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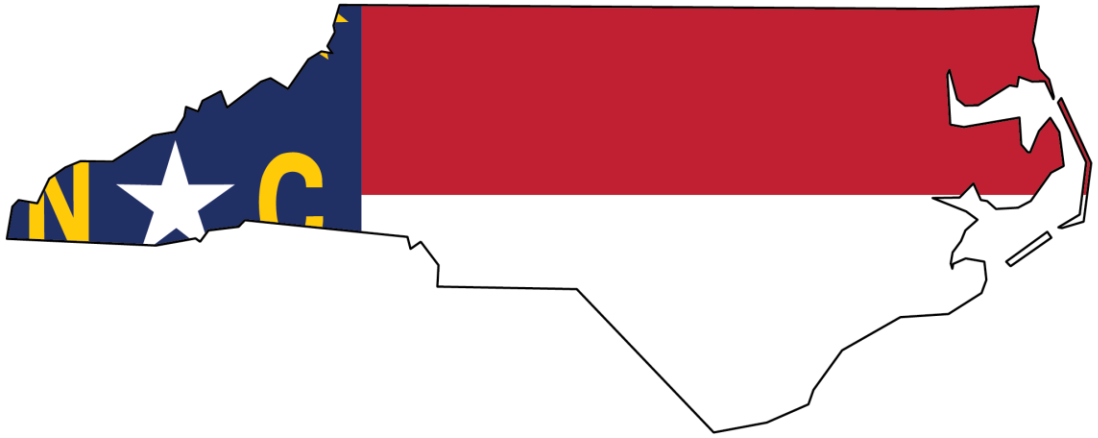
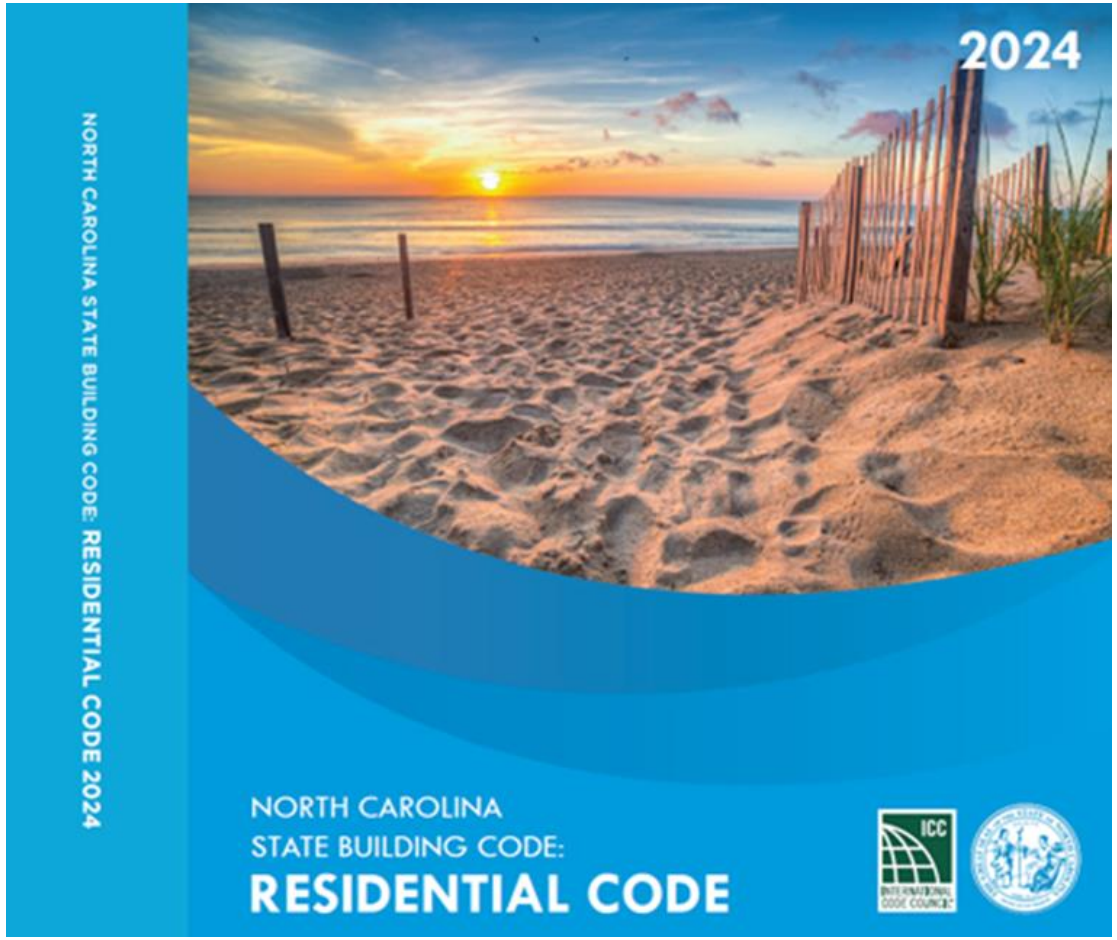


