2018 UMC and IMC

Code Changes

2020 Edu-code
Environmental Note:
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2018 IMC
Chapter 2
Definitions

ACCESS (TO)
• That which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel or similar obstruction

APPROVED AGENCY
• An established and recognized agency that is regularly engaged in conducting tests, furnishing inspection services or furnishing product certification where such agency has been approved by the code official

BUILDING
• Any structure utilized or intended for supporting or sheltering any occupancy.

COMMERCIAL COOKING APPLIANCES
• Appliances used in a commercial food service establishment for heating or cooking food.
• For the purpose of this definition, a commercial food service establishment is where food is prepared for sale or is prepared on a scale that is by volume and frequency not representative of domestic household cooking
DIRECT SOLAR SYSTEM

- A solar thermal system in which the gas or liquid in the solar collector loop is not separated from the load.

DRAIN-BACK SYSTEM

- A solar thermal system in which the fluid in the solar collector loop is gravity drained from the collector into a holding tank under prescribed circumstances.

FOOD-GRADE FLUID

- Potable water or a fluid containing additives listed in accordance with the Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Parts 174-186.

HIGH-VOLUME, LARGE-DIAMETER FAN

- A low speed ceiling fan that circulates large volumes of air and that is greater than 7 feet in diameter.

INDIRECT SOLAR SYSTEM

- A solar thermal system in which the gas or liquid in the solar collector loop circulates between the solar collector and a heat exchanger and such gas or liquid is not drained from the system or supplied to the load during normal operation.

LOW-PROBABILITY PUMP

- A pump that does not rely on a dynamic shaft seal as a singular means of containment to prevent atmospheric release of the pumped fluid.
MACHINERY ROOM

- An enclosed space that is required by Chapter 11 to contain refrigeration equipment and to comply with Sections 1105 and 1106.

NO-FLOW CONDITION (SOLAR).

- A condition where thermal energy is not transferred from a solar thermal collector by means of flow of a heat transfer fluid.

NONFOOD-GRADE FLUID

- Any fluid that is not designated as a food-grade fluid.

  - Example:
    - Ethylene glycol
    - Organic Compound
    - Ethylene glycol is highly toxic.
    - Household pets are especially susceptible to ethylene glycol poisoning from vehicle antifreeze leaks.

OCCUPATIONAL EXPOSURE LIMIT

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

POLLUTION-CONTROL UNIT (PCU).

- Manufactured equipment that is installed in a grease exhaust duct system for the purpose of extracting smoke, grease particles and odors from the exhaust flow by means of a series of filters.

PRESS-CONNECT JOINT

- A permanent mechanical joint incorporating 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.
SOLAR THERMAL SYSTEM

• A system that converts solar radiation to thermal energy for use in heating or cooling.

2018 UMC
Chapter 2
Definitions

Air Dispersion Systems:

• Materials intended for use in air handling systems in exposed locations operating under positive pressure.

Appliance definition

• 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.

Appliance Categorized Vent Diameter/Area

• The minimum vent area/diameter permissible for Category I appliances to maintain a nonpositive vent static pressure.

205.0 Combustible Material

• A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn; a material that does not meet the definition of non-combustible.
Compensating Hood

• A hood for commercial food heat processing equipment that has an outside-air supply with air delivered below or within the hood

DIRECT-VENT APPLIANCES

• Appliances that are constructed and installed so that all air for combustion is derived from the outdoors and all flue gases are discharged to the outdoors.

Joint, Press-Connect

• A permanent mechanical 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 manufacture

Line set

• A set of two refrigerant pipes that extends from the condenser to the evaporator (cooling coil) in direct systems, consisting of a suction line and a liquid line.

Refrigeration System, Indirect

• A system in which a secondary coolant cooled or heated by the refrigerating system is circulated to the air or other substance to be cooled or heated.
• Indirect systems are distinguished by the method of application given below:

Indirect Open Spray System

• A system in which a secondary coolant is in direct contact with the air or other substance to be cooled or heated
Double Indirect Open Spray System

- A system in which the secondary substance for an indirect open spray system is heated or cooled by the secondary coolant circulated from a second enclosure

Indirect Closed System

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

2018 IMC

Chapter 3

General Regulations

303.7 Pit locations

- Appliances installed in pits or excavations shall not come in direct contact with the surrounding soil and shall be installed not less than 3 inches above the pit floor.
- Excavation on the control side of the appliance shall extend not less than 30 inches horizontally

303.9 Fireplaces in Group I-2, Condition 2 occupancies

- Fuel-burning appliances and fireplaces in Group I-2, Condition 2 occupancies shall be in accordance with Section 901.4.

Institutional Group I-2 occupancy shall include buildings and structures used for medical care on a 24-hour basis for more than five persons who are not capable of self-preservation. This group shall include, but not be limited to, the following:
- Foster care facilities
- Detoxification facilities
- Hospitals
- Nursing homes
- Psychiatric hospitals

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302.1 Materials – Standards and Alternates

• 302.1 Minimum Standards.
  – Unless otherwise provided for in this code, materials, appurtenances, or devices … shall be submitted to the AHJ for approval

302.1.2 Standards

• A list of mechanical standards that appear in specific sections of this code is referenced in Table 1701.1.
  Standards referenced in Table 1701.1 shall be applied as indicated in the applicable referenced section.
• A list of additional standards, publications, practices and guides that are not referenced in specific sections of this code appear in Table 1701.2.
• The documents indicated in Table 1701.2 shall be permitted in accordance with Section 302.2

303.1 Listed Appliances

• The installation of equipment and appliances regulated by this code shall be in accordance with the conditions of the listing, the manufacturer’s installation instructions and this code.
• The manufacturer’s installation and operating instructions shall be attached to the appliance.
• Clearances of listed equipment and appliances from combustible materials shall be as specified in the listing or on the rating plate.

303.3 Unlisted Appliances

• Except as otherwise permitted
• Unlisted equipment and appliances shall be approved by the Authority Having Jurisdiction.
• Unlisted equipment and appliances shall be installed in accordance with the manufacturer’s installation instructions and with clearances from combustible materials in accordance with Section 303.10 or Section 303.10.1.

303.8 Equipment and Appliances on Roofs.

• Shall be designed or enclosed so as to withstand climatic conditions in the area in which they are installed.
• Where enclosures are provided, each enclosure shall permit easy entry and movement

303.8 Equipment and Appliances on Roofs

• Equipment and appliances on roofs shall be designed or enclosed so as to withstand climatic conditions in the area in which they are installed.
303.8 Equipment and Appliances on Roofs

• Where enclosures are provided, each enclosure shall:
  • Permit easy entry and movement
  • Be of reasonable height
  • And shall have not less than a 30 inch clearance between the entire service access panel(s) of the equipment and appliance, and the wall of the enclosure.

303.8.3 Installation of Equipment and Appliances on Roofs.

• Equipment and appliances shall be installed in accordance with the manufacturer’s installation instructions. [NFPA 54:9.4.2.1]
  • Correlates with UPC Requirements

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 54:9.1.17]
  • Correlates with UPC

303.10.1.1 Type I Hood Exhaust System

• Reduce clearances for Type I exhaust systems shall be in accordance with Section 507.4.2 through Section 507.4.2.3.
  • Clearances from the duct or the exhaust fan to the interior surface of enclosures of combustible construction shall be in accordance with Section 510.7.3 and clearances shall not be reduced.

303.10.1.2 Product Conveying Ducts

• Reduce clearances to combustibles construction for product conveying ducts shall be in accordance with
  • Section 506.10.3 through Section 506.11.6.3. {New sections}

303.10.1.2 Product Conveying Ducts

• Reduce clearances to combustibles construction for product conveying ducts shall be in accordance with:
  • Section 506.10.3 through Section 506.11.6.3.
303.10.1.3 Solid-Fuel Burning Appliances

- For solid-fuel burning appliances, the clearance, after reduction, shall not be less than 12 inches to combustible walls and not less than 18 inches to combustible ceilings.

303.10.1.3 Solid-Fuel Burning Appliances

- The clearance, after reduction, shall be permitted to be less than 12 inches to combustible walls and less than 18 inches to combustible ceilings where the solid-fuel burning appliances is listed for lesser clearance.

303.13 Pit Location

- Appliances installed in pits or excavations
  1. Shall extend to a depth of 6 inches
  2. The sides of the pit or excavation shall be held back a minimum of 12 inches from the appliance.
  3. Where the depth exceeds 12 inches below adjoining grade, the walls of the pit or excavation shall be lined with concrete or masonry.

Pit locations

4. Such concrete or masonry shall extend a minimum of 4 inches above adjoining ground level

Chapter 4 VENTILATION AIR SUPPLY

2018 IMC chapter 4
Ventilation
403.3.2.4 System controls

• Where provided within a dwelling unit, controls for outdoor air ventilation systems shall include text or a symbol indicating the system’s function.

Table 404.1

<table>
<thead>
<tr>
<th>Outdoor Opening Type</th>
<th>Minimum and Maximum Opening Sizes in Louvers, Grilles and Screens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor openings in residential occupancies</td>
<td>Not &lt; (\frac{1}{8}) inch and not &gt; (\frac{1}{2}) inch</td>
</tr>
<tr>
<td>Indoor openings in other than residential occupancies</td>
<td>&gt; (\frac{1}{4}) inch and not &gt; 1 inch</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm

a. For rectangular openings, the table requirements apply to the shorter side. For round openings, the table requirements apply to the diameter. For square openings, the table requirements apply to any side.

403.3.2.5 Ventilating equipment

• Exhaust equipment serving single dwelling units shall be listed and labeled to provide the minimum required air flow in accordance with ANSI/AMCA 210-ANSI/ASHRAE 51.

404.1 Enclosed parking garages

• Mechanical ventilation systems for enclosed parking garages shall operate continuously or shall be automatically operated by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors.

