mm) vent height. For a 2 foot (610 mm) rise on the vent connector for the water heater, read the shaded columns for draft hood-equipped appliances to find that a 3 inch (76 mm) diameter vent connector has a capacity of 37 000 Btu/h (10.8 kW). Therefore, a 3 inch (76 mm) single-wall metal vent connector can be used with the water heater. For a draft hood-equipped furnace with a 3 foot (914 mm) rise, read across the appropriate row to find that a 5 inch (127 mm) diameter vent connector has a maximum capacity of 120 000 Btu/h (35 kW) (which is too small for the furnace), and a 6 inch (152 mm) diameter vent connector has a maximum vent capacity of 172 000 Btu/h (50 kW). Therefore, a 6 inch (152 mm) diameter vent connector should be used with the 150 000 Btu/h (44 kW) furnace. Because both vent connector horizontal lengths are less than the maximum lengths listed in Section 803.2.1, the table values can be used without adjustments.

In the common vent capacity portion of Table 803.2(2), find the row associated with a 30 foot (9144 mm) vent height and read over to the NAT + NAT portion of the 6 inch (152 mm) diameter column to find a maximum combined capacity of 257 000 Btu/h (75 kW). Since the two appliances total only 185 000 Btu/h (54 kW), a 6 inch (152 mm) common vent can be used. [NFPA 54: F.2.1]

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**G 102.2 Example 5(a): Common Venting a Draft Hood-Equipped Water Heater with a Fan-Assisted Furnace into a Type B Vent.** In this case, a 35 000 Btu/h (10.3 kW) input draft hood-equipped water heater with a 4 inch (102 mm) diameter draft hood outlet, 2 feet (610 mm) of connector rise, and 4 feet (1219 mm) of horizontal length is to be common vented with a 100 000 Btu/h (29 kW) fan-assisted furnace with a 4 inch (102 mm) diameter flue collar, 3 feet (914 mm) of connector rise, and 6 feet (1829 mm) of horizontal length. The common vent consists of a 30 foot (9144 mm) height of Type B vent. What are the recommended vent diameters for each connector and the common vent? The installer would like to use a single-wall metal vent connector. (See Figure G 102.2)

Solution:
Water Heater Vent Connector Diameter. Since the water heater vent connector horizontal length of 4 feet (1219 mm) is less than the maximum value listed in Table 803.2(2), the venting table values can be used without adjustments.

Using the Vent Connector Capacity portion of Table 803.2(2), read down the Total Vent Height \( (H) \) column to 30 feet (9144 mm) and read across the 2 feet (610 mm) Connector Rise \( (R) \) row to the first Btu/h rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3 inch (76 mm) vent connector has a
maximum input rating of 37 000 Btu/h (10.8 kW). Although this rating is greater than the water heater input rating, a 3 inch (76 mm) vent connector is prohibited by Section 803.2.18. A 4 inch (102 mm) vent connector has a maximum input rating of 67 000 Btu/h (19.6 kW) and is equal to the draft hood outlet diameter. A 4 inch (102 mm) vent connector is selected. Since the water heater is equipped with a draft hood, there are no minimum input rating restrictions.

Furnace Vent Connector Diameter. Using the Vent Connector Capacity portion of Table 803.2(2), read down the Total Vent Height (H) column to 30 feet (9144 mm) and across this row to find the smallest vent diameter in the FAN + NAT column that has a Btu/h rating equal to or greater than 135 000 Btu/h (40 kW). The 4 inch (102 mm) common vent has a capacity of 132 000 Btu/h (39 kW) and the 5 inch (127 mm) common vent has a capacity of 202 000 Btu/h (59 kW). Therefore, the 5 inch (127 mm) common vent should be used in this example.

Summary: In this example, the installer can use a 4 inch (102 mm) diameter, single-wall metal vent connector for the water heater and a 4 inch (102 mm) diameter, single-wall metal vent connector for the furnace. The common vent should be a 5 inch (127 mm) diameter Type B vent. [NFPA 54:F.2.2]

G 102.3 Example 5(b): Common Venting into an Interior Masonry Chimney. In this case, the water heater and fan-assisted furnace of Example 5(a) are to be common-vent into a claytile-lined masonry chimney with a 30 foot (9144 mm) height. The chimney is not exposed to the outdoors below the roof line. The internal dimensions of the clay tile liner are nominally 8 inches (203 mm) by 12 inches (305 mm). Assuming the same vent connector heights, laterals, and materials found in Example 5(a), what are the recommended vent connector diameters, and is this an acceptable installation?

Solution:
Table 803.2(4) is used to size common venting installations involving single-wall connectors into masonry chimneys.

Water Heater Vent Connector Diameter. Using Table 803.2(4), Vent Connector Capacity, read down the Total Vent Height (H) column to 30 feet (9144 mm), and across this row to find the FAN + NAT column that has a Btu/h rating equal to or greater than the water heater input rating. The table shows that a 4 inch (76 mm) vent connector has a maximum input of 57 000 Btu/h (16.7 kW), while a 3 inch (102 mm) vent connector has a maximum input of 50 000 Btu/h (15 kW) and must therefore be used.

Furnace Vent Connector Diameter. Using the Vent Connector Capacity portion of Table 803.2(4), read down the Total Vent Height (H) column to 30 feet (9144 mm) and across this row to find the FAN + NAT column that has a Btu/h rating equal to or greater than the furnace input rating. The 4 inch (102 mm) connector has a maximum input rating of 100 000 Btu/h (29 kW) furnace in this example falls within this range, so a 4 inch (102 mm) connector is adequate.

Masonry Chimney. From Table G 102.3, the Equivalent Area for a Nominal Liner size of 8 inches (203 mm) by 12 inches (305 mm) is 63.6 of a square inches (0.041 m²). Using Table 803.2(4), Common Vent Capacity, read down the FAN + NAT column under the Minimum Internal Area of Chimney value of 63 to the row for 30 foot (9144 mm) height to find a capacity value of 739 000 Btu/h (217 kW). The combined input rating of the furnace and water heater, 135 000 Btu/h (39 kW) and a maximum input rating of 37 000 Btu/h (10.8 kW), is less than the table value so this is an acceptable installation.

Section 803.2.17 requires the common vent area to be no greater than seven times the smallest listed appliance categorized vent area, flue collar area, or draft hood outlet area. Both appliances in this installation have 4 inch (102 mm) diameter outlets. From Table G 102.3, the equivalent area for an inside diameter of 4 inches (102 mm) is 12.2 of a square inches (0.008 m²). Seven times 12.2 equals 85.4, which is greater than 63.6, so this configuration is acceptable. [NFPA 54:F.2.3]

G 102.4 Example 5(c): Common Venting into an Exterior Masonry Chimney. In this case, the water heater and fan-
assisted furnace of Examples 5(a) and 5(b) are to be common-vented into an exterior masonry chimney. The chimney height, clay-tile-liner dimensions, and vent connector heights and laterals are the same as in Example 5(b). This system is being installed in Charlotte, North Carolina. Does this exterior masonry chimney need to be relined? If so, what corrugated metallic liner size is recommended? What vent connector diameters are recommended? [See Table G 102.3 and Figure 803.1.2(6)]

Solution:

According to Section 803.2.20, Type B vent connectors are required to be used with exterior masonry chimneys. Use Table 803.2(8) and Table 803.2(9) to size FAN+NAT common venting installations involving Type-B double-wall connectors into exterior masonry chimneys.

The local 99 percent winter design temperature needed to use Table 803.2(8) and Table 803.2(9) can be found in ASHRAE Handbook – Fundamentals. For Charlotte, North Carolina, this design temperature is 19°F (-7.2°C).

Chimney Liner Requirement. As in Example 5(b), use the 63 square inch (0.04 m²) internal area columns for this size clay tile liner. Read down the 63 square inches (0.04 m²) column of Table 803.2(8) to the 30 foot (9144 mm) height row to find that the combined appliance maximum input is 747 000 Btu/h (218.9 kW). The combined input rating of the appliances in this installation, 135 000 Btu/h (40 kW), is less than the maximum value, so this criterion is satisfied. Table 803.2(9), at a 19°F (-7.2°C) design temperature, and at the same vent height and internal area used earlier, shows that the minimum allowable input rating of a space-heating appliance is 470 000 Btu/h (137.7 kW). The furnace input rating of 100 000 Btu/h (29 kW) is less than this minimum value. So this criterion is not satisfied, and an alternative venting design needs to be used, such as a Type B vent shown in Example 5(a) or a listed chimney liner system shown in the remainder of the example.

According to Section 803.2.19, Table 803.2(1) or Table 803.2(2) is used for sizing corrugated metallic liners in masonry chimneys, with the maximum common vent capacities reduced by 20 percent. This example will be continued assuming Type B vent connectors.

Water Heater Vent Connector Diameter. Using Table 803.2(1) Vent Connector Capacity, read down the total Vent Height (H) column to 30 feet (9144 mm), and read across the 2 feet (610 mm) Connector Rise (R) row to the first Btu/hour rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3 inch (76 mm) vent connector has a maximum capacity of 39 000 Btu/h (11.4 kW). Although this rating is greater than the water heater input rating, a 3 inch (76 mm) vent connector is prohibited by Section 803.2.20. A 4 inch (102 mm) vent connector has a maximum input rating of 70 000 Btu/h (20.5 kW) and is equal to the draft hood outlet diameter. A 4 inch (102 mm) vent connector is selected.

**TABLE G 102.3**

**MASONRY CHIMNEY LINER DIMENSIONS WITH CIRCULAR EQUIVALENTS**

[NFPA 54: TABLE F.2.3]

(portion of table not shown remains unchanged)

Furnace Vent Connector Diameter. Using Table 803.2(1), Vent Connector Capacity, read down the total Vent Height (H) column to 30 feet (9144 mm), and read across the 3 feet (914 mm) Connector Rise (R) row to the first Btu/h rating in the FAN MAX column that is equal to or greater than the furnace input rating. The 100 000 Btu/h (29 kW) furnace in this example falls within this range, so a 4 inch (102 mm) connector is adequate.

Chimney Liner Diameter. The total input to the common vent is 135 000 Btu/h (40 kW). Using the Common Vent Capacity portion of Table 803.2(1), read down the total Vent Height (H) column to 30 feet (9144 mm) and across this row to find the smallest vent diameter in the FAN + NAT column that has a Btu/h rating greater than 135 000 Btu/h (40 kW). The 4 inch (102 mm) common vent has a capacity of 138 000 Btu/h (40.4 kW). Reducing the maximum capacity by 20 percent results in a maximum capacity for a 4 inch (102 mm) corrugated liner of 110 000 Btu/h (32 kW), less than the total input of 135 000 Btu/h (40 kW). So a larger liner is needed. The 5 inch (127 mm) common vent capacity listed in Table 803.2(1) is 210 000 Btu/h (62 kW), and after reducing by 20 percent is 168 000 Btu/h (49.2 kW). Therefore, a 5 inch (127 mm) corrugated metal liner should be used in this example.

Single Wall Connectors. Once it has been established that relining the chimney is necessary, Type B double-wall vent connectors are not specifically required. This example could be redone using Table 803.2(2) for single-wall vent connectors. For this case, the vent connector and liner diameters would be the same as found for Type B double-wall connectors. [NFPA 54: F.2.4]

G 103.0 Example of Combination Indoor and Outdoor Combustion Air Opening Design. Determine the required combination of indoor and outdoor combustion air opening sizes for the following appliance installation example.

Example Installation: A fan-assisted furnace and a draft hood-equipped water heater with the following inputs are located in a 15 foot by 30 foot (4572 mm by 9144 mm) basement with an 8 foot (2438 mm) ceiling. No additional indoor spaces can be used to help meet the appliance combustion air needs.

Fan-Assisted Furnace Input: 100 000 Btu/h (29 kW)
Draft Hood-Equipped Water Heater Input: 40 000 Btu/h (11.7 kW)

Solution:
(1) Determine the total available room volume.
   Appliance room volume.
   15 feet by 30 feet (4572 mm by 9144 mm) with an 8 foot (2438 mm) ceiling = 3600 cubic feet (101.94 m³)

(2) Determine the total required volume.
   The Standard Method to determine combustion air is used to calculate the required volume.
   The combined input for the appliances located in the basement is calculated as follows:
   100 000 Btu/h (29 kW) + 40 000 Btu/h (11.7 kW) = 140 000 Btu/h (41 kW)
   The Standard Method requires that the required volume be determined based on 50 cubic feet per 1000 Btu/h (4.83 m³/kW).
   Using Table G 103.0 the required volume for a 140 000 Btu/h (41 kW) water heater combined input is 7000 cubic feet (198.22 m³).

Conclusion:
The indoor volume is insufficient to supply combustion air since the total of 3600 cubic feet (101.94 m³) does not meet the required volume of 7000 cubic feet (198.22 m³). Therefore, additional combustion air must be provided from the outdoors.

(3) Determine the ratio of the available volume to the required volume:
\[
\frac{3600 \text{ cubic feet}}{7000 \text{ cubic feet}} = 0.51
\]

(4) Determine the reduction factor to be used to reduce the full outdoor air opening size to the minimum required based on ratio of indoor spaces:
\[
1.00 - 0.51 \text{ (from Step 3)} = 0.49
\]

(5) Determine the single outdoor combustion air opening size as though all combustion air is to come from outdoors. In this example, the combustion air opening directly communicates with the outdoors:
\[
\frac{140 000 \text{ Btu/h}}{3000 \text{ British thermal units per square inch (Btu/in}^2)} = 47 \text{ square inches (0.03 m}^2)\]

(6) Determine the minimum outdoor combustion air opening area:
Outdoor opening area = 0.49 (from Step 4) x 47 square inches (0.03 m²)
   = 23 square inches (0.01 m²)
Section 701.7.3(3) requires the minimum dimension of the air opening should not be less than 3 inches (76 mm). [NFPA 54:1.1]

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Appendix G is being revised to the latest edition of NFPA 54-2021.
APPENDIX H
IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR LEGIONELLA GROWTH

Part I – General

H 101.0 General.
H 101.1 Applicability. Part I of this appendix provides guidelines on the impact of water temperature in minimizing Legionella growth potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building mechanical systems. Legionella control for plumbing systems shall be in accordance with the plumbing code. This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guideline document for scalding or Legionella.

Note: Published documents which address Legionella risk management include ASHRAE 188 or ASHRAE Guideline 12.

Published documents which address professional qualifications for Legionella risk assessment include ASSE Series 12000.

There are additional factors associated with the potential for scalding and Legionella growth other than temperature. For scalding potential, other factors include, but are not limited to, user age, health, body part, length of contact time, and water source.

For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

H 102.0 Definitions.
H 102.1 General. For the purpose of this appendix, the following definitions shall apply.
Biofilm. Microorganisms and the slime they secrete that grow on any continually moist surface.
Control. The management to maintain compliance with established criteria.
Disinfection. Chemical or physical control measures or procedures used to kill or inactivate pathogens.
Disinfection, Online. The procedure while the equipment is in operation.
Disinfection, Offline. The procedure while the equipment is not in operation.
Halogenation. A chemical reaction that involves the addition of one or more halogens, including, but not limited to, chlorine, bromine, or iodine, commonly used to disinfect water systems.
Hazard. See Risk.
Legionella Concentrations. The extent of colonization of Legionella measured in Colony Forming Units per milliliter (CFU/mL).
Legionella Growth Potential. The likelihood that Legionella bacteria will reproduce.
Monitor. Observing and checking the progress or quality of (something) or measuring the physical and chemical characteristics of control measures.
Nutrient. Any element or compound essential as a raw material for an organism’s growth and development.
Risk. The potential to cause harm resulting from exposure.
Test. The measurement of the physical, chemical, or microbial characteristics or quality of water.
**H 103.0 Building Water Systems and System Equipment Documentation.**

**H 103.1 Design Documentation.** Construction documents shall be required for new construction, renovation, refurbishment, replacement, or repurposing of an occupiable building water system, including a water management plan, and shall be submitted to the Authority Having Jurisdiction.