Continuing Education

Course #: CS-5040

2024 Mechanical and Fuel Gas Code Updates and the IMPACT of A2L Refrigerants

2024 NCRC: Chapters 11-24 remain as they were in the 2018 NCRC



- Amendments to the 2018 NCRC Chapters 11-24 will be included in the 2024 NCRC.
- Minor editorial changes were made to Chapters 12-24 in order to coordinate section numbers with the rest of the book.
- Standards referenced in Chapters 11-24 remain the same edition as the 2018 NCRC: in some cases, this leads to multiple editions of a referenced standard in the reference chapter.

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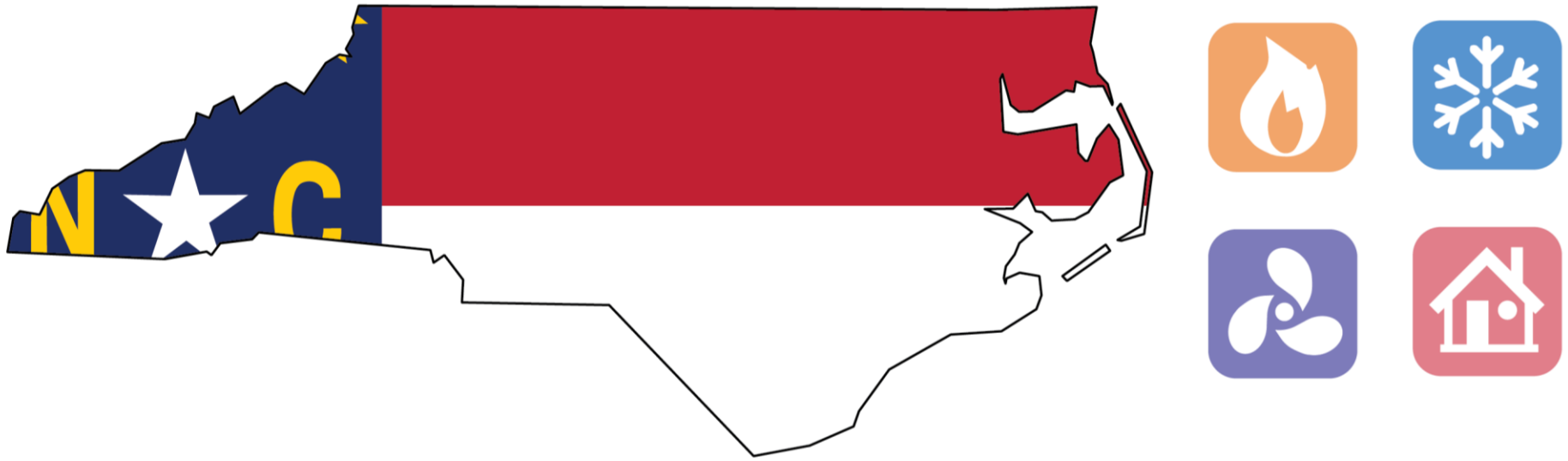

Significant Changes in the 2024 Fuel Gas Code

Course# CS-5040:
Sponsored by NCMIA

2024
North Carolina Fuel Gas Code

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2018 Marginal Markings

Reminder: 2018 NCFGC utilized the 2015 IFGC as the base code

→ IFGC marking, Deletion from the 2012 IFGC

| IFGC marking, Technical Change from the 2012 IFGC

*, ** IFGC marking, Relocated Text

<u>Underlined language indicated NC-specific change</u>

2024 Marginal Markings

Reminder: 2024 NCFGC utilized the 2021 IFGC as the base code, incorporating changes from the 2018 IFGC as well

IFGC marking, Deletion from the 2018 IFGC ←

IFGC marking, Technical Change from the 2018 IFGC |

NCFGC marking, NC-specific Deletion from the 2021 IFGC <

NCFGC marking, NC-specific Technical Change from the 2021 IFGC ||

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2018 NCFGC

101.6 Requirements of other State agencies, occupational licensing boards or commissions.

The *North Carolina State Building Codes* do not include all additional requirements for buildings and structures that may be imposed by other State agencies, occupational licensing boards and commissions. It shall be the responsibility of a permit holder, registered design professional, contractor or occupational license holder to determine whether any additional requirements exist.