• Automatic operation shall cycle the ventilation system between the following two modes of operation:
  1. Full-on at an airflow rate of not less than 0.75 cfm per square foot of the floor area served.
  2. Standby at an airflow rate of not less than 0.05 cfm per square foot of the floor area served.
### 2018 IMC chapter 4

**Ventilation**

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**Table 403.3.1.1 Minimum Ventilation Rates**

<table>
<thead>
<tr>
<th>Occupancy Classification</th>
<th>Occupant Density #1000 ft(^2)*</th>
<th>People Outdoor Airflow Rate in (\text{CFM}, R_{\text{p}})</th>
<th>Area Outdoor Airflow Rate in (\text{CFM}, R_{\text{a}})</th>
<th>Exhaust Airflow Rate in (\text{CFM}, R_{\text{e}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion control rooms</td>
<td>15</td>
<td>5</td>
<td>0.06</td>
<td>—</td>
</tr>
<tr>
<td>Dry cleaning, laundry</td>
<td>20</td>
<td>15</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Commercial laundries</td>
<td>20</td>
<td>7.5</td>
<td>0.06</td>
<td>—</td>
</tr>
</tbody>
</table>

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**Table 403.3.1.1 Minimum Ventilation Rates**

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<th>Exhaust Airflow Rate in (\text{CFM}, R_{\text{e}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and beverage service</td>
<td>100</td>
<td>7.5</td>
<td>0.12</td>
<td>—</td>
</tr>
<tr>
<td>Kitchens (cooking)</td>
<td>20</td>
<td>7.5</td>
<td>0.12</td>
<td>0.7</td>
</tr>
</tbody>
</table>

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401.0 General
This chapter contains requirements for ventilation air supply, exhaust, and makeup air requirements for occupiable spaces within a building.

402.2 Natural Ventilation
• Exceptions:
  (2) A mechanical ventilation system is not required where:
  (a) natural ventilation openings comply with the requirements of Section 402.2 and are permanently open or have controls that prevent the openings from being closed during periods of expected occupancy or (b) the zone is not served by heating or cooling equipment. [ASHRAE 62.1:6.4]

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 ($Evz$) shall be determined in accordance with Equation 404.3.2(1).

• $Evz$ - 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.

• $Ez$ - Zone air distribution effectiveness:
  A measure of the effectiveness of supply air distribution to the breathing zone.

• $Ez$ is determined in accordance with Section 403.2.2.
501.2 Independent system required

- Kitchen exhaust systems shall be constructed in accordance with Section 505 for domestic cooking operations and Sections 506 through 509 for commercial cooking operations.

502.4 Stationary storage battery systems

- The exhaust system shall be designed to provide air movement across all parts of the floor for gases having a vapor density greater than air and across all parts of the vault ceiling for gases having a vapor density less than air.

502.4.1 Flammability limit in rooms

- The ventilation system shall be designed to limit the maximum concentration of flammable gas to 25 percent of the lower flammability limit or, for hydrogen, limit the maximum concentration to 1.0 percent of the total volume of the room.

502.4.2 Ventilation rate in rooms

- Continuous ventilation shall be provided at a rate of not less than 1 cubic foot per minute per square foot of floor area of the room and not less than 150 cfm.

502.5 Ventilation of battery systems in cabinets

- Stationary storage battery systems installed in cabinets, as regulated by Section 1206.2.11.3.1 of the International Fire Code, shall be provided with ventilation in accordance with Section 502.4.

502.16 Repair garages for vehicles fueled by lighter than-air fuels

- Repair garages used for the conversion and repair of vehicles that use compressed natural gas, liquefied natural gas, hydrogen or other lighter-than-air motor fuels shall be provided with an approved mechanical exhaust ventilation system.
502.16 Repair garages for vehicles fueled by lighter-than-air fuels.

- The mechanical exhaust ventilation system shall be in accordance with Section 502.16.1 or 502.16.2 as applicable

502.16 Exceptions:

1. Repair garages where work is not performed on the fuel system and is limited to exchange of parts and maintenance not requiring open flame or welding on the compressed natural gas, liquefied natural gas, hydrogen or other lighter-than-air fueled motor vehicle.

2. Repair garages for hydrogen-fueled vehicles where work is not performed on the hydrogen storage tank and is limited to the exchange of parts and maintenance not requiring open flame or welding on the hydrogen-fueled vehicle.
   - During the work, the entire hydrogen fuel system shall contain a quantity of hydrogen that is less than 200 cubic feet.

502.16.1 Repair garages for hydrogen-fueled vehicles

- Repair garages used for the repair of hydrogen-fueled vehicles shall be provided with an approved exhaust ventilation system in accordance with this code and Chapter 6 of NFPA 2.

502.16.2 Exhaust ventilation system

- Repair garages used for the repair of compressed natural gas, liquefied natural gas or other lighter-than-air motor fuel, other than hydrogen, shall be provided with an approved mechanical exhaust ventilation system.
502.16.2 Exhaust ventilation system

• The mechanical exhaust ventilation system shall be in accordance with this code and Sections 502.16.2.1 and 502.16.2.2.

502.16.2 Exhaust ventilation system

• Exception:
  • Where approved, natural ventilation shall be an alternative to mechanical exhaust ventilation.

502.16.2.1 Design

• For indoor locations, air supply inlets and exhaust outlets for mechanical ventilation shall be arranged to provide uniformly distributed air movement with inlets uniformly arranged on walls near floor level and outlets located at the high point of the room in walls or the roof.

502.16.2.1 Design

• Failure of the exhaust ventilation system shall cause the fueling system to shut down.
  • The exhaust ventilation rate shall be not less than 1 cubic foot per minute per 12 cubic feet of room volume.

502.16.2.2 Operation

• The mechanical exhaust ventilation system shall operate continuously.
  • Exceptions:
    • 1. Mechanical exhaust ventilation systems that are interlocked with a gas detection system designed in accordance with the International Fire Code.

502.16.2.2 Operation

2. Mechanical exhaust ventilation systems in garages that are used only for the repair of vehicles fueled by liquid fuels or odorized gases, such as compressed natural gas, where the exhaust ventilation system is electrically interlocked with the lighting circuit.
504.4 Exhaust installation

• Clothes dryer exhaust ducts shall be sealed in accordance with Section 603.9

504.4.1 Exhaust termination outlet and passageway size.

• The passageway of dryer exhaust duct terminals shall be undiminished in size and shall provide an open area of not less than 12.5 square inches.

504.8.2 Duct installation

• Where dryer exhaust ducts are enclosed in wall or ceiling cavities, such cavities shall allow the installation of the duct without deformation.

505.1 General

• Domestic cooking exhaust equipment shall comply with the requirements of this section

505.2 Domestic cooking exhaust

• Where domestic cooking exhaust equipment is provided, it 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 comply 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.
4. Microwave ovens with integral exhaust for installation over the cooking surface shall be listed and labeled in accordance with UL 923.
505.3 Exhaust ducts

- Installations in Group I-1 and I-2 occupancies shall be in accordance with the International Building Code and Section 904.13 of the International Fire Code.

904.13 Domestic cooking systems in Group I-2

- In Group I-2 Condition 1 occupancies where cooking facilities are installed in accordance with Section 407.2.6 of the International Building Code

407.2.6 Nursing home cooking facilities

- In Group I-2, Condition 1, occupancies, rooms or spaces that contain a cooking facility with domestic cooking appliances shall be permitted to be open to the corridor where all of the following criteria are met:

  1. The number of care recipients housed in the smoke compartment is not greater than 30.
  2. The number of care recipients served by the cooking facility is not greater than 30.
  3. Only one cooking facility area is permitted in a smoke compartment.
  4. The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.
  5. The corridor is a clearly identified space delineated by construction or floor pattern, material or color.
  6. The space containing the domestic cooking facility shall be arranged so as not to obstruct access to the required exit.

407.2.6 Nursing home cooking

7. A domestic cooking hood installed and constructed in accordance with Section 505 of the International Mechanical Code is provided over the cooktop or range.
8. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire extinguishing system of a type recognized for protection of domestic cooking equipment.
- Pre-engineered automatic extinguishing systems shall be tested in accordance with UL 300A and listed and labeled for the intended application.
- The system shall be installed in accordance with this code, its listing and the manufacturer’s instructions.

9. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.
10. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.
11. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.
12. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.
13. A portable fire extinguisher shall be installed in accordance with Section 906 of the International Fire Code.
### 904.13 Domestic cooking systems in Group I-2 Condition 1

- The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment.
- Pre-engineered automatic extinguishing systems shall be tested in accordance with UL 300A and listed and labeled for the intended application.
- The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.

### 904.13.1 Manual system operation and interconnection

- Annual actuation and system interconnection for the hood suppression system shall be in accordance with Sections 904.12.1 and 904.12.2, respectively.

### 904.13.2 Portable fire extinguishers for domestic cooking equipment in Group I-2 Condition 1

- A portable fire extinguisher complying with Section 906 shall be installed within a 30-foot distance of travel from domestic cooking appliances.

### 505.6 Other than Group R

- In other than Group R occupancies, where domestic cooktops, ranges, and open-top broilers are used for domestic purposes, domestic cooking exhaust systems shall be provided.

### 506.3.13.2 Termination through an exterior wall

- Such terminations shall be located in accordance with Section 506.3.13.3 and shall not be located within 3 feet of any opening in the exterior wall.

### 506.5.2 Pollution-control units

- The installation of pollution-control units shall be in accordance with the manufacturer’s installation instructions and all of the following:
  1. Pollution-control units shall be listed and labeled in accordance with UL 1978.
  2. Fans serving pollution-control units shall be listed and labeled in accordance with UL 762.
  3. Pollution-control units shall be mounted and secured in accordance with the manufacturer’s installation instructions and the International Building Code.
506.5.2 Pollution-control units

4. Pollution-control units located indoors shall be listed and labeled for such use.
   • Where enclosed duct systems, as required by Section 506.3.11, are connected to a pollution control unit, such unit shall be located in a room or space having the same fire-resistance rating as the duct enclosure.
   • Access shall be provided for servicing and cleaning of the unit.
   • The space or enclosure shall be ventilated in accordance with the manufacturer’s installation instructions.

5. A clearance of not less than 18 inches shall be maintained between the pollution-control unit and combustible material.