**H 103.2 Onsite Documentation.** Documentation shall be maintained onsite and shall be readily accessible to the Authority Having Jurisdiction.

**H 104.0 Potential Exposure.**

**H 104.1 Legionella Growth Potential.** The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in a water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential.

**H 104.2 Scald Potential.** Where the water system’s temperature(s) range pose(s) a scald potential, protection shall be provided in accordance with the plumbing code.

**FIGURE H 104.1 WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL**

For SI units: °C = (°F-32)/1.8

* Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.

**H 105.0 Disinfection.**

**H 105.1 Disinfection Documentation.** Where required by the Authority Having Jurisdiction, documentation for disinfection of building mechanical systems shall be provided by the registered design professional in the construction documents.

**H 105.1.1 Copper-Silver Ionization.** Copper-silver ionization methods and procedures shall include the following documentation.

1. Copper and silver ionization concentrations.
2. Methods and documentation for monitoring ion levels.
3. Electrode cleaning cycles and methods.

**H 105.1.2 Ultraviolet Light.** Ultraviolet light methods shall include the following documentation:

1. Locations of ultraviolet light units.
2. Cleaning cycles and methods of the quartz sleeves and housing.

**H 105.2 Chemical Disinfection.** Chemical biocide treatment shall be permitted to be used in accordance with the following:

1. Oxidizing biocides in accordance with manufacturer’s guidelines.
2. Non-oxidizing biocides in accordance with manufacturer’s guidelines.
3. Alternating the use of different types of biocides, dose, and frequency is recommended.
(4) These treatment methods can be used for continuous, online disinfection or shock treatment online or offline.
H 105.3 Non-Chemical Treatment. Non-chemical treatment devices shall be permitted to be used in accordance with manufacturer’s guidelines.
H 105.3.1 Thermal Shock. Thermal treatment using heat shock at 158°F (70°C) for 30 minutes shall be permitted in accordance with applicable guidelines and the manufacturer’s instructions.
H 105.3.2 Physical Cleaning. When implemented, physical cleaning shall only be performed as an offline method and shall be performed before the chemical disinfection methods in Section 105.1 have been performed. Building outdoor air intakes shall be closed during physical cleaning prior to commencing. Physical cleaning shall be in accordance with the manufacturer’s instructions.
H 105.4 Inspection and Maintenance. The system shall be monitored and maintained to prevent scale buildup, sediment, corrosion, and biofouling.
H 105.5 Frequency of Cleaning and Disinfection. Where a water management plan is implemented, the frequency of cleaning and disinfection logs shall be readily accessible to the water management team and the Authority Having Jurisdiction.

H 105.6 Control Measures. Evaluation of control measures for Legionella shall consider potential unintended consequences of such measures that may affect overall health risk, including the formation of toxic disinfection byproducts (whether regulated or unregulated), resultant increase in other plumbing-associated pathogens, and scalding.

Part II – Minimizing Legionella Growth Potential in Cooling Towers and Other Mechanical Systems.

H 201.0 General.
H 201.1 Applicability. Part II of this appendix applies to water sources that frequently provide optimal conditions for growth of Legionella organisms in accordance with Figure H 104.1, including, but not limited to, cooling towers, evaporative condensers, decorative water features, filters, ice makers, evaporative air coolers, fluid coolers that use evaporation to reject heat, industrial processes that use water to remove excess heat, industrial and municipal waste treatment plants, and other mechanical systems.
H 201.2 Water Management Plan, Where Required. A water management plan shall be established when required by the criteria of the Authority Having Jurisdiction.
H 201.3 Water Management Plan, Where Implemented. Where a water management plan is implemented, the plan shall be in accordance with the following:
(1) Determine a water management plan team.
(2) Provide description of the building’s water system.
(3) Identify areas of Legionella growth potential in accordance with temperature ranges as shown in Figure H 104.1.
(4) Determine applicable control measures and monitoring procedures.
(5) Ensure the water management plan is effective and operating as designed.
(6) Document and communicate all the activities of the water management plan.
H 201.4 Water Sampling. An analysis of water samples from a source capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table H 201.5 and Figure H 201.5.
H 201.5 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with applicable levels as stated in Section H 201.5.1 through Section H 201.5.3.
H 201.5.1 Levels Less than 10 CFU/ML. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment plan in accordance with Table H 201.5.
H 201.5.2 Levels Between 10 CFU/ML and 100 CFU/ML. Water samples containing Legionella levels greater than 10 CFU/mL but less than 100 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.
H 201.5.3 Levels Between 100 CFU/ML and 1000 CFU/ML. Water samples containing Legionella levels greater than 100 CFU/mL but less than 1,000 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL in accordance with H 202.14.
H 201.5.3 Levels Greater than 1000 CFU/ML. Water samples containing Legionella levels greater than 1,000 CFU/mL shall require the water treatment plan to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.
#### TABLE H 201.5
**LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS**

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>( \geq 10 ) and &lt;100</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>( \geq 100 ) and &lt;1000</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL. <em>The emergency response plan for cooling towers is addressed in Section H 202.14.</em></td>
</tr>
<tr>
<td>( \geq 1000 )</td>
<td>Review water treatment plan, notify Authority Having Jurisdiction (if required), institute immediate online disinfection, and retest water 3 to 7 days after decontamination. If retest ( \geq 1000 ) CFU/mL, repeat system decontamination.</td>
</tr>
</tbody>
</table>

**H 201.6 Air Sampling.** Air sampling for Legionella shall not be used as a means of measuring potential Legionella exposure.

**H 202.0 Cooling Towers.**

**H 202.1 General.** Cooling towers shall be installed, maintained, and tested as required by this Appendix and the Authority Having Jurisdiction.

**H 202.2 Risk Factors.** The following risk factors shall be identified, assessed, controlled, and monitored:

1. Stagnant water due to dead legs, intermittent operation, or seasonal usage.
2. The presence of nutrients or biofilm.
3. Water temperature within a range that supports microbial growth as specified in Figure H 104.1.
4. Water exposed to direct sunlight which promotes algae growth.
5. Water quality, including, but not limited to, the following factors:
   a. System cleanliness
   b. pH levels
   c. Presence of corrosion
   d. Presence of scale and biofouling
   e. Conductivity levels
   f. Dissolved and suspended solids
   g. Control of water treatment chemicals
   h. Control of bleed-off or blowdown
6. System size
7. Physical condition of system
8. Aerosol generation, dispersion, and drift elimination
9. System site location
10. Access for inspection, cleaning, and maintenance
11. Concentration of Legionella as specified in Table H 201.5.

**H 202.3 Water Temperature.** The system shall be designed to maintain low sump-water operating temperatures.

**H 202.4 Drift Eliminators.** Drift eliminators shall be installed in accordance with Section 1126.0, Section E 403.2, and Section E 403.5.1; and shall be accessible to allow inspection, maintenance, and cleaning of internal components.

**H 202.5 Side Stream Filtration.** When suspended solids are visible in the cooling tower water system, side stream filtration shall be permitted to be used to control suspended solids in cooling tower circulating water. Makeup water quality, design of cooling tower fill, recirculation rate, and total system volume shall be included in the design of such equipment.

**H 202.6 Equipment Site Location.** The site location of new or replacement open- or closed-circuit cooling towers or evaporative condensers shall be in accordance with the following:

1. Shall not be located where contamination from building systems or facility processes can be drawn into the equipment. Equipment shall be installed no less than 10 feet (3048 mm) away from building exhaust or plumbing vents.
2. Shall not be located where equipment discharges into occupied spaces, roadways, walkways, outdoor air intakes, and building openings. Equipment shall be installed no less than 10 feet (3048 mm) away from building intakes or plumbing vents.

**H 202.7 System Commissioning.** System commissioning shall include procedures for cleaning of the cooling system. Ongoing water treatment in accordance with Section H 201.5 shall be initiated once the system is charged with water.

**H 202.8 System Start-Up and Shutdown.** System start-up and shutdown procedures shall include, but not be limited to the following:
(1) Management of hazardous conditions associated with untreated water, including the following:
   (a) Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system
       drainage for shutdown periods longer than 3 days, or the duration specified by the water management plan.
   (b) Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
   (c) Start-up from an undrained or stagnant system that exceeds 3 days, or the number of idle days specified by the
       water management plan or the manufacturer’s recommendations.

**H 202.9 System Maintenance and Inspection.** System components requiring maintenance and inspection shall be
accessible. A schedule for maintenance and inspection of system shall be included in the water management plan
documents. Cooling tower maintenance and inspection shall include, but not be limited to, the following areas:

1. **Water treatment system**
2. Louvers
3. Piping dead legs
4. Cold water basins
5. Crossflow hot water basin
6. Counterflow spray system
7. Drift eliminators
8. Fill material and fill air entrance and exit surfaces
9. Purging of stagnant water or low-flow zones within the basin

**H 202.10 Water Treatment.** Water treatment shall control microbiological activity, scale, corrosion, sediment, and solids
in the system, and shall be in accordance with the following:
   (1) All equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
   (2) The minimum required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
   (3) The minimum requirements for documenting system water treatment.

**H 202.11 Disinfection.** Methods for disinfection of cooling towers shall include, but not be limited to, the halogenation
methods and procedures for flushing and disinfection in accordance with Section 1122.0 and for reclaimed (recycled)
and onsite treated nonpotable water in accordance with Section E 403.5.2. The responsible person for initiating disinfection shall be identified in the water management plan documents and the disinfection process shall include the following:
   (1) Online disinfection.
   (2) Emergency disinfection.

**H 202.12 Water Treatment Chemicals.** Water treatment chemicals, such as biocides, shall be applied using an
automated dosing system at regular intervals. The frequency and quantity of chemical dosing shall be based on the
microbial activity of the system and the chemical parameters of the circulating water.

**H 202.13 Makeup Valves.** The location of cooling tower makeup valves shall be in accordance with the registered
design professional construction documents and approved by the Authority Having Jurisdiction. Makeup valves shall be
provided with backflow prevention in accordance with ASME A112.1.2 for air gaps or backflow preventers in accordance
with the plumbing code.

**H 202.14 Emergency Response Plan.** An emergency response plan shall be provided when required by the
Authority Having Jurisdiction and shall include, but not be limited to, the following:
   (1) Procedures to be followed if there are cases of Legionellosis associated with the use of cooling towers or
evaporative condensers.
   (2) Procedures to be followed if cooling towers or evaporative condensers reach Legionella levels of 1000 CFU/mL or
greater.
   (3) Testing for Legionella shall be performed. Procedures shall include the type of tests to be performed, sampling, and
   the interpretation of test results.
   (4) Procedures for emergency disinfection.
   (5) Procedures for other actions identified by the water management plan to prevent exposure to contaminated water.

**H 202.15 Control of Bleed-Off.** An automated bleed-off, or blowdown, system shall be used to remove water from the
system and replace with makeup water to limit the concentration of dissolved and suspended solids. Additional manual
bleed-off shall be permitted to be used to control scale or biofouling. The water for bleed-off shall be taken from the
return line of the cooling water system to the cooling tower. Bleed-off shall only occur while chemical dosing is turned off.

**H 202.16 Alternative Systems.** Alternative systems and technologies that do not pose microbial risk and do not provide
the opportunity for Legionella bacteria to grow shall be evaluated, including but not limited to off-peak thermal storage
and geothermal coupled options.

**H 203.0 Other Mechanical Systems.**

**H 203.1 General.** Other mechanical systems and portions thereof shall be installed, maintained, and tested as required
by this section and the Authority Having Jurisdiction.

**H 203.2 Sand Filters.** Sand filters shall be maintained or replaced in accordance with applicable guidelines as
determined by the Authority Having Jurisdiction.

**H 203.3 Water Softeners.** Water softeners shall be installed and maintained in accordance with the plumbing code.

**H 203.4 Dehumidifiers.** Dehumidifiers shall be required in enclosed areas with swimming pools, spas, and hot tubs.
Dehumidifiers shall be maintained in accordance with ASHRAE 188 and the manufacturer’s instructions.

**H 203.5 Misters, Atomizers, Air Washers, Nebulizers, and Humidifiers.** Misters, atomizers, air washers, nebulizers,
and humidifiers shall be disinfected in accordance with ASHRAE 188. The minimum remediation action for humidifiers
shall be in accordance with Table H 203.6.
### TABLE H 203.6
LEGIONELLA REMEDIATION ACTIONS IN HUMIDIFIERS

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;/=1 and &lt;10</td>
<td>Prompt cleaning and/or biocide treatment of the system.</td>
</tr>
<tr>
<td>&gt;/=10</td>
<td>Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.</td>
</tr>
</tbody>
</table>

**H 203.7 Evaporative Air Coolers.** Evaporative air coolers shall be completely drained and cleaned in accordance with the manufacturer’s instructions. When not in use, evaporative air coolers shall be completely drained.

**H 203.8 Ice Machines.** Ice machines not used for human consumption shall be flushed and maintained in accordance with ASHRAE 188.

**H 203.9 Spas and Hot Tubs.** Spas and hot tubs shall be maintained and tested in accordance with ASHRAE Guideline 12 and cleaned and disinfected in accordance with the manufacturer’s recommendations.

**H 203.10 Decorative Water Features.** Decorative water features shall be maintained in accordance with ASHRAE 188. Decorative water features shall be drained, cleaned, and disinfected in accordance with the manufacturer’s instructions and the Authority Having Jurisdiction.

**H 203.11 Water Supply Systems.** The minimum remediation action for water supply systems shall be in accordance with the plumbing code.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.1.2-2012 (R2017)</td>
<td>Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)</td>
<td>Fittings</td>
</tr>
<tr>
<td>ASSE Series 12000-2018</td>
<td>Infection Control Risk Assessment for All Building Systems</td>
<td>Risk Management</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

**SUBSTANTIATION:**
The purpose of the new Appendix H is to establish minimum Legionellosis risk management requirements for building mechanical systems. Cooling towers’ potential for spreading Legionella bacteria is especially pressing given the associated diseases’ symptomatic similarities to COVID-19 and the propensity they have for exacerbating respiratory illnesses.
APPENDIX J
THE SAFE OPERATION, CLOSURE AND RESTARTING OF COOLING TOWERS

J 101.0 General.
J 101.2 Applicability. The provisions of this appendix address risk management practices of mechanical systems for safe operation during normal operation, interruption to normal operation (system shutdown), and restarting of cooling towers.
J 101.3 Building Water Systems. This appendix shall be applicable to building water systems for cooling towers.
J 101.4 Building Types. This appendix shall be applicable to the following building types:
(1) Non-residential (low- and high-rise)
   (a) Office buildings
   (b) Mercantile (seasonal retail)
   (c) Schools/dormitories
   (d) Hotels/motels
   (e) Assemblies
   (f) Health care facilities
(2) Residential
   (a) All except single and double family residence

J 201.0 Definitions.
J 201.1 General. For the purposes of this appendix, the following definitions shall apply:
Building Water. Water collected, conveyed, circulated, stored, drained, or discharged by building plumbing systems for use in and around buildings.
Building Water Systems. Potable and non-potable water systems in the building, or on site.
Normal Operation. The state of a building water system when the building is open and being used as intended. This includes the normal hours of operation and the number of people that occupy the building.
Risk. The potential for harm to humans resulting from exposure to Legionella.
Risk Management. Systematic activities to reduce risk.
System Restarting. The set of actions that should be taken to ready a mechanical system for normal operations after an extended period of no or limited operations.