2024 NCFGC

101.6 Requirements of other State agencies, occupational licensing boards or commissions. The *North Carolina State Building Code* does not include all additional require-ments for buildings and structures that may be imposed by

101.6 Requirements of other State agencies, occupational licensing boards or commissions. The *North Carolina State Building Code* does not include all additional requirements for buildings and structures that may be imposed by

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CHAPTER 2

DEFINITIONS

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AIR, EXHAUST. Air being removed from any space or piece of equipment or appliance and conveyed directly to the atmosphere by means of openings or ducts. Relief air is classified as exhaust air.

APPLIANCE. Any apparatus or device that utilizes a fuel or a raw material as a fuel to produce light, heat, power, refrigeration or air conditioning. Also, an apparatus that compresses fuel gases.

New

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and that is directly heated or cooled or that is indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

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FURNACE, CENTRAL. A self-contained appliance for heating air by transfer of heat of combustion through metal to the air, and designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location

~~**Downflow furnace.** A furnace designed with airflow discharge vertically downward at or near the bottom of the furnace.~~

~~**Forced air-furnace with cooling unit.** A single-package unit, consisting of a gas-fired forced-air furnace of one of the types listed below combined with an electrically or fuel gas-powered summer air-conditioning system, contained in a common casing.~~

~~**Forced-air type.** A central furnace equipped with a fan or blower that provides the primary means for circulation of air.~~

~~**Gravity furnace with booster fan.** A furnace equipped with a booster fan that does not materially restrict free circulation of air by gravity flow when the fan is not in operation.~~

~~**Gravity type.** A central furnace depending primarily on circulation of air by gravity.~~

~~**Horizontal forced-air type.** A furnace with airflow through the appliance essentially in a horizontal path.~~

~~**Multiple-position furnace.** A furnace designed so that it can be installed with the airflow discharge in the upflow, horizontal or downflow direction.~~

~~**Upflow furnace.** A furnace designed with airflow discharge vertically upward at or near the top of the furnace. This classification includes "highboy" furnaces with the blower mounted below the heating element and "lowboy" furnaces with the blower mounted beside the heating element.~~

POINT OF DELIVERY. For natural gas systems, the point of delivery is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a *system shutoff* valve is provided ~~at~~ after the outlet of the service meter assembly, such valve shall be considered to be downstream of the point of delivery. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the first regulator that reduces pressure.

PRESS-CONNECT JOINT. A permanent mechanical joint incorporating an elastomeric seal or an elastomeric seal and corrosion-resistant grip or bite ring. The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer.

New

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REGULATOR. A device for controlling and maintaining a uniform supply pressure, either pounds-to-inches water column (MP regulator) or inches-to-inches water column (appliance regulator).

~~Types of appliance regulators are as follows:~~

~~**Adjustable.**~~

~~1. Spring type, limited adjustment. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable over a range of not more than 15 percent of the outlet pressure at the midpoint of the adjustment range.~~

~~2. Spring type, standard adjustment. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable. The adjustment means shall be concealed.~~

~~**Multistage.** A regulator for use with a single gas whose adjustment means is capable of being positioned manually or automatically to two or more predetermined outlet pressure settings. Each of these settings shall be adjustable or non-adjustable. The regulator may modulate outlet pressures automatically between its maximum and minimum predetermined outlet pressure settings.~~

~~**Nonadjustable.**~~

~~1. Spring type, nonadjustable. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is not field adjustable.~~

~~2. Weight type. A regulator in which the regulating force acting upon the diaphragm is derived from a weight or combination of weights.~~

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New Definitions

REGULATOR, MONITORING. A pressure regulator set in series with another pressure regulator for the purpose of preventing an overpressure in the downstream piping system.

REGULATOR, SERIES. A pressure regulator in series with one or more other pressure regulators.

SERVICE METER ASSEMBLY. The meter, valve, regulator, piping, fittings and equipment installed by the service gas supplier before the point of delivery.

SYSTEM SHUTOFF. A valve installed after the point of delivery to shut off the entire piping system.

TOILET, GAS-FIRED. A packaged and completely assembled appliance containing a toilet that incinerates refuse instead of flushing it away with water.

UNIT HEATER. A self-contained, automatically controlled, vented, fuel-gas-burning, space-heating appliance, intended for installation in the space to be heated without the use of ducts, and having integral means for circulation of air.