6. Roof-mounted pollution-control units shall be listed for outdoor installation and shall be mounted not less than 18 inches above the roof.

7. Exhaust outlets for pollution-control units shall be in accordance with Section 506.3.13.

8. An airflow differential pressure control shall be provided to monitor the pressure drop across the filter sections of a pollution-control unit.
   • When the airflow is reduced below the design velocity, the airflow differential pressure control shall activate a visual alarm located in the area where cooking operations occur.

9. Pollution-control units shall be provided with a factory-installed fire suppression system.

10. Service space shall be provided in accordance with the manufacturer’s instructions for the pollution-control unit and The requirements of Section 306.

11. Wash-down drains shall discharge through a grease interceptor and shall be sized for the flow.
   • Drains, shall be sealed with a trap or other approved means to prevent air bypass.
   • Where a trap is utilized it shall have a seal depth that accounts for the system pressurization and evaporation between cleanings.

12. Protection from freezing shall be provided for the water supply and fire suppression systems where such systems are subject to freezing.

13. Duct connections to pollution-control units shall be in accordance with Section 506.3.2.3. Where water splash or carryover can occur in the transition duct as a result of a washing operation, the transition duct shall slope downward toward the cabinet drain pan for a length not less than 18 inches.
   • Ducts shall transition to the full size of the unit’s inlet and outlet openings.

14. Extra-heavy-duty appliance exhaust systems shall not be connected to pollution-control units except where such units are specifically designed and listed for use with solid fuels.

15. Pollution-control units shall be maintained in accordance with the manufacturer’s instructions.
507.2.6 Clearances for Type I hood

2. Type I hoods listed and labeled for clearances less than 18 inches in accordance with UL 710 shall be installed with the clearances specified by such listings.

SECTION 509 - FIRE SUPPRESSION SYSTEMS

- 509.1 Where required.
- Cooking appliances required by Section 507.2 to have a Type I hood shall be provided with an approved automatic fire suppression system complying with the International Building Code and the International Fire Code.

510.8.1 Duct cleanout

- Ducts conveying combustible dust as part of a dust collection system shall be equipped with cleanouts that are provided with approved access, predesigned to be disassembled for cleaning, or engineered for automatic cleanouts.
- Where provided, cleanouts shall be located at the base of each vertical duct riser and at intervals not exceeding 20 feet in horizontal sections of duct.

513.6.1 Minimum pressure difference

- The pressure difference across a smoke barrier used to separate smoke zones shall be not less than 0.05-inch water gage in fully sprinklered buildings.

513.12.4 Automatic control

- Where complete automatic control is required or used, the automatic control sequences shall be initiated from an appropriately zoned automatic sprinkler system complying with Section 903.3.1.1 of the International Fire Code, from manual controls provided with ready access for the fire department, and any smoke detectors required by engineering analysis.
504.3 Domestic Range

• Ducts used for domestic kitchen range or cooktop ventilation shall be of metal and shall have smooth interior surfaces.

504.4 Clothes Dryers

• Transition ducts used to connect the dryer to the exhaust duct shall be listed and labeled in accordance with UL 2158A, or installed in accordance with the clothes dryer manufacturer’s installation instructions.

504.2 Independent Exhaust Systems

• Single or combined mechanical systems shall be independent of other exhaust systems.

504.4 Clothes Dryers

• A clothes dryer exhaust duct shall not be connected to a vent connector, gas vent, chimney, and shall not terminate into a crawl space, attic, or other concealed space.

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 including two 90 degree elbows. A length of 2 feet shall be deducted for each 90 degree 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.
504.4.2.2 Transition Ducts.

- Listed clothes dryer transition ducts not more than 6 feet in length shall be permitted to be used to connect the domestic dryer to the exhaust ducts.

Exception was turned into a new section.

504.4.2 Transition 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.

504.4.2.3 Exhaust Duct Power Ventilators

- Dryer exhaust duct power ventilators for single residential clothes dryers shall be listed and be installed in accordance with the manufacturer’s installation instructions.

505.0 Product-Conveying Systems.

505.1.1 Mechanical Ventilation

- A mechanical ventilation system shall be interlocked to operate with the equipment used to produce vapors, fumes, or dusts that are flammable or hazardous.

505.2 Incompatible Materials

- Incompatible materials shall not be conveyed in the same system.
505.4 Air-Moving Devices

- Air-moving devices shall be sized to establish the velocity required to capture, control, and convey materials through the exhaust system.

505.5 Generating Flames, Sparks, or Hot Materials

- Operations generating flames, sparks, or hot material such as from grinding wheels and welding shall not be manifolded into an exhaust system that air conveys flammable or combustible materials.

505.6 Fire Dampers

- Fire dampers shall be permitted to be installed in exhaust systems in accordance with the following:
  1. Where ducts pass through fire barriers
  2. Where a collection system installed on the end of the system is protected with an automatic extinguishing system
  3. Where the duct system is protected with an automatic extinguishing system
  4. Where ducts have been listed with interrupters
  5. Where necessary to facilitate the control of smoke pursuant to the applicable NFPA standards [NFPA 91:4.2.9]

505.6.1 Prohibited

- Fire dampers shall not be installed if the material being exhausted is toxic and if a risk evaluation indicates that the toxic hazard is greater than the fire hazard.

505.7 Fire Detection and Alarm Systems

- Unless the conditions in Section 505.7.1 or Section 505.7.2 exist, fire detection and alarm systems shall not be interlocked to shut down air-moving devices. [NFPA 91:4.2.14]

505.7.1 Automatic Extinguishing System

- Where shutdown is necessary for the effective operation of an automatic extinguishing system, it shall be permitted to interlock fire detection and alarm systems to shut down air-moving devices. [NFPA 91:4.2.14.1]
505.7.2 Shut Down Permitted

- Where a documented risk analysis acceptable to the Authority Having Jurisdiction shows that the risk of damage from fire and the products of combustion would be higher with air-moving devices operating, it shall be permitted to interlock fire detection and alarm systems to shut down air-moving devices. [NFPA 91:4.2.14.2]

506.3 Penetrations

- Exhaust ducts shall not pass through fire walls, as defined by NFPA 221. [NFPA 91:4.2.11]

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- Exhaust ducts shall not pass through fire walls, as defined by NFPA 221.
506.4 Condensate

- Joints in duct construction shall be liquid tight when the conveying system contains condensable vapors or liquids in suspension.
  - [NFPA 91:4.3.6.1]

506.4.1 Drainage

- Provisions shall be made for drainage of condensate at low points in the duct.
  - [NFPA 91:4.3.6.2]

506.10 Duct Clearances

- Unless the conditions in Section 506.10.1 or Section 506.10.2 exist, duct systems and system components shall have a clearance of at least 6 inches from stored combustible materials, and not less than 1/2 of an inch clearance from combustible construction.
  - [NFPA 91:4.7.1]

506.10.1 Protection Provided

- Where stored combustible material or combustible construction is protected from ductwork by the use of materials or products listed for protection purposes, clearance shall be maintained in accordance with those listings.
  - [NFPA 91:4.7.1.1]

506.10.2 Systems Conveying Combustible Materials

- Unless the conditions in Section 506.10.3 exist, duct systems and system components handling combustible material shall have a clearance of not less than 18 inches from combustible construction or a combustible material.
  - [NFPA 91:4.7.2]

506.10.3 Reduced Clearance Permitted

- When the ductwork system is operating at 140°F or below and is equipped with an approved automatic extinguishing system designed for the specific hazard, the clearance shall be permitted to be reduced to 6 inches from combustible materials and 1/2 of an inch from combustible construction.
  - [NFPA 91:4.7.2.1]
506.10.4 Clearance Increases

- All duct systems and system components operating at temperatures above 140°F shall have clearances from stored combustible materials or combustible construction not less than those listed in Table 506.10.4.
- [NFPA 91:4.7.3]

506.11.4 Duct and Thermal Shield

- With all clearance reduction systems, not less than 1 inch clear space shall be provided between the duct and the thermal shield.
- [NFPA 91:4.7.4.5]

508.1 Where Required

- 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.

508.10.2 Noncanopy-Type Hoods

- Noncanopy-type commercial cooking hoods shall be installed and sized in accordance with the manufacturer’s installation instructions, and Section 508.4.2.1 and Section 508.4.2.2.
- Exception: Listed hood assemblies designed and installed specifically for the intended use.

The code only addressed size and locations for canopy-type hoods but not for non-canopy-type hoods.
508.4.10.3 Labeling.

Type I hoods shall bear a label indicating the exhaust flow rate in cubic feet per minute per lineal foot.

Hoods are designed in accordance with the appliance in which they are installed and the addition of a label will ensure, if the existing appliance is replaced, that the hood is of sufficient capacity to handle the exhaust of the replacement appliance.

519.0 Type II Hood Exhaust System Requirements

519.1 Where Required

Type II hoods shall be installed above equipment and dishwashers that generate steam, heat, and products of combustion, and where grease or smoke is not present.

519.6 Makeup Air

Makeup air shall be provided in accordance with Section 511.3.

519.0 Type II Hood Exhaust System Requirements

Exceptions:

1. Dishwashing machines connected to a Type II duct system and exhausted directly to the outdoors.

519.6 Makeup Air

Makeup air shall be provided in accordance with Section 511.3.
Chapter 6 – DUCT SYSTEMS

SECTION 602 PLENUMS

• **602.1 General**
  • Supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces, mechanical equipment rooms and the framing cavities addressed in Section 602.3.

602.2.1 Materials within plenums

• **5. Combustible materials fully enclosed within one of the following:**
  5.3. Materials listed and labeled for installation within a plenum and listed for the application.

602.2.1.1 Wiring

• Combustible electrical wires and cables and optical fiber cables exposed within a plenum shall:
  1. Be listed and labeled as having a peak optical density not greater than 0.50
  2. An average optical density not greater than 0.15
  3. A flame spread distance not greater than 5 feet when tested in accordance with NFPA 262,
  4. or shall be installed in metal raceways or metal sheathed cable.