SUBSTANTIATION:
General: The new appendix will identify the standards for risk management of building mechanical systems specifically associated with cooling towers. Legionnaires' disease linked to aerosolization of contaminated water vapor from cooling towers has increased in recent decades, and these standards are presented to provide reasonable control measures established for Legionella levels.
Definitions: The definitions in this new appendix have been added and are necessary for clarity and enforcement of standards Legionella levels in cooling towers.
J 301.0 Normal Operation, Cooling Towers.
J 301.1 Legionella. Section J 301.2 through Section J 301.4.1.1 shall apply to cooling towers under normal operation. *Note:* Water based mechanical system are generally closed and pressurized and have no potential to affect the health of occupants, except at the cooling tower. Cooling towers can carry Legionella on aerosolized water droplets and infect occupants in and outside of the building.

J 301.2 Water Management Program, Cooling Towers. For each cooling tower system, the owner shall have a maintenance program and plan prepared by a qualified person in accordance with ASHRAE 188, the manufacturer’s instructions, and the requirements of this section. The plan shall be kept current and amended by a qualified person or building owner designee as needed to reflect any changes in the management and maintenance team, system design, operation or system control requirements for the cooling tower system. The plan shall be kept in the building where a cooling tower or cooling tower system is located, or in an adjacent building or structure on the same location and shall be made available to the Authority Having Jurisdiction for inspection.

The water management program shall include, but not be limited to, the following:

1. **Management and maintenance team.** Identification, including names and contact information (such as mail, email addresses and telephone numbers) and description of the function of each person on the cooling tower system management and maintenance team, including:
   - (a) The owner of the building where each cooling tower system is located, and any manager or other person designated by the owner as responsible for compliance with the requirements of the Authority Having Jurisdiction.
   - (b) Person designated by the owner as a responsible person, as defined by the Authority Having Jurisdiction.
   - (c) Consultants, service company and qualified person who cleans, disinfects, delivers chemicals or services the cooling tower system.

2. **Cooling tower system.** Identification, specifications and description of each cooling tower system and all components located at a specific address, including:
   - (a) The number of cooling towers in the cooling tower system.
   - (b) The location of each cooling tower in relation to the building and the building address, block and lot number.
   - (c) The dimensions and characteristics of the cooling tower system including total recirculating water volume, cooling tower tonnage, biocide delivery method, flow rate and other key characteristics.
   - (d) The purpose of the cooling tower system and seasonal or year-round operation including start and end date, if applicable. For systems with multiple cooling towers, conditional operation, such as cycling or scaling related to cooling demand, shall also be noted.
   - (e) The identification and/or registration number for each cooling tower where required by the Authority Having Jurisdiction.
   - (f) The cooling tower manufacturer, model number and serial number, if applicable.
   - (g) Flow diagram or schematic of the cooling tower system, identifying all of the principal components and appurtenances of the cooling tower system including makeup water and waste stream plumbing locations.

3. **Risk management assessment.** The assessment shall identify risk factors for Legionella proliferation and specify risk management procedures for all or parts of each cooling tower system, and anticipated conditions including:
   - (a) Any dead legs or stagnant water in the recirculation system.
   - (b) Operating configurations and conditions that may occur after periods of extended inactivity lasting more than three
days, including idling or low circulation while not being fully drained.
(c) System parts that require continual operation throughout the year making regular, periodic offline cleaning and disinfection difficult.
(d) Any components that may add additional risk factors for organic material buildup and microbial growth such as strainers and out-of-use filters.
(e) Sources of elevated organic contamination, including, but not limited to windblown debris, bird waste and plant material.
(f) Design configurations that present risk of direct sun exposure on basin, deck or fill.
(g) Ventilation intakes or other routes for human exposure to cooling tower aerosols.
(h) System components adversely affecting water quality management procedures.
(i) Other risks or limiting factors or constraints in the cooling tower system's design and functioning.
(4) Cooling tower operation:
(a) Control measures, corrective actions, documentation, including a written checklist for routine monitoring, and reporting as required by the Authority Having Jurisdiction, and any routine maintenance activities recommended by the manufacturer's instructions, including performance measures, which may sufficiently demonstrate adequate implementation of the operation requirements described in the maintenance program and plan. Where there is a conflict between the requirements of this Section and the manufacturer's instructions, the maintenance program and plan shall reflect the most stringent requirement.
(b) Specific, detailed seasonal and temporary shutdown and start-up procedures.
(c) Notification and communication strategies among management and maintenance team members regarding the required corrective actions in response to process control activities, monitoring, sampling results and other actions taken to maintain the cooling tower system.

J 201.0 Definitions.
J 201.1 General. For the purposes of this appendix, the following definitions shall apply:

**Water Management Program (WMP).** A risk management plan to help building managers identify risks to water quality and establish clear guidelines for managing these risks at various points in the building lifecycle, including start-up, normal operation, under occupancy, water system shutdown, and water system restart. Such programs are often focused on Legionella risk prevention and are required in some states for certain building types to combat waterborne pathogens such as Legionellosis.

**Legionella.** The name of the genus of bacteria that can cause a pneumonia called Legionnaires’ disease or a flu-like illness called Pontiac fever when inhaled, aspirated or directly introduced into the lungs of susceptible individuals. It is a common aquatic bacteria found in natural and building water systems, as well as in some soils.

**Legionellosis.** The term used to describe Legionnaires’ disease, Pontiac fever, and any illness caused by exposure to Legionella bacteria.

**Monitoring.** Conducting a planned sequence of observations or measurements of the physical and chemical characteristics of control measures.

### TABLE 1701.2

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
The new appendix will address the necessary risk management practices needed for mechanical systems such as cooling towers.

Definitions: The definitions in this new appendix have been added and are necessary for clarity and enforcement of standards Legionella levels in cooling towers.
J 301.3 Water Treatment and Filtration Equipment. Water treatment and filtration of cooling towers shall be in accordance with Section J 301.3.1 through Section J 301.4.1.1.

J 301.3.1 Water Treatment. Water treatment shall be provided to control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:
(1) Equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
(2) The required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
(3) The requirements for documenting system water treatment.

J 301.3.2 Disinfection. The responsible person for initiating disinfection shall be identified in the water management program documents and the disinfection process shall include the following:
(1) Online disinfection.
(2) Emergency disinfection.

J 301.3.3 Water Treatment Chemicals. Water treatment chemicals, such as biocides, shall be applied using an automated dosing system, where possible, at regular intervals. The frequency and quantity of chemical dosing shall be defined in the water management program, and performed accordingly, based on the microbial activity of the system and the chemical parameters of the circulating water.

Prior to changing an existing chemical treatment system or introducing a new chemical treatment agent, cooling tower design, installation, operation, and maintenance shall be evaluated by a qualified person or building owner designee to ensure compatibility between the chemicals and the cooling tower system's materials, and to minimize microbial growth and the release of aerosols.

The evaluation shall describe the optimum level of chemicals required to achieve the desired result in a manner which can be used as a system performance measure.
(1) Daily automatic treatment while in operation. Water in a cooling tower system shall be treated at least once a day when the system is in operation and such treatment shall be automated, unless the water management program and plan explicitly state how manual or less frequent biocide additions will provide effective control of Legionella growth.
(2) Recirculating system. A cooling tower system shall be operated and programmed to continually recirculate the water, irrespective of the building's cooling demand of the system.

Exception: Where the water management program specifies in detail how the intended water treatment schedule will be carried out, and how effective biofilm and microorganism control will be achieved when the whole or a part of the system is idle during the scheduled chemical injection.

(3) Chemicals and biocides. Chemicals and biocides shall be used in quantities and combinations sufficient to control the presence of Legionella, minimize biofilms, and prevent scaling and corrosion that may facilitate microbial growth. It is recommended that oxidizing chemicals be used as the primary biocide control. For systems where oxidizing chemicals cannot be used as the primary biocide to control the presence of Legionella, building owners shall submit an alternative plan for effective bacteriological control for approval by the Authority Having Jurisdiction.

(a) Biocide applications. Any person who performs cleaning and disinfection or applies biocides in a cooling tower system shall be a certified person as required by the Authority Having Jurisdiction.
(b) Registered biocides. Only biocide products registered with the Authority Having Jurisdiction may be used to meet the disinfection requirements of this Appendix.
(c) Records. Water treatment records shall be kept for all chemicals and biocides added, noting the purpose of their use, the manufacturer’s name, the brand name, the safety data sheet, the date and time of each addition, and the
amount added each week.
(d) Chemical and biocide additions. Chemicals and biocides shall be added in accordance with this appendix and the procedures described in the water management program addressing, as applicable, feeding mechanism, feeding location, frequency, set timer, duration, triggering events, control procedures, and target biocide residuals. Water treatment chemicals and biocides shall be used in accordance with the product label and manufacturer’s instructions.

J 301.4 Water Quality Monitoring. Water quality in the cooling tower shall be monitored as follows:
(1) Water quality parameters, including but not limited to pH, temperature, conductivity and biocidal indicators, shall be measured and recorded as specified in the water management program and plan as follows:
(a) Manual measurements as required by the manufacturer’s recommendation and the Authority Having Jurisdiction.
(b) When continuous, automated and/or remote measurements and recordings are used, the water management program and plan shall show how effective measurements of system process control are being monitored.
(2) A bacteriological indicator to estimate microbial content of recirculating water shall be collected and interpreted in accordance with Table J 301.4(2) at least once each week while the cooling tower system is operating. Indicators shall be taken at times and from water sampling points, as detailed in the water management program, that will be representative of water microbial content. Indicators may be taken at any time from constant chemical treatment systems. Indicators from systems that use intermittent biocide applications shall be taken before biocide application and reflect normal cooling tower operating conditions.
(3) Legionella culture testing shall be conducted not less than every 90 days during cooling tower system operation. A Legionella sample shall be analyzed by an accredited laboratory where Legionella appears on the laboratory’s scope of accreditation, or other laboratory approved by the Authority Having Jurisdiction. When required, the test results of all Legionella bacteria at or above the magnitude of (1000 CFU/mL) as indicated in Table J 301.4(1) shall be reported to the Authority Having Jurisdiction within 24 hours of receiving the test results.
(4) System monitoring and sampling locations shall be representative of the entire cooling tower system. The system shall be operating with water circulating in the system for at least one hour prior to water quality measurements or collection of samples.
(5) The maintenance program and plan shall identify the procedures, responsible parties, required response time(s) and notification protocol for corrective actions and shall include, at a minimum, corrective actions that shall be implemented according to the result levels in Table J 301.4(1).

J 301.4.1 Water Sampling. An analysis of water samples from a location capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table J 301.4(1).

J 301.4.1.1 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with applicable levels in accordance with the following:
(1) Levels Less than 10 CFU/mL. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment program in accordance with Table J 301.4(1).
(2) Levels Between 10 CFU/mL and 1000 CFU/mL. Water samples containing Legionella levels greater than 10 CFU/mL but less than 1000 CFU/mL shall require the water treatment program to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table J 301.4(1).
(3) Levels Greater than 1000 CFU/mL. Water samples containing Legionella levels greater than 1,000 CFU/mL shall require the water treatment program to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table J 301.4(1).

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment</td>
</tr>
</tbody>
</table>

TABLE J 301.4(1)
LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS

525
Review water treatment program, institute immediate online disinfection, and retest water 3 days to 7 days after disinfection.

If the results of a retest are still \( \geq 1000 \) CFU/mL, carry out system decontamination.

**TABLE J 301.4(2)**
CORRECTIVE ACTIONS REQUIRED FOR BACTERIOLOGICAL INDICATOR RESULTS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>HETEROTROPHIC PLATE COUNT AND DIP SLIDE RESULT (CFU/mL)</th>
<th>PROCESS TRIGGERED BY TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(&lt; 10,000)</td>
<td>Maintain water chemistry and biocide levels.</td>
</tr>
<tr>
<td>2</td>
<td>( \geq 10,000 ) to (&lt; 100,000)</td>
<td>Initiate immediate disinfection by increasing biocide concentration or using a different biocide within 24 hours, reviewing treatment program, retesting water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this table until level 1 is reached.</td>
</tr>
<tr>
<td>3</td>
<td>( \geq 100,000 ) to (&lt; 1,000,000)</td>
<td>Initiate immediate disinfection by increasing biocide concentration or using a different biocide within 24 hours, reviewing treatment program, performing visual inspection to evaluate need to perform cleaning and further disinfection. Retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this Table until level 1 is reached.</td>
</tr>
<tr>
<td>4</td>
<td>( \geq 1,000,000)</td>
<td>Initiate immediate disinfection by increasing biocides within 24 hours. Within 48 hours perform remediation of the tower by hyperhalogenating.</td>
</tr>
</tbody>
</table>

1

2
Cleaning, and flushing. Review treatment program, retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this Table until level 1 is reached.

**Notes:**

1. Performed by an accredited laboratory
2. At a minimum, dose the cooling water system with 5 ppm to 10 ppm free halogen residual for at least 1 hour; pH 7.0 to 7.6

**Note:** There is no evidence that HPC values alone directly relate to human health risk, based on epidemiological studies and a lack of correlation with the occurrence of waterborne pathogens. Threshold concentrations of HPC were selected based on interference with the coliform test and not health-related considerations. HPC is an analytic method used to measure the variety of heterotrophic bacteria that are common in water. Legionella require specialized culture media for isolation and detection, do not grow on the media used for HPC testing, and their presence is not correlated with HPC values. HPC is a useful tool for monitoring the efficiency of the water treatment process, measuring bacterial regrowth, and evaluating the function of disinfection systems.

**SUBSTANTIATION:**

Legionella Monitoring: The verbiage and tables in this new appendix will clearly identify the standards for water treatment, sampling, and acceptable Legionella levels in cooling tower water systems.
Proposals

Item #: 327

UMC 2024  Section: J 401.0 - J 401.1.3

SUBMITTER: Jay Egg  
Egg Geothermal  
Rep. Chair, Mechanical Systems Working Group

RECOMMENDATION:
Add new text

**J 401.0 Interruption to Normal Operation.**  
**J 401.1 Shutdown Date.** When an interruption to normal operation occurs (system shutdown), a shutdown date shall be established prior to shutting down a cooling tower. A shutdown date of a cooling tower shall be a date after which the cooling tower is unlikely to be restarted for the season. Where shutdown of the cooling tower is required, a shutdown date shall be determined, and the requirements of Section J 401.1.1 through Section 401.1.4 shall be completed.

**J 401.1.1 Reduce Solids and Sterilize the System.** The cooling tower shall be drained prior to system shutdown. Biocide shall be applied in accordance with the manufacturer's instructions to kill any bacteria or contaminants.

**J 401.1.2 Drain, Inspect and Clean the System.** Where an interruption to normal operation occurs, the following actions shall be performed:

1. The cooling tower fill, sump, heat exchangers, chillers, and piping shall be drained.
2. The system shall be cleaned as required by the manufacturer's instructions.
3. The system shall be inspected, and maintenance shall be performed as required by the manufacturer.
4. The controllers shall be taken offline.
5. The protective probes shall be removed.
6. The tower fill and sump shall be drained.
7. The heat exchangers, chillers and piping shall be drained and protected in accordance with the manufacturer's instructions.