~~**High-static pressure type.** A self-contained, automatically controlled, vented *appliance* having integral means for circulation of air against 0.2 inch (15 mm H2O) or greater static pressure. Such *appliance* is equipped with provisions for attaching an outlet air duct and, where the *appliance* is for indoor installation remote from the space to be heated, is also equipped with provisions for attaching an inlet air duct.~~

~~**Low-static pressure type.** A self-contained, automatically controlled, vented *appliance*, intended for installation in the space to be heated without the use of ducts, having integral means for circulation of air. Such units are allowed to be equipped with louvers or face extensions made in accordance with the manufacturer's specifications.~~

Service shutoff. A valve, installed by the serving gas supplier between ~~the service meter or~~ source of supply and the point of delivery, ~~the customer service system,~~ to shut off the entire piping system.

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CHAPTER 3
GENERAL REGULATIONS

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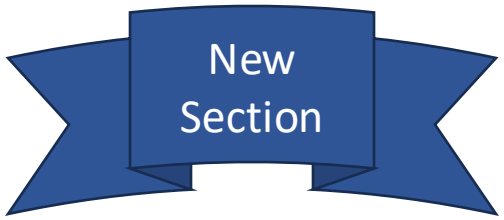

301.16 Pipe penetrations. Openings for pipe penetrations in walls, floors or ceilings shall be larger than the penetrating pipe. Openings through concrete or masonry building elements shall be sleeved. The annular space surrounding pipe penetrations shall be protected in an approved manner in accordance with the International Building Code.

301.14 Rodentproofing. (no change)
301.14.1 Foundation and exterior wall sealing. (no change)

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303.3 Prohibited locations. Appliances shall not be located in sleeping rooms, bathrooms, toilet rooms, closets used for storage, or surgical rooms, or in a space that opens only into such rooms or spaces, except where the installation complies with one of the following:

1. The appliance is a direct-vent appliance installed in accordance with the conditions of the listing and the manufacturer's instructions.
2. Vented room heaters, wall furnaces, vented decorative appliances, vented gas fireplaces, vented gas fireplace heaters and decorative appliances for installation in vented solid fuel-burning fireplaces are installed in rooms that meet the required volume criteria of Section 304.5.
3. A single wall-mounted unvented room heater is installed in a bathroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 6,000 Btu/h (1.76 kW). The bathroom shall meet the required volume criteria of Section 304.5.
4. A single wall-mounted unvented room heater is installed in a bedroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 10,000 Btu/h (2.93 kW). The bedroom shall meet the required volume criteria of Section 304.5.
5. The appliance is installed in a room or space that opens only into a bedroom or bathroom, and such room or space is used for no other purpose and is provided with a solid weather-stripped door equipped with an approved self-closing device. Combustion air shall be taken directly from the outdoors in accordance with Section 304.6.
6. A clothes dryer is installed in a residential bathroom or toilet room having a permanent opening with an area of not less than 100 square inches (0.06 m2) that communicates with a space outside of a sleeping room, bathroom, toilet room or storage closet.

303.3.1 Fireplaces and decorative appliances in Group I-2 occupancies. In Group I-2, Condition 2 occupancies, gas fireplace appliances and decorative gas appliances shall be prohibited except where such appliances are direct-vent appliances installed in public lobby and waiting areas that are not within smoke compartments containing patient sleeping areas. In Group I-2, Condition 1 occupancies, gas fireplace appliances and decorative gas appliances shall be prohibited in patient sleeping rooms. In Group I-2 occupancies, the appliance controls shall be located where they can be accessed only by facility staff. Such fireplaces shall comply with Sections 501.2 and 604.1 of this code and Section 915 of the International Fire Code.

CO Detection

Discharge to the Outdoors and Decorative Appliances

Group I-2: used for medical care on a 24-hour basis for more than five persons who are incapable of self-preservation.

1. Condition 1: Provides nursing or medical care, but not emergency care, surgery, etc.
2. Condition 2: Provides nursing or medical care, including emergency care, surgery, etc.

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303.4 Protection from vehicle impact damage. Appliances shall not be installed in a location subject to vehicle impact damage except where protected by an approved means. ~~Protection is not required for appliances located out of the vehicle's normal travel path.~~

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 2 inches (51 mm) above the pit floor. The sides of the pit or excavation shall be held back not less than 12 inches (305 mm) from the appliance. Where the depth exceeds 12 inches (305 mm) below adjoining grade, the walls of the pit or excavation shall be lined with concrete or masonry, such concrete or masonry shall extend not less than 4 inches (102 mm) above adjoining grade and shall have sufficient lateral load-bearing capacity to resist collapse. Excavation on the control side of the appliance shall extend not less than 30 inches (762 mm) horizontally. The appliance shall be protected from flooding in an approved manner.

304.8 Engineered installations. Engineered combustion air installations shall provide an adequate supply of combustion, ventilation and dilution air determined using engineering methods.