Section was a Re-Write

602.2.1.1 Wiring

• Combustible optical fiber and communication raceways exposed within a plenum shall:
  1. Be listed and labeled as having a peak optical density not greater than 0.5
  2. An average optical density not greater than 0.15
  3. A flame spread distance not greater than 5 feet when tested in accordance with UL 2024.

Only plenum-rated wires and cables shall be installed in plenum-rated raceways.
Section was a Re-Write
602.2.1.2 Fire sprinkler piping

- Plastic fire sprinkler piping exposed within a plenum shall:
  1. Be used only in wet pipe systems
  2. Shall be listed and labeled as having a peak optical density not greater than 0.50
  3. An average optical density not greater than 0.15
  4. A flame spread distance not greater than 5 feet when tested in accordance with UL 1887.

602.2.1.3 Pneumatic tubing

- Combustible pneumatic tubing exposed within a plenum shall
  1. Shall be listed and labeled as having a peak optical density not greater than 0.50
  2. An average optical density not greater than 0.15
  3. A flame spread distance not greater than 5 feet when tested in accordance with UL 1820

602.2.1.6 Foam plastic in plenums as interior finish or interior trim

- Foam plastic in plenums used as interior wall or ceiling finish or interior trim shall exhibit
  1. A flame spread index of 25 or less
  2. A smoke-developed index of 50 or less
- When tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, and shall be tested in accordance with NFPA 286 and meet the acceptance criteria of Section 803.1.2 of the International Building Code.

602.2.1.6 Foam plastic in plenums as interior finish or interior trim

- As an alternative to testing to NFPA 286, the foam plastic shall be approved based on test conducted in accordance with Section 2603.9 of the International Building Code.

602.2.1.6 Foam plastic in plenums

- Exceptions:
  1. Foam plastic in plenums used as interior wall or ceiling finish or interior trim shall exhibit a flame spread index of 75 or less and a smoke developed index of 450 or less when tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, where it is separated from the airflow in the plenum by a thermal barrier complying with Section 2603.4 of the International Building Code.

- Exceptions:
  2. Foam plastic in plenums used as interior wall or ceiling finish or interior trim, shall exhibit a flame spread index of 75 or less and a smoke developed index of 450 or less when tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, where it is separated from the airflow in the plenum by corrosion-resistant steel having a base metal thickness of not less than 0.0160 inch.
1. Foam plastic in plenums used as interior wall or ceiling finish or interior trim, shall exhibit a flame spread index of 75 or less and a smoke developed index of 450 or less when tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, where it is separated from the airflow in the plenum by not less than a 1-inch thickness of masonry or concrete.

2. Plastic piping and tubing used in plumbing systems shall be listed and labeled as having a flame spread index not greater than 25 and a smoke developed index not greater than 50 when tested in accordance with ASTM E84 or UL 723.

3. Plastic water distribution piping and tubing listed and labeled in accordance with UL 2846 as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, and installed in accordance with its listing.

4. Pipe and duct insulation shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which they are exposed in service.

- The test temperature shall not fall below 250°F.
- Pipe and duct insulation shall be listed and labeled.

5. Nonmetallic phenolic ducts shall be constructed and installed in accordance with the SMACNA Phenolic Duct Construction Standards.
603.8.2 Sealing

- Ducts shall be sealed, secured and tested prior to concrete encasement or direct burial.
- Ducts shall be leak tested as required by Section C403 of the International Energy Conservation Code.

Are these ducts properly sealed?

This is the proper section C403.2.9

C403.2.9 Duct and plenum insulation and sealing

- Duct and plenum insulation and sealing.
- Supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces and where located outside the building with a minimum of R-8 insulation where located outside the building.

IECC 2015

C403.2.9 Duct and plenum insulation and sealing

- In Climate Zones 1 through 4 and a minimum of R-12 insulation in Climate Zones 5 through 8.
- Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum of R-8 insulation.
- Insulation in Climate Zones 1 through 4 and a minimum of R-12 insulation in Climate Zones 5 through 8.

IECC 2015

C403.2.9.1.1 Low-pressure duct systems.

- Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the International Mechanical Code.

IECC 2015

C403.2.9.1.1 Low-pressure duct systems.

- Longitudinal and transverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2 inches water gauge (w.g.) (498 Pa) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems or tapes installed in accordance with the manufacturer’s instructions.

IECC 2015

R403.3.3 Duct testing (Mandatory)

Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test:
   - Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test.
   - All registers shall be taped or otherwise sealed during the test.

2. Post construction test:
   - Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure.
   - Registers shall be taped or otherwise sealed during the test.
R403.3.3 Duct testing (Mandatory)

- Exception:
  - A duct air leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.
  - A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

603.9 Joints, seams and connections

- Exception:
  - For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams and locking-type joints and seams.
  - This exception shall not apply to snap-lock and button-lock type joints and seams located outside of conditioned spaces.

604.11 Vapor retarders

- Exception:
  - A vapor retarder is not required for spray polyurethane foam insulation having a water vapor permeance of not greater than 3 perms per inch [1722 ng/(s • m2 • Pa)] at the installed thickness.

607.1.2 Ducts that penetrate fire-resistance-rated assemblies without dampers

- Ducts that penetrate fire-resistance-rated walls and are not required by this section to have fire dampers shall comply with the requirements of Sections 714.3 through 714.4.3 of the International Building Code.

607.3.1 Damper testing

- Only fire dampers labeled for use in dynamic systems shall be installed in heating, ventilating and air-conditioning systems designed to operate with fans on during a fire.
607.3.1 Damper testing

- Only ceiling radiation dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire.

607.3.2.1 Fire damper ratings

Fire dampers shall have the minimum rating specified in Table 607.3.2.1.

<table>
<thead>
<tr>
<th>TYPE OF PENETRATION</th>
<th>MINIMUM DAMPER RATING (Hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2-hour fire-resistance-rated assemblies</td>
<td>1/2</td>
</tr>
<tr>
<td>2-hour or greater fire-resistance-rated assemblies</td>
<td>3</td>
</tr>
</tbody>
</table>

607.3.2.3 Combination fire/smoke damper ratings

- Combination fire/smoke dampers shall have the minimum rating specified for fire dampers in Table 607.3.2.1 and shall have the minimum rating specified for smoke dampers in Section 607.3.2.2.

607.5.5 Shaft enclosures

- Shaft enclosures that are permitted to be penetrated by ducts and air transfer openings shall be protected with listed fire and smoke dampers installed in accordance with their listing.

607.6.2 Membrane penetrations

- Exceptions:
  1. A fire-resistance-rated assembly tested in accordance with ASTM E119 or UL 263 showing that ceiling radiation dampers are not required in order to maintain the fire resistance rating of the assembly.

  2. Where exhaust duct or outdoor air duct penetrations are protected in accordance with Section 714.5.1.2 of the International Building Code, are located within the cavity of a wall and do not pass through another dwelling unit or tenant space.
607.6.2 Membrane penetrations

• Exceptions:
  3. Where duct and air transfer openings are protected with a duct outlet penetration system tested as part of a fire-resistance-rated assembly in accordance with ASTM E119 or UL 263

607.6.1 Ceiling radiation dampers testing and installation

• Ceiling radiation dampers shall be tested in accordance with Section 607.3.1.
• Ceiling radiation dampers shall be installed in accordance with the details listed in the fire-resistance-rated assembly and the manufacturer's installation instructions and the listing.

601.2 Sizing Requirements

Manual D has a requirement for a clear path of return air from all rooms

602.1 Concealed Building Spaces

• Concealed building spaces or independent construction within buildings shall be permitted to be used as ducts or plenums.

• Exception:
  • In healthcare facilities, concealed spaces shall not be permitted to be used as ducts or plenums.
602.2 Combustibles Within Ducts & Plenums

- Materials exposed within ducts or plenums:
  - Flame-spread index of not more than 25
  - Smoke-developed rating index of not more than 50

602.2 Exceptions

1. Return-air and outside-air ducts, plenums or concealed spaces that serve a dwelling unit shall be permitted to be of combustible construction.

602.8 General Requirements

- Corridors:
  - Not to be used to convey air to or from rooms if the corridor is required to be fire-resistant construction per the Building Code.

SECTION 603.0

603.2 General

- Ducts Under Floor or Crawl Space
  - Air ducts installed under a floor in a crawl space shall be installed as follows:
    1. Shall not prevent access to any area of the crawl space.
    2. Where it is required to move under ducts for access to areas of the crawl space, a minimum vertical clearance of eighteen inches shall be provided.

603.3 Metal Ducts

- Metal ducts shall be securely fastened:
  - At each change of direction per SMACNA HVAC Duct Construction Standards – Metal and Flexible.
- Riser ducts held in place:
  - By metal straps or angles and channel secured to the structure.
603.3 Metal Ducts
• 4" separation from earth.
• Install in buildings with clearance for full thickness of fireproofing on structural members.

603.3 Horizontal Round Metal Duct
• 603.2.3 Each circular band shall be provided with a means of connecting to the suspending support.
• 603.3.3 Ducts located in seismic zones C-F shall be in accordance with the building code.

603.4 Factory-Made Flexible Air Ducts and Connectors
• Shall not be used for vertical risers in air-duct systems serving more than two stories
• Shall not penetrate a fire-resistance-rated assembly or construction.
• Shall be installed with not less than 4 inches of separation from earth
• The temperature of the air to be conveyed in a duct shall not exceed 250°F. Flexible air connectors shall not be permitted.

603.5 Flexible Air Ducts
• Flexible air ducts:
  • Shall comply with UL 181
  • Shall be installed in accordance with the manufacturer’s installation instructions, and SMACNA HVAC Duct Construction Standards - Metal and Flexible.
603.5 Flexible Air Ducts

• (1) Ducts shall be installed using the minimum required length to make the connection.
• (2) Horizontal duct runs shall be supported at not more than 4 feet intervals.
• (3) Vertical risers shall be supported at not more than 6 feet intervals

603.5 Flexible Air Ducts

• (4) Sag between support hangers shall not exceed 1/2 inch per foot of support spacing.
• (5) Supports shall be rigid and shall be not less than 1 1/2 inches wide at point of contact with the duct surface.
• (6) Duct bends shall be not less than one duct diameter bend radius.