**J 401.1.3 Refill, Flush and Drain the Cooling Tower System.** Where an interruption to normal operation occurs, the following additional actions shall be performed:

1. The system shall be refilled.
2. A nonoxidizing biocide shall be added and recirculated in accordance with the manufacturer's instructions.
3. The cooling tower system shall be fully drained.

**Note:** It is possible that the cooling tower equipment is drained, but the cooling tower system remains in operation. A system operating on standby mode is not considered shut down. If water remains in the cooling tower system, the system is not considered shut down and water must circulate with regular biocide additions and active management.

**J 401.1.4 Records.** Records of all procedures and actions performed shall be kept.

SUBSTANTIATION:
Building Closure / Reduced Operation Procedures: The building closure procedures section of this new appendix will identify the best practices for placing the building cooling tower water system on minimum or reduced capacity, while maintaining acceptable levels of Legionella in the cooling tower water system.
Proposals

Item #: 328

UMC 2024  Section: J 201.0 - J 201.1, J 501.0 - J 501.3.1, Table 1701.2

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, Mechanical Systems Working Group

RECOMMENDATION:
Add new text

J 501.0 System Shutdown.
J 501.1 General. Cooling towers that are in shutdown mode shall comply with the following:
(1) Operating configurations and conditions that may occur after periods of extended inactivity lasting more than three
days, including idling or low circulation while not being fully drained.
(2) Specific, detailed seasonal and temporary shutdown and start-up procedures.

J 501.2 Shutdown Procedures. System start-up and shutdown procedures shall include, but not be limited to, the
following:
(1) Management of hazardous conditions associated with untreated water, including the following:
(a) Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system
drainage for shutdown periods longer than three days, or the duration specified by the water management program.
(b) Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
(c) Start-up from an undrained or stagnant system that exceeds three days, or the number of idle days specified by the
water management program or the manufacturer’s recommendations.

J 501.3 Legionella Prevention. The mechanical hydronic system shall be checked that it is safe to use after a
prolonged shutdown to minimize the risk of Legionnaires’ disease and other diseases associated with water.
Note: Stagnant or standing water in a mechanical hydronic system can increase the risk for growth and spread
of Legionella and other biofilm-associated bacteria. When water is stagnant, hot water temperatures can decrease to
the Legionella growth range (77 °F (25°C) through 110°F (43°C)). Stagnant water can also lead to low or undetectable
levels of disinfectant, such as chlorine.

J 501.3.1 Maintenance Personnel. Personal protective equipment shall be provided for maintenance personnel.
Maintenance personnel shall wear personal protective equipment in accordance with the facilities’ risk assessment.
Respiratory protection may be appropriate in enclosed spaces where aerosol generation is likely. Personal protective
equipment shall be used in accordance with all local state and Federal requirements. Where respirators are used, a
respiratory protection program in accordance with 29 CFR 1910.134 shall be required.
Note: Maintenance personnel at increased risk of developing Legionnaires’ disease, such as those with weakened
immune systems, should consult with a medical provider regarding participation in flushing, cooling tower cleaning, or
other activities that may generate aerosols.

J 201.0 Definitions.
J 201.1 General. For the purposes of this appendix, the following definitions shall apply:
Disinfector. Chemical agent or physical treatments used to kill or inactivate pathogens.
Disinfection. The process of killing or inactivating pathogens.
System Reopening. The set of actions that should be taken to ready a building for normal operations after an extended
period of no or limited operations.
TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 CFR 1910.134</td>
<td>Respiratory Protection</td>
<td>Respiratory Protection</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**

Cooling Tower Shutdown Procedures: The Cooling Tower Shutdown procedure section of this new appendix will identify the best practices for shutting down operation building Water Systems associated with cooling towers to minimize Legionella risk upon restart.

Definitions: The definitions in this new appendix have been added and are necessary for clarity and enforcement of standards Legionella levels in cooling towers.
J 601.0 System Restart.

J 601.1 Startup Procedures. When a cooling tower has been shut down or left untreated for five or more days, a full startup procedure shall be completed before startup or continuing operation. The startup procedure shall be completed as follows:

1. Clean the cooling tower through power washing and/or scrubbing, not more than 15 days before the first use, to remove biofilm, scale or other debris. Once cleaned, disinfect with an approved biocide(s) to kill pathogens, such as Legionella.
2. Enlist a qualified person or building owner designee to conduct and document the pre-startup inspection. The required inspection shall be as follows:
   (a) Visually assessing the cooling tower system.
   (b) Inspecting all components for the presence of contaminants and other adverse conditions.
   (c) Checking that the water treatment equipment is working properly.
   (d) Records of the procedure shall be completed.
3. Once disinfected, the cooling tower system shall be filled with water and begin circulating biocides and chemicals, as specified in the water management program. At this point, the system shall be considered operational and shall meet the requirements of the Authority Having Jurisdiction.
4. Collect and analyze a water sample for the presence of Legionella. The sample shall be analyzed by a laboratory approved by the Authority Having Jurisdiction. The results shall be interpreted and the actions described in Table J 301.4(2) shall be performed.
5. Startup records of all procedures and actions performed shall be kept on file. Startup records shall include, but not be limited to, the following:
   (a) Cooling tower system ID
   (b) System startup date
   (c) Individual cooling tower startup date (if different than the system startup date)
   (d) Dates and procedures for startup cleaning and disinfection
   (e) Service provider
   (f) Pre-startup inspection
   (g) Legionella sampling and test results
   (h) Disinfection dose and circulation time
   (i) Water monitoring
   (j) Treatment logs

SUBSTANTIATION:
Building and Cooling Tower Reopening Procedures: The cooling tower reopening procedure section of this new appendix will identify best practices by which a cooling tower that has been offline for an extended period may be restarted while maintaining acceptable levels of Legionella in the cooling tower water system.
APPENDIX J

PROFESSIONAL QUALIFICATIONS

J 101.0 General.
J 101.1 Scope. The provisions of this appendix address minimum qualifications for installers, inspectors, or employers for systems covered within the scope of this code.

J 102.0 Qualifications.
J 102.1 General. Where permits are required, the Authority Having Jurisdiction shall have the authority to require contractors, installers, or service technicians to demonstrate competency. Where determined by the Authority Having Jurisdiction, the contractor or technician shall be licensed or certified to perform such work. Professional qualifications shall be required for an individual to demonstrate the required level of competency.

J 102.2 Inspectors and Plans Examiners. Professional qualification for mechanical system inspectors and mechanical plans examiners shall be in accordance with ASSE/IAPMO/ANSI Series 16000.

J 102.2.1 Qualification for Mechanical Inspector. Professional qualification for mechanical inspectors shall be in accordance with ASSE 16020.

J 102.2.2 Qualification for Mechanical Plan Examiner. Professional qualification for mechanical plan examiners shall be in accordance with ASSE 16020.

J 102.3 Residential Mechanical Service Technician. Professional qualification for residential mechanical service technicians shall be in accordance with ASSE/IAPMO/ANSI Series 13000.

J 102.3.1 Qualification for Residential Mechanical Service Technician. Professional qualification for residential mechanical service technicians shall be in accordance with ASSE 13020.

J 102.4 Hydronic Systems. Personnel qualification for installers and designers of hydronic heating and cooling systems, as well as installers of solar water heaters shall be in accordance with ASSE/IAPMO/ANSI Series 19000.

J 102.4.1 Qualification for Solar Water Heating System Installer. Professional qualification for solar water heating system installers shall be in accordance with ASSE 19110.

J 102.4.2 Qualification for Hydronic Heating and Cooling System Installer. Professional qualification for hydronic heating and cooling system installers shall be in accordance with ASSE 19210.

J 102.4.3 Qualification for Hydronic Heating and Cooling System Designer. Professional qualification for hydronic heating and cooling system designers shall be in accordance with ASSE 19220.

J 102.5 Water Management and Infection Control Risk Assessment for Building Systems. Professional qualification for construction and maintenance personnel and employers to identify and manage potentially hazardous exposure to bloodborne, waterborne and airborne pathogens. Also includes qualifications for members of a water safety team involved in the development of a risk assessment analysis, and water management and sampling plan, for protection from Legionella and other waterborne pathogens and persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella. Qualifications are in accordance with ASSE/IAPMO/ANSI Series 12000.

J 102.5.1 Qualification for Environment of Care, Infection Control and Construction Risk Assessment. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment procedures to protect facility operations, occupants, workers or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE 12010.

J 102.5.2 Qualification for Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard for Construction and Maintenance Employers. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment requirements and procedures to protect facility operations, occupants, workers, or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE 12020. It also provides general knowledge of employer.
responsibilities to the worker and to the facility.

J 102.5.3 Qualification for Water Quality Program, Pipefitters and HVAC Technicians. Professional qualification for water quality program for pipefitters and HVAC technicians shall be in accordance with ASSE 12062.

J 102.5.4 Legionella Water Safety and Management Personnel. Professional qualification of persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella shall be in accordance with ASSE 12080.

**TABLE 1701.2**
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>ASSE/IAPMO/ANSI</td>
<td>Professional Qualifications Standard for Inspectors and Plans Examiners</td>
<td>Professional Qualifications</td>
</tr>
<tr>
<td>ASSE 16020-2019</td>
<td>Professional Qualifications Standard for the Mechanical Inspector</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE 16050-2019</td>
<td>Professional Qualifications Standard for the Mechanical Plan Examiner</td>
<td>Professional Qualifications</td>
</tr>
<tr>
<td>ASSE/IAPMO/ANSI</td>
<td>Service Plumber and Residential Mechanical Service Technician Professional Qualifications Standard</td>
<td>Professional Qualifications</td>
</tr>
<tr>
<td>ASSE 13020-2015 (R2020)</td>
<td>Professional Qualifications Standard for the Residential Mechanical Service Technician</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE/IAPMO/ANSI</td>
<td>Hydronic Systems Professional Qualifications Standard</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE/IAPMO/ANSI</td>
<td>Professional Qualifications Standard for Water Management and Infection Control Risk Assessment for Building Systems</td>
<td>Professional Qualifications</td>
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<tr>
<td>ASSE 12010-2021</td>
<td>Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard</td>
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<td>ASSE 12020-2021</td>
<td>Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard for Construction and Maintenance Employers</td>
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<tr>
<td>ASSE 12062-2021</td>
<td>Water Quality Program Professional Qualifications Standard for Pipefitters and HVAC Technicians</td>
<td>Professional Qualifications</td>
</tr>
<tr>
<td>ASSE 12080-2021</td>
<td>Professional Qualifications Standard for Legionella Water Safety and Management Specialist</td>
<td>Professional Qualifications</td>
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</tbody>
</table>

Note: The ASSE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
By including these Professional Qualification Standards in the Appendix of this code it creates a base line for what an AHJ may or should expect from installers and inspectors of these systems.
Proposals

Item #: 331
UMC 2024  Section: Table 1701.1

SUBMITTER: Karl Best
AHRI

RECOMMENDATION:
Revise text

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tbody>
<tr>
<td>AHRI 700-2047a-2019</td>
<td>Specifications for Refrigerants</td>
<td>Refrigerants</td>
<td>1104.7, 1104.7.3</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The AHRI standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The above revision reflect the latest update to the AHRI standard that is referenced in Table 1701.1.
Proposals

Item #: 332
UMC 2024  Section: Table 1701.1

SUBMITTER: Joseph Brooks
AMCA

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
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<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
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<tr>
<td>AMCA 540-2013</td>
<td>Test Method for Louvers Impacted by Wind Borne Debris</td>
</tr>
<tr>
<td>AMCA 550-2015</td>
<td>Test Method for High Velocity Wind Driven Rain Resistant Louvers <em>(with revisions through September 2018)</em></td>
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</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The AMCA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the AMCA standards that are referenced in Table 1701.1.
Proposals

Item #: 333

UMC 2024 Section: Table 1701.1, Table 1701.2

SUBMITTER: Emily Toto
ASHRAE

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
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<tr>
<td><strong>STANDARD NUMBER</strong></td>
<td><strong>STANDARD TITLE</strong></td>
</tr>
<tr>
<td>ASHRAE 15-2016 2019</td>
<td>Safety Standard for Refrigeration Systems</td>
</tr>
<tr>
<td>ASHRAE 34-2016 2019</td>
<td>Designation and Safety Classification of Refrigerants</td>
</tr>
<tr>
<td>ASHRAE 62.1-2016 2019</td>
<td>Ventilation for and Acceptable Indoor Air Quality</td>
</tr>
<tr>
<td>ASHRAE 170-2017 2017</td>
<td>Ventilation of Health Care Facilities</td>
</tr>
</tbody>
</table>

Note: The ASHRAE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

<table>
<thead>
<tr>
<th>TABLE 1701.2</th>
<th>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</th>
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<tbody>
<tr>
<td><strong>DOCUMENT NUMBER</strong></td>
<td><strong>DOCUMENT TITLE</strong></td>
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<tr>
<td>ASHRAE 52.2-2042 2017</td>
<td>Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size</td>
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<tr>
<td>ASHRAE 62.2-2016 2019</td>
<td>Ventilation and Acceptable Indoor Air Quality in Residential Buildings</td>
</tr>
<tr>
<td>ASHRAE Handbook-2016 2020</td>
<td>HVAC Systems and Equipment</td>
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</table>

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASHRAE standards that are referenced in Table 1701.1 and Table 1701.2.
Proposals

Item #: 334

UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: Carlton Ramcharran
ASME

RECOMMENDATION:
Revise text

### TABLE 1701.1
REFERENCED STANDARDS

<table>
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<tr>
<th>STANDARD NUMBER</th>
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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tr>
<td>ASME B1.20.1-2013 (R2018)</td>
<td>Pipe Threads, General Purpose (Inch)</td>
<td>Joints</td>
<td>1211.2(3), 1211.4(7), 1211.12(3), 1211.13(2), 1308.5.6</td>
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<tr>
<td>ASME B31.3-2016 2018</td>
<td>Process Piping</td>
<td>Process Piping</td>
<td>1406.1</td>
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<tr>
<td>ASME B31.5-2016 2019</td>
<td>Refrigeration Piping and Heat Transfer Components</td>
<td>Refrigeration Piping</td>
<td>1109.1.1, 1109.1.3</td>
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<tr>
<td>ASME BPVC Section I-2017 2019</td>
<td>Rules for Construction of Power Boilers</td>
<td>Boilers</td>
<td>1002.1(1), Table 1003.2.1</td>
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<tr>
<td>ASME BPVC Section IV-2017 2019</td>
<td>Rules for Construction of Heating Boilers</td>
<td>Boilers</td>
<td>1002.1(2)</td>
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<td>ASME BPVC Section VIII.1-2017 2019</td>
<td>Rules for Construction of Pressure Vessels Division 1</td>
<td>Pressure Vessels</td>
<td>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</td>
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(portion of table not shown remain unchanged)

Note: The ASME standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

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<tr>
<td>ASME A13.1-2015 2020</td>
<td>Scheme for the Identification of Piping Systems</td>
<td>Piping</td>
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</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASME standards that are referenced in Table 1701.1 and Table 1701.2.
Proposals

Item #: 335
UMC 2024  Section: Table 1701.1

SUBMITTER: Terry Burger
ASSE

RECOMMENDATION:
Revise text

TABLE 1701.1
REFERENCE STANDARDS

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(portion of table not shown remain unchanged)

Note: The ASSE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASSE standards that are referenced in Table 1701.1.
Proposals

Item #: 336
UMC 2024 Section: 303.8.4.1, Table 1701.1

SUBMITTER: Lauren Bauerschmidt
ASSP

RECOMMENDATION:
Revise text

303.8.4.1 Guards and Rails. Guards or rails shall be required where the following exist:
(1) The clearance between the appliance and a roof edge or open end of an equipment platform is less than 6 feet (1829 mm).