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305.3 Elevation of ignition source. Equipment and appliances having an ignition source shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor in all hazardous locations and all public garages, private garages, repair garages, motor fuel-dispensing facilities and parking garages. For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

305.3.2 Parking garages. Connection of a parking garage with any room in which there is a fuel-fired appliance shall be by means of a vestibule providing a two-doorway separation.

Exceptions:

1. A single door is permitted where the sources of ignition in the appliance are elevated in accordance with Section 305.3.
2. This section shall not apply to appliance installations complying with Section 305.4.

305.7 Clearances from grade. Equipment and appliances installed at grade level shall be supported on a level concrete slab or other approved material extending not less than 2 inches (76 mm) above adjoining grade or shall be suspended not less than 6 inches (152 mm) above adjoining grade. Such supports shall be installed in accordance with the manufacturer's instructions.

~~**305.7 Under-floor and exterior grade installations.**~~

~~**305.7.1 Exterior grade installations.** Equipment and appliances installed above grade level shall be supported on a solid base or on approved material that is a minimum of 2 inches (51 mm) thick.~~

~~**305.7.2 Under-floor installation.** Suspended equipment shall be a minimum of 6 inches (152 m) above the adjoining grade.~~

~~**305.7.3 Crawl space supports.** A support shall be provided at each corner of the unit not less than 8 inches by 8 inches (204 mm by 204 mm). The unit shall be supported a minimum of 2 inches (51 mm) above grade. When constructed of brick, the bricks shall be mortared together. All units stacked shall be mortared together. Fabricated units, formed concrete, or other approved materials shall be permitted.~~

~~**305.7.4 Drainage.** Below-grade installations shall be provided with a natural drain or an automatic lift or sump pump. For pit requirements, see Section 303.7.~~

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306.3 Appliances in attics and above hard ceilings. Attics containing appliances shall be provided with an opening and unobstructed passageway large enough to allow removal of the largest component of the appliance. The passageway shall be not less than 30 inches (762 mm) high and 22 inches (559 mm) wide and not more than 20 feet (6096 mm) in length measured along the centerline of the passageway from the opening to the appliance. The passageway shall have continuous solid flooring not less than 24 inches (610 mm) wide. A level service space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be present at the front or service side of the appliance. The clear access opening dimensions shall be not less than 20 inches by 30 inches (508 mm by 762 mm) and large enough to allow removal of the largest component of the appliance.

Exceptions:

1 and 2 – no change

306.3.1 Electrical requirements. A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be provided at or near the equipment or appliance location in accordance with the North Carolina Electrical Code.

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306.4 Appliances under floors. Under-floor spaces containing appliances shall be provided with an access opening and unobstructed passageway large enough to remove the largest component of the appliance. The passageway shall be not less than 22 inches (559 mm) high and 36 inches (914 mm) wide, nor more than 20 feet (6096 mm) in length measured along the centerline of the passageway from the opening to the appliance. A level service space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be present at the front or service side of the appliance. If the depth of the passageway or the service space exceeds 12 inches (305 mm) below the adjoining grade, the walls of the passageway shall be lined with concrete or masonry extending 4 inches (102 mm) above the adjoining grade and having sufficient lateral-bearing capacity to resist collapse. The clear access opening dimensions shall be not less than 22 inches high by 30 inches wide (559 mm by 762 mm), and large enough to allow removal of the largest component of the appliance.

Exceptions:

1 and 2 – no change

306.4.1 Electrical requirements. A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be provided at or near the equipment or appliance location in accordance with the North Carolina Electrical Code.

306.5 Equipment and appliances on roofs or elevated structures. Where equipment or appliances requiring periodic maintenance are installed on, located on, or suspended from an elevated structure or the roof of a building such that personnel will have to climb higher than 16 feet (4877 mm) above grade or finished floor to access such equipment or appliances, an interior or exterior means of access shall be provided. Such access shall not require climbing over obstructions greater than 30 inches (762 mm) in height or walking on roofs having a slope greater than 4 units vertical in 12 units horizontal (33-percent slope). Such access shall not require the use of portable ladders. Where access involves climbing over parapet walls, the height shall be measured to the top of the parapet wall.

Exception: Where permanent means of access is technically infeasible, wall-mounted equipment and appliance maintenance, replacement and repairs that are over 16 feet can be serviced by temporary lift equipment and methods other than the use of portable ladders.