603.5 Flexible Air Ducts

• (7) Screws shall not penetrate the inner liner of non-metallic flexible ducts unless permitted in accordance with the manufacturer’s installation instructions.
• (8) Fittings for attaching non-metallic ducts shall be beaded and have a collar length of not less than 2 inches for attaching the duct.

603.5 Flexible Air Ducts

• Exception:
  A bead shall not be required where metal worm-gear clamps are used or where attaching metallic ducts using screws in accordance with the manufacturer’s installation instructions.

603.5 Flexible Air Ducts

• (9) Duct inner liner shall be installed at not less than 1 inch on the collar and past the bead prior to the application of the tape and mechanical fastener. Where mastic is used instead of tape, the mastic shall be applied in accordance the mastic manufacturer’s instructions.

603.5 Flexible Air Ducts

• (10) Duct outer vapor barriers shall be secured using two wraps of approved tape. A mechanical fastener shall be permitted to be used in place of, or in combination with, the tape.
603.5 Flexible Air Ducts

- (11) Flexible air ducts shall not penetrate a fire-resistance rated assembly or construction.
- (12) The temperature of the air to be conveyed in a flexible air duct shall not exceed 250°F.
- (13) Flexible Air ducts shall be sealed in accordance with Section 603.10.

603.8 Support of Ducts

- Installers shall provide the manufacturer's field fabrication and installation instructions.
- Factory-made air ducts that are in accordance with UL 181 shall be supported in accordance with the manufacturer's installation instructions.
- Other ducts shall comply with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

603.10 Joints and Seams of Ducts

- Ducts and plenums shall be sealed with materials listed and labeled in accordance with UL 181A or UL 181B, and marked in accordance with Table 603.10.

603.10.1 Duct Leakage Tests

- Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual.
- 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.
603.10.1 Duct Leakage Tests

- 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.

603.11 Cross Contamination

- Exhaust ducts and venting systems under positive pressure shall not extend into or pass through ducts and plenums.

603.12 Underground Installation

- Ducts installed underground shall be approved for the installation and shall have a slope of not less \( \frac{1}{8} \) inch per foot (10.4 mm/m).

603.13 Air Dispersion Systems

- Where installed, 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.
- Air dispersion systems shall be listed and labeled in accordance with UL 2518.
805.7 Insulation shield

- Where factory-built chimneys pass through insulated assemblies, an insulation shield constructed of steel having a thickness of not less than 0.0187 inch (No. 26 gage) shall be installed to provide clearance between the chimney and the insulation material.

805.7 Insulation shield

- The clearance shall be not less than the clearance to combustibles specified by the chimney manufacturer’s installation instructions.

805.7 Insulation shield

- Where chimneys pass through attic space, the shield shall terminate not less than 2 inches above the insulation materials and shall be secured in place to prevent displacement.

805.7 Insulation shield

- Insulation shields provided as part of a listed chimney system shall be installed in accordance with the manufacturer’s instructions.
CHAPTER 9
SPECIFIC APPLIANCES, FIREPLACES AND SOLID FUEL-BURNING EQUIPMENT

901.4 Solid fuel-burning fireplaces and appliances in Group I-2, Condition 2.

- In Group I-2, Condition 2 occupancies, solid fuel-burning fireplaces and appliances are prohibited.

902.2 Combustion Air from Bedroom or Bathroom

- Appliances shall not be installed so their combustion, ventilation, and dilution air are obtained only from a bedroom or bathroom unless the bedroom or bathroom has the required volume in accordance with Section 701.4. [NFPA 54:10.1.2]

POOL AND SPA HEATERS

- 916.1 General
- Pool and spa heat pump water heaters shall comply with UL 1995 or CSA C22.2 No. 236.

Exception:
Portable residential spas and portable residential exercise spas shall comply with UL 1563 or CSA C22.2 No. 218.1.

HIGH-VOLUME LARGE-DIAMETER FANS

- 929.1 General
- Where provided, high-volume large-diameter fans shall be tested and labeled in accordance with AMCA 230, listed and labeled in accordance with UL 507, and installed in accordance with the manufacturer’s instructions.
902.3 Added or Converted Appliances

- When additional or replacement appliances or equipment is installed or an appliance is converted to gas from another fuel, the location in which the appliances or equipment is to be operated shall be checked to verify the following:
  (1) Air for combustion and ventilation is provided where required, in accordance with the provisions of Section 701.0. Where existing facilities are not adequate, they shall be upgraded to meet Section 701.0 specifications.

(2) The installation components and appliances meet the clearances to combustible material provisions of Section 303.10. It shall be determined that the installation and operation of the additional or replacement appliances do not render the remaining appliances unsafe for continued operation.

(3) The venting system is constructed and sized in accordance with the provisions of Section 802.0. Where the existing venting system is not adequate, it shall be upgraded to comply with Section 802.0. [NFPA 54:9.1.2]

902.7 Use of Air or Oxygen Under Pressure

- Where air or oxygen under pressure is used in connection with the gas supply, effective means such as a back pressure regulator and relief valve shall be provided to prevent air or oxygen from passing back into the gas piping.
- Where oxygen is used, installation shall be in accordance with NFPA 51. [NFPA 54:9.1.5]

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 shall be installed. [NFPA 54:9.1.18]

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.
902.15 Venting of Gas Appliance Pressure Regulators

(2) Vent limiting means shall be employed on listed appliance pressure regulators only.

(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 shut-off 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.

902.15 Venting of Gas Appliance Pressure Regulators

(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]

904.5 Low-Water Cutoff

• 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 where the flow rate is not capable of protecting the boiler against overheating.

Revised to correlate with NFPA 54-2012

CHAPTER 10 UMC

BOILERS AND PRESSURE VESSELS

1002.5 Dual Purpose Water Heater

• Water heaters utilized for combined space- and water-heating applications shall be listed or labeled in accordance with the standards referenced in Table 1203.2, and shall be installed in accordance with the manufacturer’s installation instructions.

1003.3 Gauges

• Steam boilers shall be provided with a pressure gauge and a water level glass.
CHAPTER 10 2018 IMC

BOILERS, WATER HEATERS AND PRESSURE VESSELS

1006.6 Safety and relief valve discharge

• The discharge piping serving pressure relief valves, temperature relief valves and combinations of such valves shall:
  1. Not be directly connected to the drainage system.
  2. Discharge through an air break located in the same room as the appliance.
  3. Not be smaller than the diameter of the outlet of the valve served and shall discharge full size to the air break.
  4. Serve a single relief device and shall not connect to piping serving any other relief device or equipment.
  5. Discharge to the floor, to the pan serving the boiler or storage tank, to a waste receptor or to the outdoors.
  6. Discharge in a manner that does not cause personal injury or structural damage.
  7. Discharge to a termination point that is readily observable by the building occupants.
  8. Not be trapped.
  9. Be installed so as to flow by gravity.
  10. Not terminate more than 6 inches above the floor or waste receptor.

WATER HEATERS

• Solid-fuel fired water heaters shall comply with UL 2523.
• Solar thermal water heating systems shall comply with Chapter 14 and ICC 900/SRCC 300.

1006.6 Safety and relief valve discharge

11. Not have a threaded connection at the end of such piping.
12. Not have valves or tee fittings.
13. Be constructed of those materials listed in Section 605.4 of the International Plumbing Code or materials tested, rated and approved for such use in accordance with ASME A112.4.1.
HOT WATER BOILER EXPANSION TANK

• 1009.1 Where required
  Exception:
  Expansion tanks shall not be required in the collector loop of drain-back systems.

CHAPTER 11 IMC

REFRIGERATION

1101.6 General

• Refrigeration systems shall comply with the requirements of this code and, except as modified by this code, ASHRAE 15.
• Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, ASHRAE 15, IAR 2, IAR 3, IAR 4 and IAR 5.

1104.2.2 Industrial occupancies and refrigerated rooms

• This section applies only to rooms and spaces that:
  A. Are within industrial occupancies;
  B. Contain a refrigerant evaporator;
  C. Are maintained at temperatures below 68°F;
  D. Are used for manufacturing, food and beverage preparation, meat cutting, other processes and storage.

Where a machinery room would otherwise be required by Section 1104.2, a machinery room shall not be required where all of the following conditions are met:
1104.2.2 Industrial occupancies and refrigerated rooms

1. The space containing the machinery is separated from other occupancies by tight construction with tight-fitting doors.
2. Access is restricted to authorized personnel.

3. Refrigerant detectors are installed as required for machinery rooms in accordance with Section 1105.3.
   • Exceptions:
     1. Refrigerant detectors are not required in unoccupied areas that contain only continuous piping that does not include valves, valve assemblies, equipment, or equipment connections.

What about the roof?

2. Where approved alternatives are provided, refrigerant detectors for ammonia refrigeration are not required for rooms or areas that are always occupied, and for rooms or areas that have high humidity or other harsh environmental conditions that are incompatible with detection devices.

4. Surfaces having temperatures exceeding 800°F and open flames are not present where any Group A2, B2, A3 or B3 refrigerant is used (see Section 1104.3.4).

5. All electrical equipment and appliances conform to Class 1, Division 2, hazardous location classification requirements of NFPA 70 where the quantity of any Group A2, B2, A3 or B3 refrigerant, other than ammonia, in a single independent circuit would exceed 25 percent of the lower flammability limit (LFL) upon release to the space.

6. All refrigerant-containing parts in systems with a total connected compressor power exceeding 100 horsepower except evaporators used for refrigeration or dehumidification, condensers used for heating, control and pressure relief valves for either, low-probability pumps and connecting piping—are located either outdoors or in a machinery room.
MACHINERY ROOM, GENERAL REQUIREMENTS

1105.6.1.1 Indoor exhaust opening location

• Indoor mechanical exhaust intake openings shall be located where refrigerant leakage is likely to concentrate based on the refrigerant’s relative density to air, and the locations of the air current paths and refrigerating machinery.