(2) The open end of the equipment platform is located more than 30 inches (762 mm) above the roof, floor, or grade below.

Where guards or rails are installed, they shall be constructed so as to prevent the passage of a 21 inch (533 mm) diameter ball, resist the imposed loading conditions, and shall extend not less than 30 inches (762 mm) beyond each side of the equipment or appliance.

Exception: Guards shall not be required where a permanent fall arrest anchorage connector system in accordance with ASSE ASSP Z359.1 is installed.

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(portion of table not shown remain unchanged)

Note: ASSP Z359.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASSP standards that are referenced in Table 1701.1.
Proposals

Item #: 337
UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: Steve Mawn
ASTM

RECOMMENDATION:
Revise text

### TABLE 1701.1
**REFERENCED STANDARDS**

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### TABLE 1701.1  
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Note: The ASTM standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

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### TABLE 1701.2  
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

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<td>ASTM A568/A568M-2017a 2019a</td>
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**SUBSTANTIATION:**

The above revisions reflect the latest updates to the ASTM standards that are referenced in Table 1701.1 and Table 1701.2.
Proposals

Item #: 338

UMC 2024  Section: Table 1701.1

SUBMITTER: Peter Portela  
AWS

RECOMMENDATION:  
Revise text

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(portion of table not shown remain unchanged)

Note: The AWS standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:  
The above revision reflects the latest update to the AWS standard that is referenced in Table 1701.1.
Proposals

Item #: 339
UMC 2024  Section: Table 1701.1

SUBMITTER: Paul Olson
AWWA

RECOMMENDATION:
Revise text

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(portion of table not shown remain unchanged)

Note: The AWWA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the AWWA standards that are referenced in Table 1701.1.
# TABLE 1701.1
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STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

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(portion of table not shown remain unchanged)

Note: The CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.
**SUBSTANTIATION:**
The above revisions reflect the latest updates to the CSA standards that are referenced in Table 1701.1 and Table 1701.2.

(portions of table not shown remain unchanged)
Proposals

Item #: 341
UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: Kyle Thompson
IAPMO

RECOMMENDATION:
Revise text

TABLE 1701.1
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<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tbody>
<tr>
<td>IAPMO PS 117-2017-2019</td>
<td>Press and Nail Connections</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The IAPMO standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 293-2012 (R2020)</td>
<td>Tubing and Fittings for Special Hydronic Radiant Drywall Panels</td>
<td>HVAC, Fittings, Tubing</td>
</tr>
<tr>
<td>IAPMO PS 120-2004 2019</td>
<td>Flashing and Stand Combination for Air Conditioning Units (Residential or Commercial Unit Curb)</td>
<td>Air Conditioning Flashing Stand</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the IAPMO standards that are referenced in Table 1701.1 and Table 1701.2.
Proposals

Item #: 342
UMC 2024 Section: 218.0, Table 1701.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
<tbody>
<tr>
<td>IAPMO/ANSI UPC 1-2021</td>
<td>Uniform Plumbing Code</td>
<td>Plumbing Systems</td>
<td>218.0</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: IAPMO/ANSI UPC 1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

(below shown for reference only)

218.0 – P –

**Plumbing Code.** The Uniform Plumbing Code (**UPC**) promulgated by the International Association of Plumbing and Mechanical Officials (**IAPMO**), as adopted by this jurisdiction.

**SUBSTANTIATION:**
Table 1701.1 is being updated to include the reference to the Uniform Plumbing Code (UPC), an ANSI standard, which is referenced in Section 218.0.
Proposals

Item #: 343
UMC 2024  Section: Table 1701.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

### TABLE 1701.1
**REFERRED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
<tbody>
<tr>
<td>IAPMO/ANSI USHGC 1-2021</td>
<td>Uniform Solar, Hydronics and Geothermal Code</td>
<td>Solar, Hydronics, Geothermal</td>
<td>1207.4, 1501.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO/ANSI USHGC 1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

(below shown for reference only)

**1207.0 Heating Appliances and Equipment.**

**1207.4 Solar Heat Collector Systems.** Solar water heating systems used in hydronic panel radiant heating systems shall be installed in accordance with the Uniform Solar, Hydronics and Geothermal Code (USHGC).

**1501.0 General.**

**1501.1 Applicability.** See Section 1203.0 and the Uniform Solar, Hydronics and Geothermal Code (USHGC), published by the International Association of Plumbing and Mechanical Officials. The Uniform Solar, Hydronics and Geothermal Code (USHGC) provides requirements that shall be permitted to be adopted as part of the code by the Authority Having Jurisdiction.

**SUBSTANTIATION:**
Table 1701.1 is being updated to include the reference to the Uniform Solar, Hydronics and Geothermal Code (USHGC), an ANSI standard, which is referenced in Section 1207.4 and Section 1501.1, in accordance with the IAPMO Rules and Regulations.
Proposals

Item #: 344
UMC 2024  Section: Table 1701.1

SUBMITTER: Eric Smith
IIAR

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
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<tbody>
<tr>
<td>REFERENCED STANDARDS</td>
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<td>STANDARD NUMBER</td>
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<td>IIAR/ANSI 4-2015 2020</td>
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</tbody>
</table>

(portion of table not shown remain unchanged)

Note: IIAR 4 and IIAR 5 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

Note: IIAR 2 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
The above revisions reflect the latest updates to the IIAR standards that are referenced in Table 1701.1.
Proposals

Item #: 345
UMC 2024 Section: Table 1701.1, Table 1701.2

SUBMITTER: Alex Ing
NFPA

RECOMMENDATION: Revise text

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>NFPA 2-2016-2020</td>
<td>Hydrogen Technologies Code</td>
<td>Gaseous Hydrogen Systems</td>
<td>937.1</td>
</tr>
<tr>
<td>NFPA 17-2047-2021</td>
<td>Dry Chemical Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3(3), 513.3.5</td>
</tr>
<tr>
<td>NFPA 17A-2017-2021</td>
<td>Wet Chemical Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3(4), 513.2.5.6, 513.3.5</td>
</tr>
<tr>
<td>NFPA 30A-2018-2021</td>
<td>Motor Fuel Dispensing Facilities and Repair Garages</td>
<td>Miscellaneous</td>
<td>303.11.1</td>
</tr>
<tr>
<td>NFPA 31-2046-2020</td>
<td>Installation of Oil-Burning Equipment</td>
<td>Fuel Gas, Appliances</td>
<td>301.5, 1002.2.2, 1301.1</td>
</tr>
<tr>
<td>NFPA 58-2017-2020</td>
<td>Liquefied Petroleum Gas Code</td>
<td>Fuel Gas</td>
<td>303.7, 516.2.1, 1308.5.4.2.3, 1308.5.8.4, 1310.6(7), 1312.11</td>
</tr>
<tr>
<td>NFPA 70-2047-2020</td>
<td>National Electrical Code</td>
<td>Miscellaneous</td>
<td>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</td>
</tr>
<tr>
<td>NFPA 90B-2018-2021</td>
<td>Installation of Warm Air Heating and Air-Conditioning Systems</td>
<td>HVAC</td>
<td>604.1</td>
</tr>
<tr>
<td>NFPA 654-2047-2020</td>
<td>Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids</td>
<td>Dust Explosion Prevention, Gutters</td>
<td>506.6, Table 505.9</td>
</tr>
<tr>
<td>NFPA 780-2047-2020</td>
<td>Installation of Lightning Protection Systems</td>
<td>Fuel Gas</td>
<td>1311.5</td>
</tr>
<tr>
<td>NFPA 853-2045</td>
<td>Installation of Stationary Fuel Cell Power</td>
<td>Fuel Cell Power</td>
<td>1601.1</td>
</tr>
</tbody>
</table>
Note: The NFPA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**TABLE 1701.2**
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 30-2018-2021</td>
<td>Flammable and Combustible Liquids Code</td>
<td>Combustible Liquids, Flammable Liquids</td>
</tr>
<tr>
<td>NFPA 91-2016-2020</td>
<td>Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids</td>
<td>Product Conveying Ducts</td>
</tr>
<tr>
<td>NFPA 221-2018-2021</td>
<td>High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls</td>
<td>Building Fire Walls, Fire Barrier</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**SUBSTANTIATION:**
The above revisions reflect the latest updates to the NFPA standards that are referenced in Table 1701.1 and Table 1701.2.
Proposals

Item #: 346
UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER:  Jeremy Brown
NSF

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
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</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>NSF/ANSI 358-1-2017</td>
<td>Polyethylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems</td>
</tr>
<tr>
<td>NSF/ANSI 358-2-2017</td>
<td>Polypropylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems</td>
</tr>
<tr>
<td>NSF/ANSI 358-3-2016</td>
<td>Cross-linked polyethylene (PEX) pipe and fittings for water-based ground-source (geothermal) heat pump systems</td>
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</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The NSF standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

<table>
<thead>
<tr>
<th>TABLE 1701.2</th>
<th>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</th>
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</thead>
<tbody>
<tr>
<td>DOCUMENT NUMBER</td>
<td>DOCUMENT TITLE</td>
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<tr>
<td>NSF/ANSI/CAN 60-2017</td>
<td>Drinking Water Treatment Chemicals - Health Effects</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the NSF standards that are referenced in Table 1701.1 and Table 1701.2.
### Proposals

**Item #: 347**

**UMC 2024** Section: Table 1701.1, Table 1701.2

**SUBMITTER:** John Taecker  
UL LLC

**RECOMMENDATION:**  
Revise text

#### TABLE 1701.1  
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tr>
<td>UL 127-2011</td>
<td>Factory-Built Fireplaces (with revisions through <strong>July 27, 2016 February 25, 2020</strong>)</td>
<td>Fireplaces</td>
<td>802.5.1.1, 913.1, 913.1.1</td>
</tr>
<tr>
<td>UL 197-2010</td>
<td>Commercial Electric Cooking Appliances (with revisions through <strong>January 26, 2018 July 10, 2020</strong>)</td>
<td>Appliances, Commercial Cooking, Electric Appliances</td>
<td>921.1</td>
</tr>
<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through <strong>June 27, 2014 January 21, 2020</strong>)</td>
<td>Refrigeration Components</td>
<td>1109.2</td>
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<tr>
<td>UL 268A-2008</td>
<td>Smoke Detectors for Duct Application (with revisions through <strong>August 12, 2016 August 18, 2020</strong>)</td>
<td>Smoke Detectors</td>
<td>609.1</td>
</tr>
<tr>
<td>UL 295-2017</td>
<td>Commercial-Industrial Gas Burners (with revisions through <strong>August 22, 2019</strong>)</td>
<td>Gas Burners</td>
<td>910.2</td>
</tr>
<tr>
<td>UL 296-2017</td>
<td>Oil Burners (with revisions through <strong>November 29, 2017 January 8, 2021</strong>)</td>
<td>Fuel Gas, Appliances</td>
<td>910.1</td>
</tr>
<tr>
<td>UL 300-2005 2019</td>
<td>Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment (with revisions through <strong>December 16, 2014</strong>)</td>
<td>Certification</td>
<td>513.2.2, 513.2.5, 517.3.1.1(6)</td>
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<td>UL 391-2010</td>
<td>Solid-Fuel and Combination-Fuel Central and Supplementary Furnaces (with revisions through <strong>June 12, 2014 August 28, 2019</strong>)</td>
<td>Furnaces, Solid Fuel</td>
<td>904.10</td>
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<tr>
<td>UL 441-2016</td>
<td>Gas Vents (with revisions through <strong>July 27, 2016 August 28, 2019</strong>)</td>
<td>Fuel Gas</td>
<td>802.1</td>
</tr>
<tr>
<td>UL 467-2013</td>
<td>Grounding and Bonding Equipment (with revisions through <strong>June 7, 2017</strong>)</td>
<td>Grounding and Bonding</td>
<td>1311.2.5</td>
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<tr>
<td>UL 471-2010</td>
<td>Commercial Refrigerators and Freezers (with revisions through <strong>November 8, 2016 September 12, 2019</strong>)</td>
<td>Freezers, Refrigerators</td>
<td>934.1</td>
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<tr>
<td>UL 555-2006</td>
<td>Fire Dampers (with revisions through <strong>October 21, 2016 October 9, 2020</strong>)</td>
<td>Dampers</td>
<td>606.2</td>
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<td>UL 555S-2014</td>
<td>Smoke Dampers (with revisions through <strong>October 27, 2016 October 9, 2020</strong>)</td>
<td>Dampers</td>
<td>606.1</td>
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<tr>
<td>UL 651-2011</td>
<td>Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings (with revisions through <strong>June 15, 2016 March 24, 2019</strong>)</td>
<td>Piping, Plastic</td>
<td>1308.5.4.1</td>
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<td>UL</td>
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<td>Date Range</td>
<td>Section References</td>
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<td>705-2017</td>
<td>Power Ventilators (with revisions through October 8, 2018 August 30, 2019)</td>
<td></td>
<td>Power Ventilators 504.4.2.3</td>
</tr>
<tr>
<td>710B-2011</td>
<td>Recirculating Systems (with revisions through August 14, 2014 February 1, 2019)</td>
<td></td>
<td>Exhaust Hoods 508.1, 513.2.2, 516.2.2, 516.2.3</td>
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<tr>
<td>737-2011</td>
<td>Fireplace Stoves (with revisions through August 19, 2015 February 25, 2020)</td>
<td></td>
<td>Fireplace Stoves 913.2</td>
</tr>
<tr>
<td>778-2016</td>
<td>Motor Operated Water Pumps (with revisions through October 20, 2017 August 11, 2020)</td>
<td></td>
<td>Pumps 1208.1</td>
</tr>
<tr>
<td>834-2004</td>
<td>Heating, Water Supply, and Power Boilers - Electric (with revisions through September 24, 2018 July 17, 2019)</td>
<td></td>
<td>Appliances 1002.3, Table 1203.2</td>
</tr>
<tr>
<td>858-2014</td>
<td>Household Electric Ranges (with revisions through June 4, 2018 September 12, 2019)</td>
<td></td>
<td>Electric Ranges, Ranges 920.1</td>
</tr>
<tr>
<td>907-2016</td>
<td>Fireplace Accessories (with revisions through August 28, 2019)</td>
<td></td>
<td>Fireplace Accessories 913.3</td>
</tr>
<tr>
<td>921-2016</td>
<td>Commercial Dishwashers (with revisions through September 29, 2017)</td>
<td></td>
<td>Appliances 519.1</td>
</tr>
<tr>
<td>921-2016</td>
<td></td>
<td>Commercial Dishwashers (with revisions through August 19, 2015 February 25, 2020)</td>
<td></td>
</tr>
<tr>
<td>923-2013</td>
<td>Microwave Cooking Appliances (with revisions through July 49, 2017 August 27, 2020)</td>
<td></td>
<td>Microwaves 920.3.2(3), 920.4.2(3)</td>
</tr>
<tr>
<td>959-2010</td>
<td>Medium Heat Appliance Factory-Built Chimneys (with revisions through June 12, 2014 August 28, 2019)</td>
<td></td>
<td>Fuel Gas, Appliances 802.5.1</td>
</tr>
<tr>
<td>1482-2011</td>
<td>Solid-Fuel Type Room Heaters (with revisions through August 19, 2015 February 25, 2020)</td>
<td></td>
<td>Room Heaters, Solid Fuel Heaters 802.5.1.1, 916.3</td>
</tr>
<tr>
<td>1738-2010</td>
<td>Venting Systems for Gas-Burning Appliances, Categories II, III, and IV (with revisions through November 7, 2014 February 6, 2020)</td>
<td></td>
<td>Fuel Gas, Appliances 802.4.1, 802.4.2, 802.4.3</td>
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<td>1777-2015</td>
<td>Chimney Liners (with revisions through April 11, 2019)</td>
<td></td>
<td>Chimneys, Liners 802.5.3(2), 803.1.11.2</td>
</tr>
<tr>
<td>1995-2015</td>
<td>Heating and Cooling Equipment (with revisions through August 17, 2018)</td>
<td></td>
<td>HVAC, Electric 903.1, 904.13</td>
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<tr>
<td>1996-2009</td>
<td>Electric Duct Heaters (with revisions through July 15, 2014 August 7, 2020)</td>
<td></td>
<td>Duct Heaters 905.8</td>
</tr>
<tr>
<td>2158-2018</td>
<td>Electric Clothes Dryers (with revisions through September 20, 2019)</td>
<td></td>
<td>Clothes Dryers, Electric 908.1</td>
</tr>
<tr>
<td>2162-2014</td>
<td>Commercial Wood-Fired Baking Ovens, Refractory Type (with revisions through August 1, 2019)</td>
<td></td>
<td>Baking Ovens 921.2</td>
</tr>
<tr>
<td>2200-2012</td>
<td>Stationary Engine Generator Assemblies (with revisions through July 29, 2015)</td>
<td></td>
<td>Assemblies 1602.3</td>
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<tr>
<td>2790-2010</td>
<td>Commercial Incinerators (with revisions through October 8, 2014 June 18, 2019)</td>
<td></td>
<td>Incinerators 925.2</td>
</tr>
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</table>