~~Exception: Where permanent means of access is technically infeasible, wall-mounted equipment and appliance maintenance, replacement and repairs that are over 16 feet can be serviced by motorized equipment upon approval. The owner/tenant shall provide a maintenance service and cleaning schedule contract that shall be renewed annually.~~

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306.6 Guards. Guards shall be provided where various appliances, equipment, fans or other components that require service and roof hatch openings are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof, or grade below. The guard shall extend not less than 30 inches (762 mm) beyond each end of components, appliances, equipment and fans that require service and each end of the roof hatch parallel to the roof edge. The top of the guard shall be located not less than 42 inches (1067 mm) above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21-inch-diameter (533 mm) sphere and shall comply with the loading requirements for guards specified in the International Building Code.

Exception:

1. No change
2. No change

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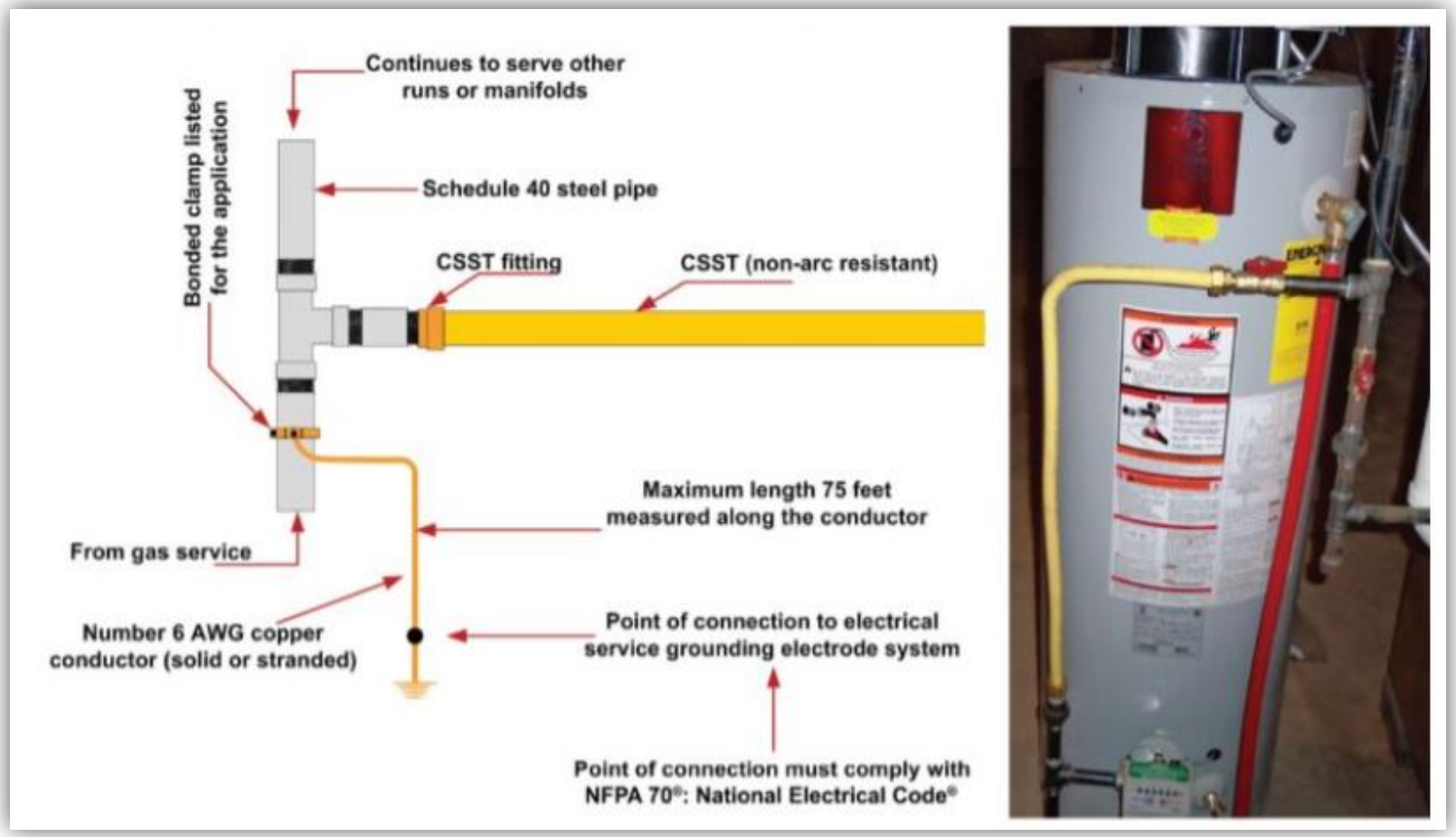
307.3 Drain pipe materials and sizes. Components of the condensate disposal system shall be ABS, cast iron, copper and copper alloy, CPVC, cross-linked polyethylene, galvanized steel, PE-RT, polyethylene, polypropylene, PVC or PVDF pipe or tubing. Components shall be selected for the pressure and temperature rating of the installation. Joints and connections shall be made in accordance with the applicable provisions of Chapter 7 of the International Plumbing Code relative to the material type. Condensate waste and drain line size shall be not less than 3 /4-inch (19 mm) pipe size and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with an approved method. Condensate piping shall be insulated to an R-value of not less than R-3 to prevent the formation of condensation on the exterior of the piping.