MACHINERY ROOM, SPECIAL REQUIREMENTS

SECTION 1106
MACHINERY ROOM, SPECIAL REQUIREMENTS

1106.4 Flammable refrigerants

• Where refrigerants of Groups A2, A3, B2 and B3 are used, the machinery room shall conform to the Class 1, Division 2, hazardous location classification requirements of NFPA 70.
• Exceptions:
  2. Machinery rooms for systems containing Group A2L refrigerants that are in accordance with Section 1106.5.

1106.5 Special requirements for Group A2L refrigerant machinery rooms

• Machinery rooms for systems containing Group A2L refrigerants shall comply with Sections 1106.5.1 through 1106.5.3.
• Exception:
  Machinery rooms conforming to the Class I, Division 2, hazardous location classification requirements of NFPA 70 are not required to comply with Sections 1106.5.1 and 1106.5.2.

1106.5.1 Refrigerant detection system

• The machinery room shall be provided with a refrigerant detection system.
• The refrigerant detection system shall be in accordance with Section 605.8 of the International Fire Code and all of the following:
  1. The detectors shall activate at or below a refrigerant concentration of 25% of the LFL.
1106.5.2 Emergency ventilation system

• An emergency ventilation system shall be provided at the minimum exhaust rate specified in ASHRAE 15 or Table 1106.5.2.
• Shutdown of the emergency ventilation system shall be by manual means.

1107.2 Piping location

• Refrigerant piping shall not be placed in any of the following:
  1. A fire-resistance-rated exit access corridor.
  2. An interior exit stairway.
  3. An interior exit ramp.
  4. An exit passageway.
  5. An elevator, dumbwaiter or other shaft containing a moving object.
  6. A shaft that has one or more openings into a fire-resistance-rated exit access corridor, interior exit stairway or ramp or exit passageway.

1107.5.2 Copper and copper-alloy pipe

• Standard iron pipe size, copper and copper-alloy (not less than 80-percent copper) pipe shall conform to ASTM B42 and ASTM B43.

1107.5.3 Copper tube

• Copper tube used for refrigerant piping erected on the premises shall be seamless copper tube of Type ACR (hard or annealed) complying with ASTM B280 or ASTM B819.
• Annealed temper copper tube shall not be used in sizes larger than a 2-inch nominal size.
• Mechanical joints other than press-connect joints listed for refrigerant piping shall not be used on annealed temper copper tube in sizes larger than 7/8-inch OD size.
1101.6 General

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

1102.2 Ammonia Refrigeration Systems

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

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.

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 without approval by the Authority Having Jurisdiction.
- Institutional Occupancies shall comply with Section 1104.3.

SECTION 1106.2

MACHINERY ROOM, SPECIAL REQUIREMENTS

- 1106.2.1 Access
  - It is ok to have other mechanical equipment in the Machinery room unless specifically prohibited elsewhere in this chapter.
1106.2.1 Access

• A machinery room shall be so dimensioned that parts are accessible with space for service, maintenance, and operations.

1106.2.1 Access

• There shall be clear head room of not less than 7.25 feet below equipment situated over passageways.

[ASHRAE 15:8.11.1]

1106.2.2 Openings

• Each refrigeration machinery room shall have:
  1. A tight-fitting door or doors opening outward
  2. Must be self-closing where they open into the building
  3. Adequate in number to ensure easy escape in an emergency.
  4. Other than access doors and panels in air ducts and air-handling units there shall be no openings that will permit passage of escaping refrigerant to other parts of the building.

[ASHRAE 15: 8.11.2]

1106.2.2.1 Detectors and Alarms

• Each refrigeration machinery room shall:
  1. Contain one or more refrigerant detectors
  2. Located where refrigerant from a leak will concentrate
  3. Actuate an alarm and mechanical ventilation at a set point not more than the corresponding Occupational Exposure Limit,

1106.2.2.1 Detectors and Alarms

• The alarm shall annunciate visual and audible alarms inside the refrigeration machinery room
• Outside each entrance to the refrigeration machinery room.
• The alarms required shall be of the manual reset type
• Reset shall be located inside the refrigeration machinery room.

CHAPTER 12 UMC
Hydronic Heating Systems
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, chilled water, steam condensate, condenser water, and ground source heat pump systems.

1201.2 Insulation

- Surfaces within reach of building occupants shall not exceed 140°F (60°C).
- Where sleeves are installed, the insulation shall continue full size through them.

1201.3 Water Hammer

- The flow of the hydronic piping system shall be controlled to prevent water hammer.

1201.4 Terminal Units

- Terminal units, valves, and flow control devices shall be installed in accordance with the manufacturer’s installation instructions.
- Isolation valves

1201.5 Return-Water Low-Temperature Protection

- Where a minimum return-water temperature to the heat source is specified by the manufacturer, the heating system shall be designed and installed to meet or exceed the minimum return-water temperature during the normal operation of the heat source.

1202.3 Compatibility

- Fluids used in hydronic systems shall be compatible with all components that will contact the fluid.
1203.3 Tankless Water Heater

- Tankless water heaters 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.

1205.2 Pressure Testing

- Exception:
  - 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-ALPE pipe and fittings products, and air testing is not prohibited by applicable codes, laws, or regulations outside this code.

1205.3 Flushing

- Heating and cooling sources, system piping and tubing shall be flushed after installation with water or a cleaning solution.
- Cleaning and flushing of the heating and cooling sources shall comply with the manufacturer’s instructions.
- The cleaning solution shall be compatible with all system components and shall be used in accordance with the manufacturer’s instructions.

1206.0 Safety Devices

1206.1 General.

- Each closed hydronic system shall be protected against pressures exceeding design limitations with not less than one pressure relief valve.

1207.3 Dual-Purpose Water Heaters

- Water used as the heat transfer fluid in the hydronic heating system shall be isolated from the potable water supply and distribution in accordance with Section 312.1, Section 1202.0, and Section 1218.0.
1208.0 Circulators

- **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.

1209.0 Expansion Tanks

- An expansion tank shall be installed in each closed hydronic system to control system pressure due to thermal expansion.
- Expansion tanks shall be of the closed or open type.
- Tanks shall be rated for the pressure of the system.

1209.2 Installation

- Expansion tanks shall be accessible for maintenance and shall be installed in accordance with the manufacturer’s installation instructions.
- Each tank shall be equipped with a shutoff device that will remain open during operation of the heating system.
- Valve handles shall be locked open or removed to prevent from being inadvertently shut off.
- Provisions shall be made for draining the tank without emptying the system.
- Expansion tanks shall be securely fastened to the structure.
- Supports shall be capable of carrying twice the weight of the tank filled with water without placing a strain on connecting piping.

1209.3 Open-Type Expansion Tanks

- Open type expansion tanks shall be located not less than 3 feet 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 in diameter shall be installed at the top of the tank.
- The overflow shall discharge through an air gap into the drainage system.
1209.4 Closed-Type Tanks

- Closed-type expansion tanks shall be designed for a hydrostatic test pressure of two and one-half times the allowable working pressure of the system.
- Expansion tanks for systems designed to operate at more than 30 pounds-force per square inch (psi) shall comply with ASME BPVC Section VIII.

1209.5 Sizing

- Expansion tanks shall be sized to accept the full expansion volume of the fluid in the system.
- The minimum capacity of a closed-type expansion tank shall be sized in accordance with Section 1004.4.

1210.1 Piping, Tubing, and Fittings

- Pipe fittings and valves shall be approved for the specific installation with the piping, materials to be installed and shall comply with the applicable standards referenced in Table 1210.1.
- Where required, exterior piping shall be protected against freezing, UV radiation, corrosion and degradation.

1210.3 Hangers and Supports

- Equipment that is part of the piping system shall be provided with additional support in accordance with this code and manufacturer’s installation instructions.

1210.4 Oxygen Diffusion Corrosion

- PEX and PE-RT tubing in closed hydronic systems shall contain an oxygen barrier.
- Exception: Closed hydronic systems without ferrous components in contact with the hydronic fluid.

1211.0 Joints and Connections

- 1211.1 General.
  - Pipe bends shall have a radius of not less than six times the outside diameter of the tubing or shall be in accordance with the manufacturer’s installation instructions.
  - Joints between pipe and fittings shall be installed in accordance with the manufacturer’s installation instructions.
1211.3 CPVC/AL/CPVC Plastic Pipe and Joints

- Joints between chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC) pipe or fittings shall be installed in accordance with one of the following methods:
  1. Mechanical joints shall include flanged and grooved.

1211.3 CPVC/AL/CPVC Plastic Pipe and Joints

- Listed solvent cement in accordance with ASTM F493 that does not require the use of primers, yellow in color, shall be permitted for pipe and fittings manufactured in accordance with ASTM D2846, 1/2 of an inch through 2 inches in diameter, 1/2 of an inch through 3 inches in diameter.

1213.3 Occupied Spaces

- An air-temperature-sensing device shall be installed in the occupied space to regulate the operation of the heat-distribution system.

1214.4 Automatic Makeup Fluid

- Where an automatic makeup fluid supply fill device is used to maintain the water content of the heat-source unit, or any closed loop in the system, the makeup supply shall be located at the expansion tank connection or other approved location.

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1214.4 Automatic Makeup Fluid

• A pressure-reducing valve shall be installed on a makeup water feed line.
• The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 1202.0 to prevent contamination due to backflow.

1214.6 Air-Removal Device

• Provision shall be made for the removal of air in the heat-distribution piping system.
• The air-removal device shall be located in the area of the hydronic piping system where air is likely to accumulate. Air-removal devices shall be installed to facilitate their removal for examination, repair, or replacement.

1214.8 Secondary Loops

• Secondary loops that are isolated from the primary heat-distribution loop by a heat exchanger are closed-loop hydronic systems and shall have an expansion tank in accordance with Section 1209.0, an air removal device in accordance with Section 1214.6, and an air-separation device in accordance with Section 1214.7.

1215.3 Freeze Protection

• Hydronic systems and components shall be designed, installed, and protected from freezing.