Note: The UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.
## TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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</thead>
<tbody>
<tr>
<td>UL 33-2010</td>
<td>Heat Responsive Links for Fire-Protection Service (with revisions through April 14, 2016 April 28, 2020)</td>
<td>Fusible Links</td>
</tr>
<tr>
<td>UL 80-2007 2009</td>
<td>Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids (with revisions through January 16, 2014 April 26, 2019)</td>
<td>Fuel Gas</td>
</tr>
<tr>
<td>UL 125-2014 2020</td>
<td>Flow Control Valves for Anhydrous Ammonia and LP-Gas (with revisions through January 12, 2018)</td>
<td>Fuel Gas</td>
</tr>
<tr>
<td>UL 132-2015</td>
<td>Safety Relief Valves for Anhydrous Ammonia and LP-Gas (with revisions through January 12, 2018 January 16, 2020)</td>
<td>Fuel Gas</td>
</tr>
<tr>
<td>UL 144-2012</td>
<td>LP-Gas Regulators (with revisions through November 05, 2014 December 10, 2019)</td>
<td>Fuel Gas</td>
</tr>
<tr>
<td>UL 174-2004</td>
<td>Household Electric Storage Tank Water Heaters (with revisions through December 15, 2016 September 15, 2020)</td>
<td>Appliances</td>
</tr>
<tr>
<td>UL 180-2012 2019</td>
<td>Liquid-Level Gauges for Oil Burner Fuels and other combustible liquids (with revisions through May 12, 2017)</td>
<td>Gauges, Level Gauges</td>
</tr>
<tr>
<td>UL 429-2013</td>
<td>Electrically Operated Valves (with revisions through January 16, 2020)</td>
<td>Valves</td>
</tr>
<tr>
<td>UL 733-1993 2019</td>
<td>Oil-Fired Air Heaters and Oil-Fired Direct-Fired Heaters (with revisions through October 9, 2013)</td>
<td>Water Heaters, Direct Fired, Oil Fired</td>
</tr>
<tr>
<td>UL 842-2015 2020</td>
<td>Valves for Flammable Fluids and Combustible Liquids (with revisions through October 27, 2017)</td>
<td>Valves</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**SUBSTANTIATION:**
The above revisions reflect the latest updates to the UL standards that are referenced in Table 1701.1 and Table 1701.2.
Proposals

Item #: 348
UMC 2024  Section: Table 1701.2

SUBMITTER: Kaley Garubba
Manufacturers Standardization Society (MSS)

RECOMMENDATION:
Revise text

<table>
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<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<td>MSS SP-80-2013 2019</td>
<td>Bronze Gate, Globe, Angle, and Check Valves</td>
<td>Valves</td>
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<td>MSS SP-106-2012 2019</td>
<td>Cast Copper Alloy Flanges and Flanged Fittings: Class 125, 150, and 300</td>
<td>Fittings</td>
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</tbody>
</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the MSS standards that are referenced in Table 1701.2.
Proposals

Item #: 349
UMC 2024  Section: Table 1701.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

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<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
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<tbody>
<tr>
<td>10 CFR 431</td>
<td>Energy Efficiency Program for Certain Commercial and Industrial Equipment</td>
<td>Energy</td>
</tr>
<tr>
<td>10 CFR 430</td>
<td>Energy Conservation Program for Consumer Products</td>
<td>Energy</td>
</tr>
<tr>
<td>29 CFR 1910.1000</td>
<td>Air Contaminants</td>
<td>Air Quality</td>
</tr>
<tr>
<td>49 CFR 192</td>
<td>Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards</td>
<td>Gas Piping</td>
</tr>
<tr>
<td>49 CFR 192.123</td>
<td>Design Limitations for Plastic Pipe</td>
<td>Piping, Plastic</td>
</tr>
<tr>
<td>ASHRAE GRP 158-1979</td>
<td>Cooling and Heating Load Calculation Manual</td>
<td>Ventilation</td>
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<td>AMCA 205-2019</td>
<td>Energy Efficiency Classification for Fans</td>
<td>Energy</td>
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<tr>
<td>UL 263-2011</td>
<td>Fire Tests of Building Construction and Materials (with revisions through September 09, 2020)</td>
<td>Fire Resistance</td>
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<td>AHRI 550/590-2020</td>
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<td>Performance Rating of Computer and Data Processing Room Air Conditioners</td>
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<td>AHAM RAC-1-2020</td>
<td>Energy Measurement Test Procedure for Room Air Conditioners</td>
<td>Air Conditioners</td>
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</table>

(portions of table not shown remain unchanged)
SUBSTANTIATION:
The above list of standards exist in the appendices, but are not addressed in Table 1701.1. The standards are being added to the Table 1701.2 Referenced Standards table in accordance with IAPMO Rules Governing Committee Projects.
UMC A2L Task Group Report

Roster:

<table>
<thead>
<tr>
<th>Member</th>
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<tbody>
<tr>
<td>Jay Egg (Chair)</td>
<td>Egg Geothermal, LLC</td>
</tr>
<tr>
<td>Julius Ballanco</td>
<td>JB Engineering and Code Consulting, P.C.</td>
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<td>Rich Benkowski</td>
<td>United Association Department of Education</td>
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<tr>
<td>David Bixby</td>
<td>Air Conditioning Contractors of America (ACCA)</td>
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<td>Dave Dias</td>
<td>Sheet Metal Workers Local 104</td>
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<tr>
<td>Eli Howard</td>
<td>SMACNA</td>
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<tr>
<td>Harshad Inamdar</td>
<td>Rheem Manufacturing</td>
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<tr>
<td>Philip Johnston</td>
<td>Daikin Applied Americas, Inc.</td>
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<tr>
<td>Jim Kendzel</td>
<td>ASA and HARDI</td>
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<tr>
<td>Robert Kuks</td>
<td>Sheet Metal Workers Local 104</td>
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<tr>
<td>David Mann</td>
<td>Self</td>
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<tr>
<td>Jay Peters</td>
<td>Codes and Standards International</td>
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<tr>
<td>Christopher Ruch</td>
<td>National Energy Management Institute Committee (NEMIC)</td>
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<tr>
<td>Stephen Spletzer</td>
<td>The Chemours Company</td>
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<td>John Taecker</td>
<td>UL LLC</td>
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<td>Rusty Tharp</td>
<td>Goodman Manufacturing</td>
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<tr>
<td>Helen Walter-Terrinoni</td>
<td>Air Conditioning, Heating, and Refrigeration Institute (AHRI)</td>
</tr>
<tr>
<td>Randy Young</td>
<td>Sacramento Joint Apprenticeship Training Committee</td>
</tr>
</tbody>
</table>

Overview:

The IAPMO Standards Council and Board of Directors requested that a task group be formed to address A2L since there were concerns and issues with A2L for human comfort applications, such as refrigerant detectors, refrigerant concentration limits, and exhaust termination requirements. Although there was not much concern with A2L for mechanical room applications, there was a need to also address such applications.

On May 2, 2019 in Denver, Colorado, the UMC TC Chair, Harvey Kreitenberg, approved the formation of a UMC A2L Task Group to address exposure risk to the public from mechanical equipment in the UMC and to provide guidance to assist in the control and intervention of Legionella associated with building mechanical systems.

The scope of the Uniform Mechanical Code (UMC) A2L Task Group was to develop recommendations to further this technology, determine the methods available to address A2L exposure risk to public health and safety, expand on the usage and control of A2L refrigerants associated with mechanical systems and equipment, and address related issues such as
flammability risk, toxicity, permissible exposure limit, leak detection systems, chemical compatibility and stability, and maintenance procedures for mechanical systems. The task group recommendations will be forwarded to the UMC Technical Committee for consideration in the development of the 2024 edition of the UMC.

The Task Group met four times via teleconference on July 8, 2020, August 24, 2020, October 19, 2020, and November 12, 2020. Proposed recommendations were obtained from members of the task group and any interested parties.

The Task Group generated recommendations based on ASHRAE 15 with several modifications to address the concerns of the committee regarding health and safety and enforceable code language. The Task Group generated four separate recommendations, as follows:

Recommendation 1 - Human Comfort
Recommendation 2 - Machinery Rooms
Recommendation 3 - Table 1104.1
Recommendation 4 - Labeling and Identification

### A2L Task Group Recommendations

#### Recommendation 1 - Human Comfort:

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>
<thead>
<tr>
<th>Table 1103.1.1 Refrigerant Safety Group Classifications</th>
</tr>
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<tbody>
<tr>
<td>Higher Flammability</td>
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<tr>
<td>Flammable</td>
</tr>
<tr>
<td>Lower Flammability</td>
</tr>
<tr>
<td>No Flame Propagation</td>
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</table>

1104.0 Requirements for Refrigerant and Refrigeration System Use.

**1104.6 Group A2L Refrigerators 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 Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with 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 Detectors.** A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:

1. The charge size of any independent circuit exceeds 0.212 × LFL (lb), where LFL is in pounds per 1000 ft³ (6...
Where:

\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]  

\[ Q \] = supply air flow rate (\( \text{m}^3/\text{h} \)),  
\[ M \] = refrigerant charge (kg),  
\[ LFL \] = lower flammability limit (g/m\(^3\)).

For SI units:

\[ Q = \frac{60 000}{LFL} \times \frac{M}{LFL} \]

Where:

\[ Q \] = the supply air flow rate (\( \text{m}^3/\text{h} \)),  
\[ M \] = refrigerant charge (kg),  
\[ LFL \] = the lower flammability limit (g/m\(^3\)).

(2) When the occupancy classification is institutional.
(3) When using the provisions of Section 1104.6.4.

**Exception:** For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

**1104.6.2.4 Refrigerant Concentration Above Limit.** When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

1. The minimum airflow rate of the supply air fan shall be in accordance with the following equation.
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 detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
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. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

**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.

**1104.6.4 Compressors and Pressure Vessel Located Indoors.** For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

1. The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   a. 6.6 lb (3 kg) for residential and institutional occupancies and
   b. 22 lb (10 kg) for commercial and public/large mercantile occupancies.
2. The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4(3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
3. A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.
4. The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (30 cm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.
5. Air that is exhausted from the ventilation system shall be either:
   a. discharged outside of the building envelope or
   b. discharged to an indoor space, provided that the refrigerant concentration will not exceed the limit specified in Section **ASHRAE 15:7.6.2.4.**
1104.6.1. In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrestor, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. [ASHRAE 15:7.6.4]

1104.6.5 Refrigerant Detectors. Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:

1. Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.
2. Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).
3. Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.
   a. For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.
   b. For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (30 cm) above the floor and within a horizontal distance of not more 3.3 feet (1.0 m) with a direct line of sight of the unit.
4. Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. [ASHRAE 15:7.6.5]

1104.6.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants shall be in accordance with Section 1104.6.

Substantiation:
Task Group Recommendation 1 - Human Comfort: These are the extracted requirements from ASHRAE 15-2019 that regulate low GWP refrigerants used in direct systems that fall into the safety classification of Group A2L. The A2L Task Group modified various portions of the extracted language as needed to address enforceability and health and safety concerns. The requirements follow the extraction policy of IAPMO.

Recommendation 2 - Machinery Rooms:

1104.0 Requirements for Refrigerant and Refrigeration System Use.  
1104.5 Flammable Refrigerants. The total of Group A2, B2, A3, and B3 refrigerants, other than Group A2L and B2L refrigerants shall not exceed 1100 pounds (498.9 kg) without approval by the Authority Having Jurisdiction. Institutional Occupancies shall comply with Section 1104.3. Machinery rooms required in accordance with Section 1106.0 based on flammability shall be constructed and maintained in accordance with Section 1106.2.1 through Section 1106.2.6 and Section 1106.13 for Group A2L and B2L refrigerants.

1106.0 Refrigeration Machinery Rooms.  
1106.1 Where Required. (remaining text unchanged)  
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 1106.2.5.2.

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 1106.4 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]

4106.6 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 a 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 15:8.11.11.4]

**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 1106.2.2 or Section 1106.2.4 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 annunciate 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 1106.13.

**1106.2.2.2 1106.2.6 Refrigerant Detectors.** Refrigerant detectors required in accordance with Section 1106.2.2.1 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 1106.2.2.1 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 1106.2.2.1 or Section 1107.1.7.

(renumber remaining sections)

**1106.2.5 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 1106.2.5.1 or Section 1106.2.5.2. Where multiple refrigerants are present, then the highest airflow quantity shall apply.

**1106.2.5.1 Ventilation - A1, A2, A3, B1, B2L, B2 and B3 Refrigerants.** The emergency ventilation for A1, A2, A3, B1, B2L, B2 and B3 refrigerants shall have the capacity to provide mechanical exhaust at a rate as determined in accordance with Equation 1106.2.5.1:

\[
Q = 100 \sqrt{G}
\]  
(Equation 1106.2.5.1)

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

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

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>MINIMUM AIRFLOW* (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-32</td>
<td>32,500</td>
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<tr>
<td>R-143A</td>
<td>28,600</td>
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<tr>
<td>R-444A</td>
<td>13,700</td>
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<td>R-444B</td>
<td>23,400</td>
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<td>R-445A</td>
<td>16,400</td>
</tr>
<tr>
<td>R-446A</td>
<td>50,500</td>
</tr>
<tr>
<td>R-447A</td>
<td>50,200</td>
</tr>
</tbody>
</table>
For SI units: 1 cubic foot per minute = 0.00047 m³/s

* The values were tabulated from the following equation:

\[ Q_{\text{A2L}} = \frac{(P \cdot V \cdot A)}{(LFL \cdot 0.50)} \] (Equation 1106.2.5.2)

Where:

- \( P \) = Refrigerant density, pounds per cubic feet (kg/m³).
- \( V \) = Refrigerant velocity equal to the refrigerant acoustic velocity (speed of sound), feet per second (m/s).
- \( A \) = Cross-section flow area of refrigerant leak, square feet (m²), \( A = 0.00136 \text{ ft}^2 (0.000126 \text{ m}^2) \).
- \( LFL \) = Lower Flammability Limit, or ETFL where no LFL exist, published value in accordance with ASHRAE 34.
- \( Q_{\text{A2L}} \) = Minimum required air flow rate, conversion to other units of measures is permitted, cubic feet per second (m³/s).