310.2 CSST. This section applies to corrugated stainless steel tubing (CSST) that is not listed with an arc-resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26. CSST gas piping systems and piping systems containing one or more segments of CSST shall be electrically continuous and bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system.



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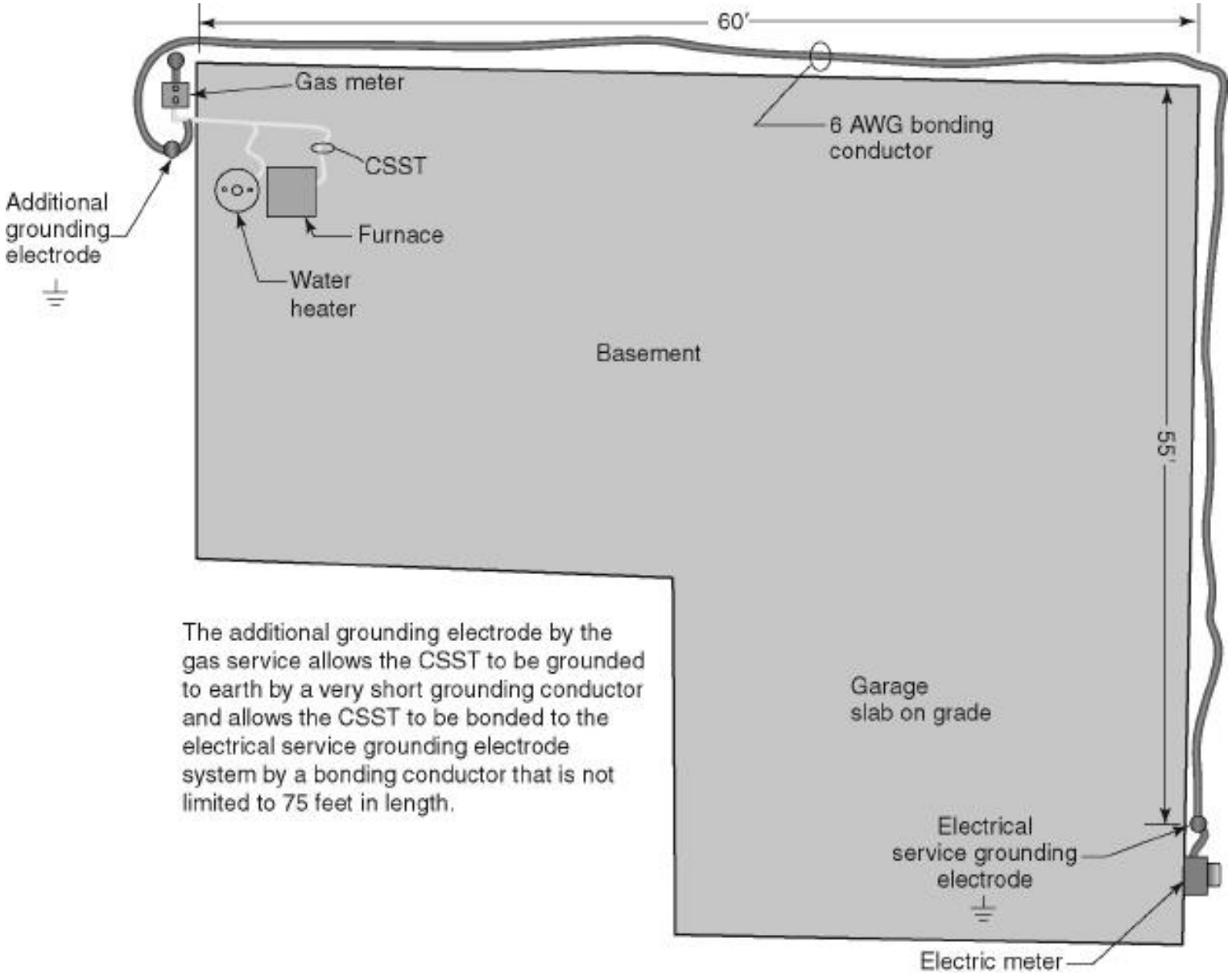

310.2.3 Bonding jumper length. The length of the bonding jumper between the connection to a gas piping system and the connection to a grounding electrode system shall not exceed 75 feet (22 860 mm). Any additional grounding electrodes installed to meet this requirement shall be bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system.