1215.5 Heat Transfer Fluid

• The ignitable flash point of heat transfer fluid in a hydronic piping system shall be a minimum of 50°F above the maximum system operating temperature.
• The heat transfer fluid shall be compatible with the makeup fluid supplied to the system.

1216.2 Sloping for Two-Pipe System

• Two-pipe steam system piping and heat-distribution units shall be sloped down at not less than 1/8 inch per foot in the direction of the steam flow.
1216.3 Sloping for One-Pipe System

- One-pipe steam system piping and heat-distribution units shall be sloped down at not less than 1/8 inch per foot towards the steam boiler, without trapping.

1216.4 Automatic Air Vents

- Steam automatic air vents shall be installed to eliminate air pressure in heat-distribution units on gravity steam piping systems.
- Air vents shall not be used on a vacuum system.

1216.5 Condensate Flow

- System piping shall be installed to allow condensate to flow to the condensate receiver or steam boiler either by gravity or pump-assisted

1217.0 Radiant Heating and Cooling

1217.1 Installation

- Radiant heating and cooling systems shall be installed in accordance with the system design.

1217.1.1 Manifolds

- Manifolds shall be equipped with isolation valves on the supply and return lines

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1217.2 Radiant Under-Floor Heating

- Floor finished surface temperatures shall not exceed the following temperatures for space heating applications:
  1. 85°F in general occupied applications.
  2. 90°F in bathrooms, foyers, distribution areas such as hallways and indoor swimming pools.
  3. 88°F in industrial spaces.
  4. 95°F in radiant panel perimeter areas, i.e., up to 2.5 feet from outside walls.

1217.2 Radiant Under-Floor Heating

- The radiant heating system temperature shall not exceed the maximum temperature rating of the materials used in its construction.

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 above the anticipated space dew point 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.

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.

1217.4 Tube Placement

- Except for distribution mains, tube spacing and 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.
1217.5 Poured Floor Structural Concrete Slab Systems (Thermal Mass).

• Where tubing is embedded in a structural concrete slab such tubes shall not be larger in outside dimension than one-third of the overall thickness of the slab and shall be spaced not less than three diameters on center except within 10 feet of the distribution manifold.

• The top of the tubing shall be embedded in the slab not less than 2 inches below the surface.

1217.5.1 Slab Penetration Tube and Joint Protection

• Where embedded in or installed under a concrete slab, tubing shall be protected from damage at penetrations of the slab with protective sleeving approved by the tubing manufacturer.

1217.5.1 Slab Penetration Tube and Joint Protection

• The space between the tubing and sleeve shall be sealed with an approved sealant compatible with the tubing.

• The tubing at the location of an expansion joint in a concrete slab shall be encased in protective pipe sleeving that covers the tubing not less than 12 inches on either side of the expansion joint or the tubing shall be installed below the slab.

1217.5.2 Insulation

• Where a poured concrete radiant floor system is installed in contact with the soil, insulation approved for such an application with a minimum R-value of 5 shall be placed between the soil and the concrete; extend to the outside edges of the concrete; and be placed on all slab edges.

1217.5.3 Joist Systems and Subfloors

• Where tubing is installed in the joist cavity, the cavity shall be insulated with not less than R-12 material below the heated space

1217.5.3 Joist Systems and Subfloors

• An air space of not less than 1 inch and not more than 3 inches shall be maintained between the top of the insulation and the underside of the floor unless a conductive plate is installed in accordance with manufacturer’s instructions

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1217.5.3 Joist Systems and Subfloors

• Where tubing is installed in panels above or in the subfloor and not embedded in concrete, the floor assembly shall be insulated with not less than R-5 material below the tubing when installed over habitable space.

1217.5.4 Wall and Ceiling Panels

• An air space of not less than 1 inch and not more than 3 inches shall be maintained between the insulation and the interior surface of the panel unless a conductive plate is installed.

1217.6.2 Radiant Wall and Ceiling Panels

• Radiant panels attached to wood, steel, masonry, or concrete framing members shall be fastened by means of anchors, bolts, or approved screws of sufficient size and anchorage to support the loads applied.

1220.2 Snow and Ice Melt Controls

• An automatic thermostatically operating control device that controls the supply hydronic solution temperature to the snow and ice melt area shall be installed in the system.
• Snow and ice melt systems shall be protected from freezing with a mixture of propylene glycol or ethylene glycol, and water or other approved fluid.
• Automotive antifreeze shall not be used.

Duplication of requirements

• 1220.2.1 Tube Placement
• 1220.2.2 Poured Concrete Slab Systems (Thermal Mass).
• 1220.2.3 Slab Penetration Tube and Joint Protection.
• 1220.2.6 Testing and Flushing

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1220.3 Hydronic Makeup Air Units

- Hydronic makeup air units that are affected by freezing shall be protected against freezing by a hydronic solution.

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 100 psi at 180°F.

1221.3 Pressure Testing

- Piping to be embedded in concrete shall be pressure-tested in accordance with Section 1205.2 prior to pouring concrete.

- During the pour, the pipe system shall maintain the test pressure of not less than one and one-half times the hydronic system operating pressure and not less than 100 psi.

- During freezing or the possibility of freezing conditions, testing shall be done with air where permitted by the manufacturer.
TABLE 1202.4
HYDRONIC PIPE

| Raised temperature polyethylene (PE-RT) | ASTM F2623, ASTM F2769; CSA B137.18 |

1203.3 Soldered joints

- Solder joints shall be made in accordance with ASTM B828.
- Cut tube ends shall be reamed to the full inside diameter of the tube end.
- A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32.

1203.6 Copper or copper-alloy tubing

- Joints between copper or copper-alloy tubing or fittings shall be:
  - Push-fit joints conforming to Section 1203.6.2 or press-connect joints conforming to Section 1203.6.3.

1203.6.3 Press-connect joints

- Press-connect joints shall be installed in accordance with the manufacturer’s instructions.

1203.9 Cross-linked polyethylene (PEX) plastic tubing

- Joints between cross-linked polyethylene plastic tubing and fittings shall conform to Sections 1203.9.1 through 1203.9.3.
- Mechanical joints shall conform to Section 1203.3.
1203.9.3 Push-fit joints

• Push-fit joints that create a seal on the outside diameter of the tubing shall not be used with tubing that has an ethylene vinyl alcohol copolymer (EVOH) oxygen barrier layer.

1203.14 Raised temperature polyethylene (PE-RT) plastic tubing.

• Joints between raised temperature polyethylene tubing and fittings shall conform to Sections 1203.14.1 through 1203.14.3.
• Mechanical joints shall conform to Section 1203.3.

1203.14.3 Push-fit joints

• Push-fit joints that create a seal on the outside diameter of the tubing shall not be used with tubing that has an ethylene vinyl alcohol copolymer (EVOH) oxygen barrier layer.

1209.3 Embedded joints

• Joints of pipe or tubing that are embedded in a portion of the building, such as concrete or plaster, shall be in accordance with the requirements of Sections 1209.3.1 through 1209.3.5.

1209.3.5 Cross-linked polyethylene (PEX) joints

• PEX tubing shall be installed in continuous lengths or shall be joined by hydronic fittings listed in Table 1202.5.
1209.5 Thermal barrier required

- Radiant floor heating systems shall be provided with a thermal barrier in accordance with Sections 1209.5.1 and 1209.5.2.
- Insulation R-values for slab-on-grade and suspended floor installation shall be in accordance with the International Energy Conservation Code.

<table>
<thead>
<tr>
<th>TABLE 1209.5 GROUND-SOURCE LOOP PIPE</th>
<th>MATERIAL</th>
<th>STANDARD Line Chapter 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorinated polyvinyl chloride (CPVC)</td>
<td>ANSI C1241, ASTM F1807, ASTM F1806, ASTM F1808, CSA B175.6</td>
<td></td>
</tr>
<tr>
<td>Polybutylene dimethyl polyethylene (PE-AL-PE)</td>
<td>ANSI F1022, ASTM F1848, CSA B175.7</td>
<td></td>
</tr>
<tr>
<td>High-Density Polyethylene (HDPE)</td>
<td>ANSI F1200, ASTM D2380, ASTM F1859, CSA B175.6, CSA C148, NSF P180-5</td>
<td></td>
</tr>
<tr>
<td>Polypropylene (PP-R)</td>
<td>ANSI F2093, CSA B175.8, NSF 14.1</td>
<td></td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC)</td>
<td>ANSI C1490, ASTM D2846, ASTM D2847, CSA B175.2, CSA B175.3</td>
<td></td>
</tr>
<tr>
<td>Rigid temperature polyethylene pipe (PE-RT)</td>
<td>ANSI F1848, ASTM F1807, ASTM D2846, ASTM F1808, ASTM F2159, ASTM F2160, ASTM F1808, ASTM F1809, CSA B175.1, CSA B175.2</td>
<td></td>
</tr>
</tbody>
</table>

1303.1.1 Joints between different piping materials

- Joints between different piping materials shall be made with approved adapter fittings.
- Joints between different metallic piping materials shall be made with approved dielectric fittings or copper-alloy converter fittings.

CHAPTER 13 IMC
FUEL OIL PIPING AND STORAGE

CHAPTER 14
SOLAR THERMAL SYSTEMS
SECTION 1401

GENERAL

1401.1 Scope

This chapter shall govern the design, construction, installation, alteration and repair of solar thermal systems, equipment and appliances intended to utilize solar energy for space heating or cooling, domestic hot water heating, swimming pool heating or process heating.

1401.4 Solar thermal equipment and appliances

- Solar thermal equipment and appliances shall conform to the requirements of this chapter and ICC 900/SRCC 300.
- Solar thermal systems shall be listed and labeled in accordance with ICC 900/SRCC 300 and shall be installed in accordance with the manufacturer’s instructions and ICC 900/SRCC 300.