For exact ventilation rates and for refrigerants not listed, the ventilation rate shall be calculated using this equation.

1106.4 Natural Ventilation. Where When a refrigerating system is located outdoors more than 20 feet (6096 mm) from buildings 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.

\[ F = \sqrt{G} \] (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. The locations of the gravity ventilation openings shall be based on the relative density of the refrigerant to air. [ASHRAE 15:8.11.5(a), (b)8.14]

1106.13 Machinery Room, A2L and B2L. When required by Section 1106.1, machinery rooms shall comply with Section 1106.13.1 through Section 1106.13.6. [ASHRAE 15:8.13]

1106.13.1 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]

1106.13.2 Communicating Spaces. Doors communicating with the building shall be approved, self-closing, tight-fitting fire doors. [ASHRAE 15:8.13.2]

1106.13.3 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]

1106.13.4 Exterior Openings. Exterior openings, if present, shall not be under any fire escape or any open stairway. [ASHRAE 15:8.13.4]

1106.13.5 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]

1106.13.6 Machinery Room Designation. When any refrigerant of Groups A2, A3, B2, or B3 are used, the machinery room shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with NFPA 70. When the only flammable refrigerants used are from Group A2L or B2L, the machinery room shall comply with both Section 1106.13.6.1 for ventilation and Section 1106.13.6.2 for refrigerant detection, or shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with NFPA 70. [ASHRAE 15:8.13.6]

1106.13.6.1 Mechanical Ventilation. The machinery room shall have a mechanical ventilation system in accordance with Section 1106.13.11. The mechanical ventilation system shall:

1. Run continuously, and failure of the mechanical ventilation system actuates an alarm, or
2. Be activated by one or more refrigerant detectors, conforming to requirements of Section 1106.13.8. [ASHRAE 15:8.13.6.1]
1106.13.6.2 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]

1106.13.7 Mechanical Equipment Control. Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door 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]

1106.13.8 Refrigerant Detectors. Each refrigerating machinery room in accordance with Section 1106.13 shall contain one or more refrigerant detectors in accordance with Section 1106.13.9. 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 1106.13.10 for alarms and Section 1106.13.11 for mechanical ventilation. Multiport-type devices shall be prohibited. [ASHRAE 15:8.13.8]

1106.13.9 Refrigerant Detectors Requirements. Refrigerant detectors required by Section 1106.13 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 1106.13.10 and Section 1106.13.11 after exposure to refrigerant concentration exceeding a limit value specified in Section 1106.13.10 and Section 1106.13.11.
3. The refrigerant detector shall have a set point not greater than the applicable Occupational Exposure Limit (OEL) value in accordance with Table 1106.2.3. 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 1106.2, 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 1106.2.3. 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 1106.2, 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 1106.13.9(5). 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 1106.13.10 and Section 1106.13.11. [ASHRAE 15:8.13.9]

1106.13.10 Alarms. Alarms required by Section 1106.13 shall comply with Section 1106.13.10 through Section 1106.13.10.4.

1106.13.10.1 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]

1106.13.10.2 Detector Activation. The refrigerant detector set points shall activate an alarm in accordance with the type of reset in Table 1106.13.10.2. Manual reset type alarms shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.10.2]

<table>
<thead>
<tr>
<th>LIMIT VALUE</th>
<th>RESPONSE TIME (seconds)</th>
<th>ALARM TYPE</th>
<th>ALARM RESET TYPE</th>
<th>VENTILATION RATE</th>
<th>VENTILATION RESET TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set point ≤ OEL</td>
<td>≤ 300</td>
<td>Trouble Alarm</td>
<td>Automatic</td>
<td>Level 1</td>
<td>Automatic</td>
</tr>
<tr>
<td>Set point ≤ RCL</td>
<td>≤ 15</td>
<td>Emergency Alarm</td>
<td>Manual</td>
<td>Level 2</td>
<td>Manual</td>
</tr>
</tbody>
</table>

1106.13.10.3 Alarm Levels. Alarms set at levels other than Table 1106.13.10.2 (such as IDLH) and automatic reset alarms are permitted in addition to those required by Section 1106.13.10. The meaning of each alarm shall be clearly marked by signage near the annunciators. [ASHRAE 15:8.13.10.3]

1106.13.10.4 Emergency. In the event of a failure during a refrigerant detector self-test in accordance with Section 1106.13.9(5), a trouble alarm signal shall be transmitted to an approved monitored location. [ASHRAE 15:8.13.10.4]

1106.13.11 Mechanical Ventilation. Machinery rooms, in accordance with Section 1106.13, shall be vented to the outdoors, using mechanical ventilation in accordance with Section 1106.13.11.1, Section 1106.13.11.2, and Section 1106.13.11.3. [ASHRAE 15:8.13.11]
### 1106.13.11.1 Mechanical Ventilation Requirements

Mechanical ventilation referred to in Section 1106.13.11 shall be in accordance with all of the following:

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

### Table 1106.13.11.2

#### Level 1 Ventilation Rate for Class 2L Refrigerants

<table>
<thead>
<tr>
<th>STATUS</th>
<th>AIRFLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operated when occupied and operated when activated in accordance with Section 1106.13.10.2 and Table 1106.13.10.2</td>
<td>The greater of the following: (1) 0.5 ft³/min per ft² (2.54 L/s per m²) of machinery room area, or (2) 20 ft³/min (9.44 L/s) per person</td>
</tr>
<tr>
<td>Operable when occupied</td>
<td>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.</td>
</tr>
</tbody>
</table>

### 1106.13.11.2 Level 1 Ventilation Rate

The refrigerating machinery room mechanical ventilation in Section 1106.13.11 shall exhaust at an airflow rate not less than shown in Table 1106.13.11.2. [ASHRAE 15:8.13.11.2]

### 1106.13.11.3 Level 2 Ventilation

A part of the refrigerating machinery room mechanical ventilation referred to in Section 1106.13.11 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 1106.13.8 shall activate ventilation at a set point and response time in accordance with Table 1106.13.10.2, at an airflow rate not less than the value determined in accordance with Section 1106.13.11.4.

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 1106.13.10.2. Manual-type ventilation reset shall have the reset located inside the refrigerating machinery room. [ASHRAE 15:8.13.11.3]

### 1106.13.11.4 Level 2 Ventilation Rate

When required by Section 1106.13.11.3, the total airflow for Level 2 ventilation shall be not less than the airflow rate determined by Figure 1106.13.11.4. [ASHRAE 15:8.13.11.4]

### 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 NFPA 70, 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 1106.2.2, and if 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 1106.2.2.2 and Section 1106.2.2.21106.13.11.

#### 1107.1.7.2 Refrigeration Detectors

For the refrigerant detector required in Section 1106.2.2.1, 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:

- Refrigerant compressors
- Refrigerant pumps
- Normally-closed automatic refrigerant valves

### 1107.1.7.3 Machinery Rooms

The machinery room shall comply with Section 1107.1.81106.13.

### 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.
**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 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, or B2 or B2L refrigerant.
3. The system does not contain any quantity of a Group A3 or B3 refrigerant.
4. The system is not required to be installed in a machinery room in accordance with Section 1106.0.
5. The refrigerant concentration limits in Section 1104.0 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]
LEVEL 2 VENTILATION RATE FOR CLASS 2L REFRIGERANTS (SI)
ASHRAE 15: FIGURE 8-2
Chapter 2
Definitions

220.0 – R – Refrigerant Concentration Limit (RCL). 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]

Table 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tbody>
<tr>
<td>ASHRAE 15-2016</td>
<td>Safety Standard for Refrigeration Systems</td>
<td>Refrigeration Systems</td>
<td>1102.1, 1106.1, Table 1113.5</td>
</tr>
<tr>
<td>ASHRAE 34-2016</td>
<td>Designation and Safety Classification of Refrigerants</td>
<td>Refrigeration Classifications</td>
<td>1102.3, 1103.1, Table 1102.3, Table 1106.2.5.2, 1106.13.9(3), 1106.13.9(4)</td>
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<tr>
<td>NFPA 70-2017</td>
<td>National Electrical Code</td>
<td>Miscellaneous</td>
<td>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), 1106.13.6, 1107.1.7, 1107.1.8, 1217.8.1, 1310.14.5(2), 1311.2.4, 1311.7</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Substantiation:
Task Group Recommendation 2 - Machinery Rooms: The proposed modification would bring the Uniform Mechanical Code in line with ASHRAE 15. The 3rd edition of UL/CSA 60335-2-40 has requirements for testing (and listing) of equipment using Group A2L refrigerants. The A2L Task Group modified various portions of the extracted language as needed to address enforceability and health and safety concerns. The requirements follow the extraction policy of IAPMO. Furthermore, a definition for Refrigerant Concentration Limit (RCL) is being added from ASHRAE 34 as the term is used but currently not defined in the code.

Recommendation 3 - Table 1104.1:

TABLE 1104.1
PERMISSIBLE REFRIGERATION SYSTEMS1

<table>
<thead>
<tr>
<th>OCCUPANCY GROUP3</th>
<th>HIGH-PROBABILITY SYSTEM</th>
<th>LOW PROBABILITY SYSTEM</th>
<th>MACHINERY ROOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>Group A1 or A2L2 only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>A-2</td>
<td>Group A1 or A3L2 only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>A-3</td>
<td>Group A1 or A3L2 only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>A-4</td>
<td>Group A1 or A3L2 only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>B</td>
<td>Group A1 or A2L2 only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>E</td>
<td>Group A1 or A3L2 only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group A1 or A2L only</td>
<td>Any</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>----------------------</td>
<td>-----</td>
</tr>
<tr>
<td>F-1</td>
<td>Group A1 or A2L only</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>F-2</td>
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<tr>
<td>U</td>
<td>Group A1 or A2L only</td>
<td>Any</td>
<td>Any</td>
</tr>
</tbody>
</table>

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. Occupancy classifications are defined in the building code.
3 See Section 1104.6 for requirements applicable to A2L equipment.

Substantiation:
Task Group Recommendation 3 - Table 1104.1: This change clarifies the acceptance of Group A2L refrigerants in high probability systems used for human comfort applications. Section 1104.6 already permits Group A2L refrigerants to be used for human comfort in direct systems provided the equipment is listed for A2L refrigerants. Footnote 4 identifies the requirements in Section 1104.6 for A2L refrigerants. This will assure that the equipment meets the listing and safety requirements of Section 1104.6.

Recommendation 4 - Labeling and Identification:

307.0 Labeling.
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, and type of
(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).

1115.0 Labeling and Identification.
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.

Substantiation:
Task Group Recommendation 4 - Labeling and Identification: The nameplate requirements in Section 307.3 are specifically for heat pumps and electric cooling appliances. These requirements include electrical ratings. The scope of Section 1115.5 is a broader scope, including products that do not have electrical ratings. Because the scope of Section 1115.5 is specific to products used in Chapter 11, this requirement belongs in Chapter 11 to provide a complete set of requirements for refrigeration installations.
UMC Legionella Task Group Report

Roster:

<table>
<thead>
<tr>
<th>Member</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Julius Ballanco (Chair)</td>
<td>JB Engineering and Code Consulting, P.C.</td>
</tr>
<tr>
<td>Richard Benkowski</td>
<td>United Association Department of Education</td>
</tr>
<tr>
<td>Julianne Baron</td>
<td>Special Pathogens Laboratory</td>
</tr>
<tr>
<td>Michael Cudahy</td>
<td>Plastic Pipe and Fittings Association (PPFA)</td>
</tr>
<tr>
<td>Scott Deitchman</td>
<td>Gordon &amp; Rosenblatt, LLC</td>
</tr>
<tr>
<td>Jay Egg</td>
<td>Egg Geo, LLC</td>
</tr>
<tr>
<td>Roger W Griffith</td>
<td>Griffith Engineering &amp; Consulting, Inc.</td>
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<tr>
<td>Chris Haldiman</td>
<td>Watts Water Technologies</td>
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<tr>
<td>Tim Keane</td>
<td>Legionella Risk Management, Inc.</td>
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<td>Lance MacNevin</td>
<td>Plastics Pipe Institute</td>
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<tr>
<td>William F McCoy</td>
<td>Phigenics</td>
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<tr>
<td>Kevin McDonough</td>
<td>United Association</td>
</tr>
<tr>
<td>Joshua Petersen</td>
<td>Water Control Corporation</td>
</tr>
<tr>
<td>William Rhoads</td>
<td>Virginia Polytechnic Institute and State University</td>
</tr>
<tr>
<td>Phil Ribbs</td>
<td>PHR Consultants</td>
</tr>
<tr>
<td>April Trafton</td>
<td>Donald F. Dickerson Associates</td>
</tr>
<tr>
<td>Phil Trafton</td>
<td>Donald F. Dickerson Associates</td>
</tr>
<tr>
<td>Randy Young</td>
<td>Sacramento Joint Apprenticeship Training Committee</td>
</tr>
<tr>
<td>Andrew Zeigler</td>
<td>Waterline Technology</td>
</tr>
</tbody>
</table>

Overview:
During the May 2, 2019 UMC Technical Committee meeting in Denver, Colorado, the UMC Technical Committee requested that a task group be formed to develop criteria to address the Legionella risk to the public from mechanical systems. The request included recommended objectives for the task group to provide guidance to assist in the control and intervention of Legionella associated with building mechanical systems, including: cooling towers, portable humidifiers, steam humidifiers, hydronic heating systems, ice machines, direct evaporative air coolers, air washers, and hydronic cooling systems, and address related issues such as: temperature, dead legs, sampling, maintenance procedures, etc.

The scope of the Legionella Task Group was to develop recommendations and guidance to assist in the control and intervention of Legionella associated with mechanical systems and equipment, determine the methods available to address Legionella exposure risk to public health and safety, and explore related issues such as water temperature, dead legs, sampling, and maintenance procedures for mechanical systems including, but not limited to: cooling
towers, ice machines, humidifiers, direct evaporative air coolers, and hydronic heating and cooling systems. The Task Group recommendations will be forwarded to the Uniform Mechanical Code (UMC) Technical Committee for consideration in the development of the 2024 edition of the UMC.

The Task Group met eight times via teleconference on March 2, 2020, April 22, 2020, June 8, 2020, August 12, 2020, October 16, 2020, November 23, 2020, December 10, 2020 and December 16, 2020. The proposed recommendations were obtained from members of the task group and any interested parties.

The Task Group generated a new Appendix H to the UMC based on the 2021 UPC Appendix N (Impact of Water temperature on the Potential for scalding and legionella Growth) relating to Legionella. The new Appendix H includes provisions for documentation, disinfection, cooling towers, and other mechanical systems.

Recommendation:

APPENDIX H
IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR LEGIONELLA GROWTH

Part I – General

H 101.0 General.
H 101.1 Applicability. Part I of this appendix provides guidelines on the impact of water temperature in minimizing Legionella growth potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building mechanical systems. Legionella control for plumbing systems shall be in accordance with the plumbing code.

This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella.

Note: Published documents which address Legionella risk management include ASHRAE 188 or ASHRAE Guideline 12.