SECTION 1402

DESIGN AND INSTALLATION

1402.1 General

- The design and installation of solar thermal systems shall comply with Sections 1402.1 through 1402.8.
- Solar thermal systems shall be listed and labeled in accordance with ICC 900/SRCC 300 and shall be installed in accordance with the manufacturer’s instructions and ICC 900/SRCC 300.
1402.2 Access

- Access shall be provided to solar thermal equipment for maintenance.
- Solar thermal systems and appurtenances shall not obstruct or interfere with the operation of any doors, windows or other building components requiring operation or access.

1402.3 Pressure and temperature

- Solar thermal system components containing pressurized fluids shall be protected against pressures and temperatures exceeding design limitations with pressure and temperature relief valves or pressure relief valves.

1402.3.1 Relief device

- Each section of the system in which excessive pressures are capable of developing shall have a relief device located so that a section cannot be valved off or otherwise isolated from a relief device.

1402.2 Access

- Roof-mounted solar thermal equipment shall not obstruct or interfere with the operation of roof-mounted equipment, appliances, chimneys, roof hatches, smoke vents, skylights and other roof penetrations and openings.

1402.3 Pressure and temperature

- System components shall have a working pressure rating of not less than the setting of the pressure relief device.

1402.3.1 Relief device

- Relief valves shall comply with the requirements of Section 1006.6.
- For indirect solar systems, pressure relief valves in solar loops shall also comply with ICC 900/SRCC 300.
1402.3.2 Vacuum

• System components that might be subjected to a vacuum while in operation or during shutdown shall be designed to withstand such vacuum or shall be protected with vacuum relief valves.

1402.4 Protection from freezing

• System components shall be protected from damage by freezing of heat transfer liquids at the lowest ambient temperatures that will be encountered during the operation of the system.

1402.4 Protection from freezing

• Freeze protection shall be provided in accordance with ICC 900/SRCC 300.
• Drain-back systems shall be installed in compliance with Section 1402.4.1 and systems utilizing freeze-protection valves shall comply with Section 1402.4.2.

1402.4.1 Drain-back systems

• Drain-back systems shall be designed and installed to allow for manual gravity draining of fluids from areas subject to freezing to locations not subject to freezing, and air filling of the components and piping.

1402.4.2 Freeze-protection valves

• Freeze-protection valves shall discharge in a manner that does not create a hazard or structural damage.
1402.5 Protection of potable water

- Where a solar thermal system heats potable water to supply a potable hot water distribution or any other type of heating system, the solar thermal system shall be in accordance with Sections 1402.5.1 through 1402.5.3 as applicable.

1402.5.1 Indirect systems

- Water supplies of any type shall not be connected to the solar heating loop of an indirect solar thermal hot water heating system.

1402.5.2 Direct systems for potable water distribution systems

- Where a solar thermal system directly heats potable water for a potable water distribution system, the pipe, fittings, valves and other components that are in contact with the potable water in the system shall comply with the requirements of the International Plumbing Code.

1402.5.3 Direct systems for other than potable water distribution systems

- Where a solar thermal system directly heats water for a system other than a potable water distribution system, a potable water supply connected to such system shall be protected against backflow in accordance with the International Plumbing Code.

1402.6 Protection of equipment

- Solar thermal equipment exposed to vehicular traffic shall be installed not less than 6 feet above the finished floor.
1402.7 Protection of structure

- In the process of installing or repairing any part of a solar thermal system, the building or structure shall be left in a safe structural condition in accordance with Sections 302, 1402.7.1 and 1402.7.2.

1402.7.1 Controlling condensation

- Where attics or structural spaces are part of a passive solar system, ventilation of such spaces, as required by Section 406, is not required where other approved means of controlling condensation are provided.

1402.7.2 Penetrations

- Roof and wall penetrations shall be flashed and sealed to prevent entry of water, rodents and insects in accordance with Section 302.

1402.8 Equipment

- The solar thermal system shall be equipped in accordance with the requirements of Sections 1402.8.1 through 1402.8.5.3.

1402.8.1 Collectors and panels

- Solar collectors and panels shall comply with Sections 1402.8.1.1 through 1402.8.1.4.
- 1402.8.1.1 Design.
- Solar thermal collectors and panels shall be listed and labeled in accordance with ICC 901/SRCC 100.

1402.8.1.2 Rooftop-mounted solar thermal collectors and systems

- The roof shall be constructed to support the loads imposed by rooftop-mounted solar collectors.
1402.8.1.2 Rooftop-mounted solar thermal collectors and systems

• Where mounted on or above the roof covering, the collector array and supporting construction shall be constructed of noncombustible materials or fire-retardant-treated wood conforming to the International Building Code to the extent required for the type of roof construction.

1402.8.1.3 Collectors as roof covering

• Roof-mounted solar collectors that also serve as a roof covering shall conform to the requirements for roof coverings in accordance with the International Building Code.

  Exception:
  The use of plastic solar collector covers shall be limited to those approved light-transmitting plastics meeting the requirements for plastic roof panels in Section 2609 of the International Building Code.

1402.8.1.4 Collector sensors

• Collector sensor installation, sensor location and the protection of exposed sensor wires from degradation shall be in accordance with ICC 900/SRCC 300, NFPA 70 and the collector manufacturer’s instructions.

1402.8.2 Ducts

• Ducts utilized in solar heating and cooling systems shall be constructed and installed in accordance with Chapter 6.

1402.8.2.1 Filtering

• Air transported to occupied spaces through dust-producing materials by means other than natural convection shall be filtered before entering the occupied space in accordance with Section 605.

1402.8.3 Piping

• Potable piping shall be installed in accordance with the International Plumbing Code.
• Hydronic piping shall be installed in accordance with Chapter 10 of this code.
• Mechanical system piping shall be supported in accordance with Section 305.
1402.8.3.1 Piping insulation

- Piping shall be insulated in accordance with the requirements of the International Energy Conservation Code.
- Exterior insulation shall be protected from degradation.
- The entire solar loop shall be insulated.
- Where split-style insulation is used, the seam shall be sealed.
- Fittings shall be fully insulated.
- Insulation shall comply with Section 1204.1

Exceptions:
1. Those portions of the piping that are used to help prevent the system from overheating shall not be required to be insulated.
2. Those portions of piping that are exposed to solar radiation, made of the same material as the solar collector absorber plate and covered in the same manner as the solar collector absorber, or that are used to collect additional solar energy, shall not be required to be insulated.

3. Piping in solar thermal systems using unglazed solar collectors to heat a swimming pool shall not be required to be insulated.

1402.8.4 Heat exchangers

- Heat exchangers used in domestic water-heating systems shall be approved for the intended use.
- The system shall have adequate protection to ensure that the potability of the water supply and distribution system is properly safeguarded.

- Heat exchangers utilizing a non-food-grade fluid shall be separated from the potable water by double-wall construction.
- An air gap open to the atmosphere shall be provided between the two walls.
- The discharge location from the double-wall heat exchanger shall be visible.

Indirect solar system using 2 separate coils and a tank
1402.8.2 Single-wall heat exchangers

- Food-grade fluids shall be used as the heat transfer fluid in single wall heat exchangers.

1402.8.5 Water heaters and hot water storage tanks

- Auxiliary water heaters, boilers and water storage tanks associated with solar thermal systems shall comply with Chapter 10 and ICC 900/SRCC 300.

1402.8.5.1 Hot water storage tank insulation

- Hot water storage tanks shall be insulated and such insulation shall have an R-value of not less than R-12.5.

1402.8.5.2 Outdoor locations

- Storage tanks and heating equipment installed in outdoor locations shall be designed for outdoor installation.

1402.8.5.3 Storage tank sensors

- Storage tank sensors shall comply with ICC 900/SRCC 300.

1402.8.6 Solar loop

- Solar loops shall be in accordance with Sections 1402.8.6.1 and 1402.8.6.2
  - 1402.8.6.1 Solar loop isolation.
  - Valves shall be installed to allow the solar loop to be isolated from the remainder of the system.
  - 1402.8.6.2 Drain and fill valve caps.
  - Drain caps shall be installed on drain and fill valves.
1402.8.7 Expansion tanks

- Liquid single-phase solar energy systems shall be equipped with expansion tanks sized in accordance with Section 1009, except that additional expansion tank acceptance volume equal to the total volume of liquid contained in the installed solar collectors and piping above the collectors shall be included.

SECTION 1403
HEAT TRANSFER FLUIDS

1403.2 Heat transfer fluids

- Heat transfer gases and liquids shall be rated to withstand the system’s maximum design temperature under operating conditions without degradation.
- Heat transfer fluids shall be in accordance with ICC 900/SRCC 300.

1403.3 Food-grade additives

- Any food-grade fluid used as a heat transfer fluid containing additives shall be third-party listed by an approved agency to the appropriate section of the Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Parts 174–186.

1403.4 Toxicity

- The use of toxic fluids shall comply with Title 15 of the Federal Hazardous Substances Act and Chapter 60 of the International Fire Code.

1403.5 Flammable gases and liquids

- A flammable liquid or gas shall not be utilized as a heat transfer fluid.
- The flash point of liquids used in occupancies classified in Group H or F shall not be lower unless approved.
SECTION 1404
LABELING

1404.1 Collectors
• Factory-built collectors shall bear a label showing the manufacturer’s name and address, model number and serial number.

1404.2 Water storage tanks
• Pressurized water storage tank shall bear a label showing the manufacturer’s name and address, model number, serial number, storage unit maximum and minimum allowable operating temperatures, and storage unit maximum and minimum allowable operating pressures.
• The label shall clarify that these specifications apply only to the water storage tanks.

1404.3 Fluid safety labeling
• Drain and fill valves shall be labeled with a description and warning that identifies the fluid in that loop as “Potable Water,” “Food-Grade Fluid,” “Non-Food-Grade Fluid” or “Toxic.”
• Labeling shall also be provided that reads as follows: “Fluid could be discharged at high temperature or pressure or both.”
• Unauthorized alterations to this system could result in a health hazard or a hazardous condition.

1404.4 Heat exchangers
• Heat exchangers shall be labeled to indicate the heat exchanger type with one of the following:
  1. “Single-wall without leak protection.”
  2. “Double-wall without leak protection.”
  3. “Double-wall with leak protection.”