Published documents which address professional qualifications for Legionella risk assessment include ASSE Series 12000.

There are additional factors associated with the potential for scalding and Legionella growth other than temperature.

For scalding potential, other factors include, but are not limited to, user age, health, body part, length of contact time, and water source.

For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

H 102.0 Definitions.
H 102.1 General. For the purpose of this appendix, the following definitions shall apply.

Biofilm. Microorganisms and the slime they secrete that grow on any continually moist surface.

Control. The management to maintain compliance with established criteria.
**Disinfection.** Chemical or physical control measures or procedures used to kill or inactivate pathogens.

**Disinfection, Online.** The procedure while the equipment is in operation.

**Disinfection, Offline.** The procedure while the equipment is not in operation.

**Halogenation.** A chemical reaction that involves the addition of one or more halogens, including, but not limited to, chlorine, bromine, or iodine, commonly used to disinfect water systems.

**Hazard.** See Risk.

**Legionella Concentrations.** The extent of colonization of Legionella measured in Colony Forming Units per milliliter (CFU/mL).

**Legionella Growth Potential.** The likelihood that Legionella bacteria will reproduce.

**Monitor.** Observing and checking the progress or quality of (something) or measuring the physical and chemical characteristics of control measures.

**Nutrient.** Any element or compound essential as a raw material for an organism’s growth and development.

**Risk.** The potential to cause harm resulting from exposure.

**Test.** The measurement of the physical, chemical, or microbial characteristics or quality of water.

**Water Management Plan.** A comprehensive risk management plan for controlling Legionella growth in building water systems.

**H 103.0 Building Water Systems and System Equipment Documentation.**

**H 103.1 Design Documentation.** Construction documents shall be required for new construction, renovation, refurbishment, replacement, or repurposing of an occupiable building water system, including a water management plan, and shall be submitted to the Authority Having Jurisdiction.

**H 103.2 Onsite Documentation.** Documentation shall be maintained onsite and shall be readily accessible to the Authority Having Jurisdiction.

**H 104.0 Potential Exposure.**

**H 104.1 Legionella Growth Potential.** The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in a water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential.

**H 104.2 Scald Potential.** Where the water system’s temperature(s) range pose(s) a scald potential, protection shall be provided in accordance with the plumbing code.

**FIGURE H 104.1**

**WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL**
For SI units: °C = (°F - 32)/1.8

* Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.

**H 105.0 Disinfection.**

**H 105.1 Disinfection Documentation.** Where required by the Authority Having Jurisdiction, documentation for disinfection of building mechanical systems shall be provided by the registered design professional in the construction documents.

**H 105.1.1 Copper-Silver Ionization.** Copper-silver ionization methods and procedures shall include the following documentation.

1. Copper and silver ionization concentrations.
2. Methods and documentation for monitoring ion levels.
3. Electrode cleaning cycles and methods.

**H 105.1.2 Ultraviolet Light.** Ultraviolet light methods shall include the following documentation:

1. Locations of ultraviolet light units.
2. Cleaning cycles and methods of the quartz sleeves and housing.

**H 105.2 Chemical Disinfection.** Chemical biocide treatment shall be permitted to be used in accordance with the following:

1. Oxidizing biocides in accordance with manufacturer’s guidelines.
2. Non-oxidizing biocides in accordance with manufacturer’s guidelines.
3. Alternating the use of different types of biocides, dose, and frequency is recommended.
4. These treatment methods can be used for continuous, online disinfection or shock treatment online or offline.
H 105.3 Non-Chemical Treatment. Non-chemical treatment devices shall be permitted to be used in accordance with manufacturer’s guidelines.

H 105.3.1 Thermal Shock. Thermal treatment using heat shock at 158°F (70°C) for 30 minutes shall be permitted in accordance with applicable guidelines and the manufacturer’s instructions.

H 105.3.2 Physical Cleaning. When implemented, physical cleaning shall only be performed as an offline method and shall be performed before the chemical disinfection methods in Section 105.1 have been performed. Building outdoor air intakes shall be closed during physical cleaning prior to commencing. Physical cleaning shall be in accordance with the manufacturer’s instructions.

H 105.4 Inspection and Maintenance. The system shall be monitored and maintained to prevent scale buildup, sediment, corrosion, and biofouling.

H 105.5 Frequency of Cleaning and Disinfection. Where a water management plan is implemented, the frequency of cleaning and disinfection logs shall be readily accessible to the water management team and the Authority Having Jurisdiction.

H 105.6 Control Measures. Evaluation of control measures for Legionella shall consider potential unintended consequences of such measures that may affect overall health risk, including the formation of toxic disinfection byproducts (whether regulated or unregulated), resultant increase in other plumbing-associated pathogens, and scalding.

Part II – Minimizing Legionella Growth Potential in Cooling Towers and Other Mechanical Systems.

H 201.0 General.
H 201.1 Applicability. Part II of this appendix applies to water sources that frequently provide optimal conditions for growth of Legionella organisms in accordance with Figure H 104.1, including, but not limited to, cooling towers, evaporative condensers, decorative water features, filters, ice makers, evaporative air coolers, fluid coolers that use evaporation to reject heat, industrial processes that use water to remove excess heat, industrial and municipal waste treatment plants, and other mechanical systems.

H 201.2 Water Management Plan, Where Required. A water management plan shall be established when required by the criteria of the Authority Having Jurisdiction.

H 201.3 Water Management Plan, Where Implemented. Where a water management plan is implemented, the plan shall be in accordance with the following:
(1) Determine a water management plan team.
(2) Provide description of the building’s water system.
(3) Identify areas of Legionella growth potential in accordance with temperature ranges as shown in Figure H 104.1.
(4) Determine applicable control measures and monitoring procedures.
(5) Ensure the water management plan is effective and operating as designed.
(6) Document and communicate all the activities of the water management plan.

H 201.4 Water Sampling. An analysis of water samples from a source capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table H 201.5 and Figure H 201.5.
H 201.5 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with applicable levels as stated in Section H 201.5.1 through Section H 201.5.3.

H 201.5.1 Levels Less than 10 CFU/ML. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment plan in accordance with Table H 201.5.

H 201.5.2 Levels Between 10 CFU/ML and 100 CFU/ML. Water samples containing Legionella levels greater than 10 CFU/mL but less than 100 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

H 201.5.3 Levels Between 100 CFU/ML and 1000 CFU/ML. Water samples containing Legionella levels greater than 100 CFU/mL but less than 1,000 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL in accordance with H 202.14.

H 201.5.3 Levels Greater than 1000 CFU/ML. Water samples containing Legionella levels greater than 1,000 CFU/mL shall require the water treatment plan to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

### TABLE H 201.5
LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>≥10 and &lt;100</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>≥100 and &lt;1000</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL. *The emergency response plan for cooling towers is addressed in Section H 202.14.</td>
</tr>
<tr>
<td>≥1000</td>
<td>Review water treatment plan, notify Authority Having Jurisdiction (if required), institute immediate online disinfection, and retest water 3 to 7 days after decontamination. If retest ≥1000 CFU/mL, repeat system decontamination.</td>
</tr>
</tbody>
</table>
**H 201.6 Air Sampling.** Air sampling for Legionella shall not be used as a means of measuring potential Legionella exposure.

**H 202.0 Cooling Towers.**

**H 202.1 General.** Cooling towers shall be installed, maintained, and tested as required by this Appendix and the Authority Having Jurisdiction.

**H 202.2 Risk Factors.** The following risk factors shall be identified, assessed, controlled, and monitored:

1. Stagnant water due to dead legs, intermittent operation, or seasonal usage.
2. The presence of nutrients or biofilm.
3. Water temperature within a range that supports microbial growth as specified in Figure H 104.1.
4. Water exposed to direct sunlight which promotes algae growth.
5. Water quality, including, but not limited to, the following factors:
   (a) System cleanliness
   (b) pH levels
   (c) Presence of corrosion
   (d) Presence of scale and biofouling
   (e) Conductivity levels
   (f) Dissolved and suspended solids
   (g) Control of water treatment chemicals
   (h) Control of bleed-off or blowdown
6. System size
7. Physical condition of system
8. Aerosol generation, dispersion, and drift elimination
9. System site location
10. Access for inspection, cleaning, and maintenance
11. Concentration of Legionella as specified in Table H 201.5.

**H 202.3 Water Temperature.** The system shall be designed to maintain low sump-water operating temperatures.

**H 202.4 Drift Eliminators.** Drift eliminators shall be installed in accordance with Section 1126.0, Section E 403.2, and Section E 403.5.1; and shall be accessible to allow inspection, maintenance, and cleaning of internal components.

**H 202.5 Side Stream Filtration.** When suspended solids are visible in the cooling tower water system, side stream filtration shall be permitted to be used to control suspended solids in cooling tower circulating water. Makeup water quality, design of cooling tower fill, recirculation rate, and total system volume shall be included in the design of such equipment.

**H 202.6 Equipment Site Location.** The site location of new or replacement open- or closed-circuit cooling towers or evaporative condensers shall be in accordance with the following:

1. Shall not be located where contamination from building systems or facility processes can be drawn into the equipment. Equipment shall be installed no less than 10 feet (3048 mm) away from building exhaust or plumbing vents.
2. Shall not be located where equipment discharges into occupied spaces, roadways, walkways, outdoor air intakes, and building openings. Equipment shall be installed no less than 10 feet (3048 mm) away from building intakes or plumbing vents.
**H 202.7 System Commissioning.** System commissioning shall include procedures for cleaning of the cooling system. Ongoing water treatment in accordance with Section H 201.5 shall be initiated once the system is charged with water.

**H 202.8 System Start-Up and Shutdown.** System start-up and shutdown procedures shall include, but not be limited to the following:

1. Management of hazardous conditions associated with untreated water, including the following:
   a. Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than 3 days, or the duration specified by the water management plan.
   b. Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
   c. Start-up from an undrained or stagnant system that exceeds 3 days, or the number of idle days specified by the water management plan or the manufacturer’s recommendations.

**H 202.9 System Maintenance and Inspection.** System components requiring maintenance and inspection shall be accessible. A schedule for maintenance and inspection of system shall be included in the water management plan documents. Cooling tower maintenance and inspection shall include, but not be limited to, the following areas:

1. Water treatment system
2. Louvers
3. Piping dead legs
4. Cold water basins
5. Crossflow hot water basin
6. Counterflow spray system
7. Drift eliminators
8. Fill material and fill air entrance and exit surfaces
9. Purging of stagnant water or low-flow zones within the basin

**H 202.10 Water Treatment.** Water treatment shall control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:

1. All equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
2. The minimum required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
3. The minimum requirements for documenting system water treatment.

**H 202.11 Disinfection.** Methods for disinfection of cooling towers shall include, but not be limited to, the halogenation methods and procedures for flushing and disinfection in accordance with Section 1122.0 and for reclaimed (recycled) and onsite treated nonpotable water in accordance with Section E 403.5.2.

The responsible person for initiating disinfection shall be identified in the water management plan documents and the disinfection process shall include the following:

1. Online disinfection.
2. Emergency disinfection.

**H 202.12 Water Treatment Chemicals.** Water treatment chemicals, such as biocides, shall be applied using an automated dosing system at regular intervals. The frequency and quantity of chemical dosing shall be based on the microbial activity of the system and the chemical parameters of the circulating water.

**H 202.13 Makeup Valves.** The location of cooling tower makeup valves shall be in accordance with the registered design professional construction documents and approved by the Authority Having Jurisdiction. Makeup valves shall be provided with backflow prevention in accordance with ASME A112.1.2 for air gaps or backflow preventers in accordance with the plumbing code.
**H 202.14 Emergency Response Plan.** An emergency response plan shall be provided when required by the Authority Having Jurisdiction and shall include, but not be limited to, the following:

1. Procedures to be followed if there are cases of Legionellosis associated with the use of cooling towers or evaporative condensers.
2. Procedures to be followed if cooling towers or evaporative condensers reach Legionella levels of 1000 CFU/mL or greater.
3. Testing for Legionella shall be performed. Procedures shall include the type of tests to be performed, sampling, and the interpretation of test results.
4. Procedures for emergency disinfection.
5. Procedures for other actions identified by the water management plan to prevent exposure to contaminated water.

**H 202.15 Control of Bleed-Off.** An automated bleed-off, or blowdown, system shall be used to remove water from the system and replace with makeup water to limit the concentration of dissolved and suspended solids. Additional manual bleed-off shall be permitted to be used to control scale or biofouling. The water for bleed-off shall be taken from the return line of the cooling water system to the cooling tower. Bleed-off shall only occur while chemical dosing is turned off.

**H 202.16 Alternative Systems.** Alternative systems and technologies that do not pose microbial risk and do not provide the opportunity for Legionella bacteria to grow shall be evaluated, including but not limited to off-peak thermal storage and geothermal coupled options.

**H 203.0 Other Mechanical Systems.**

**H 203.1 General.** Other mechanical systems and portions thereof shall be installed, maintained, and tested as required by this section and the Authority Having Jurisdiction.

**H 203.2 Sand Filters.** Sand filters shall be maintained or replaced in accordance with applicable guidelines as determined by the Authority Having Jurisdiction.

**H 203.3 Water Softeners.** Water softeners shall be installed and maintained in accordance with the plumbing code.

**H 203.4 Dehumidifiers.** Dehumidifiers shall be required in enclosed areas with swimming pools, spas, and hot tubs. Dehumidifiers shall be maintained in accordance with ASHRAE 188 and the manufacturer’s instructions.

**H 203.5 Misters, Atomizers, Air Washers, Nebulizers, and Humidifiers.** Misters, atomizers, air washers, nebulizers, and humidifiers shall be disinfected in accordance with ASHRAE 188. The minimum remediation action for humidifiers shall be in accordance with Table H 203.6.

**TABLE H 203.6
LEGIONELLA REMEDIATION ACTIONS IN HUMIDIFIERS**

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1 and &lt;10</td>
<td>Prompt cleaning and/or biocide treatment of the system.</td>
</tr>
<tr>
<td>≥10</td>
<td>Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.</td>
</tr>
</tbody>
</table>

**H 203.7 Evaporative Air Coolers.** Evaporative air coolers shall be completely drained and cleaned in accordance with the manufacturer’s instructions. When not in use, evaporative air coolers shall be completely drained.
**H 203.8 Ice Machines.** Ice machines not used for human consumption shall be flushed and maintained in accordance with ASHRAE 188.

**H 203.9 Spas and Hot Tubs.** Spas and hot tubs shall be maintained and tested in accordance with ASHRAE Guideline 12 and cleaned and disinfected in accordance with the manufacturer’s recommendations.

**H 203.10 Decorative Water Features.** Decorative water features shall be maintained in accordance with ASHRAE 188. Decorative water features shall be drained, cleaned, and disinfected in accordance with the manufacturer’s instructions and the Authority Having Jurisdiction.

**H 203.11 Water Supply Systems.** The minimum remediation action for water supply systems shall be in accordance with the plumbing code.

### TABLE 1701.2

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.1.2-2012 (R2017)</td>
<td>Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)</td>
<td>Fittings</td>
</tr>
<tr>
<td>ASSE Series 12000-2018</td>
<td>Infection Control Risk Assessment for All Building Systems</td>
<td>Risk Management</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

**Substantiation:**

The purpose of the new Appendix H is to establish minimum Legionellosis risk management requirements for building mechanical systems. Cooling towers’ potential for spreading Legionella bacteria is especially pressing given the associated diseases’ symptomatic similarities to COVID-19 and the propensity they have for exacerbating respiratory illnesses.