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310.3 Arc-resistant CSST. This section applies to corrugated stainless steel tubing (CSST) that is listed with an arc-resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26. The CSST shall be electrically continuous and bonded to an effective ground fault current path. Where any CSST component of a piping system does not have an arc-resistant jacket or coating system, the bonding requirements of Section 310.2 shall apply. Arc-resistant-jacketed CSST shall be considered to be bonded where it is connected to an appliance that is connected to the appliance grounding conductor of the circuit that supplies that appliance.

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311.1 General. Carbon monoxide detection shall be installed in new buildings in accordance with Sections 311.1.1 through 311.6. Carbon monoxide detection shall be installed in existing buildings in accordance with NCGS 143-138(b2) and applicable sections of the International Existing Building Code.

311.1.1 Where required. Carbon monoxide detection shall be provided in Group A-2, I, and R occupancies and in classrooms in Group E occupancies in the locations specified in Section 311.2 where any of the conditions in Sections 311.1.2 through 311.1.6 exist.

311.1.2 Fuel-burning appliances and fuel-burning fireplaces. Carbon monoxide detection shall be provided in Group A-2 occupancies, dwelling units, sleeping units and classrooms that contain a fuel-burning appliance or a fuel-burning fireplace.

311.1.3 Fuel-burning forced-air furnaces. Carbon monoxide detection shall be provided in Group A-2 occupancies, dwelling units, sleeping units and classrooms served by a fuel-burning, forced-air furnace.

Exception: Carbon monoxide detection shall not be required in dwelling units, sleeping units and classrooms where a carbon monoxide detector is provided in the first room or area served by each main duct leaving the furnace, and the carbon monoxide alarm signals are automatically transmitted to an approved location.

311.1.4 Fuel-burning appliances outside of dwelling units, sleeping units and classrooms. Carbon monoxide detection shall be provided in dwelling units, sleeping units and classrooms located in buildings that contain fuel-burning appliances or fuel-burning fireplaces.

Exceptions:

1. Carbon monoxide detection shall not be required in dwelling units, sleeping units and classrooms without communicating openings between the fuel-burning appliance or fuel-burning fireplace and the dwelling unit, sleeping unit or classroom.
2. Carbon monoxide detection shall not be required in dwelling units, sleeping units and classrooms where a carbon monoxide detector is provided in one of the following locations:
   2.1. In an approved location between the fuel-burning appliance or fuel-burning fireplace and the dwelling unit, sleeping unit or classroom.
   2.2. On the ceiling of the room containing the fuel-burning appliance or fuel-burning fireplace.

311.1.5 Private garages. Carbon monoxide detection shall be provided in dwelling units, sleeping units and classrooms in buildings with attached private garages.

Exceptions:

1. Carbon monoxide detection shall not be required in dwelling units, sleeping units and classrooms without communicating openings between the private garage and the dwelling unit, sleeping unit or classroom.
2. Carbon monoxide detection shall not be required in dwelling units, sleeping units and classrooms located more than one story above or below a private garage.
3. Carbon monoxide detection shall not be required where the private garage connects to the building through an open-ended corridor.
4. Where a carbon monoxide detector is provided in an approved location between openings to a private garage and dwelling units, sleeping units or classrooms.

311.1.6 Exempt garages. For determining compliance with Section 311.1.5, an open parking garage complying with Section 406.5 of the International Building Code or an enclosed parking garage complying with Section 406.6 of the International Building Code shall not be considered a private garage.

311.2 Locations. Where required by Section 311.1.1, carbon monoxide detection shall be installed in the locations specified in Sections 311.2.1 through 311.2.3.

311.2.1 Dwelling units. Carbon monoxide detection shall be installed in dwelling units outside of each separate sleeping area in the immediate vicinity of the bedrooms. Where a fuel-burning appliance is located within a bedroom or its attached bathroom, carbon monoxide detection shall be installed within the bedroom.

311.2.2 Sleeping units. Carbon monoxide detection shall be installed in sleeping units.

Exceptions:

1. Carbon monoxide detection shall be allowed to be installed outside of each separate sleeping area in the immediate vicinity of the sleeping unit where the sleeping unit or its attached bathroom does not contain a fuel-burning appliance and is not served by a forced-air furnace.
2. In Group I-3, carbon monoxide detection shall be allowed to be installed outside of each separate sleeping area in the immediate vicinity of the sleeping unit.

311.2.3 Group E occupancies. Carbon monoxide detectors shall be installed in classrooms in Group E occupancies. Carbon monoxide alarm signals shall be automatically transmitted to an on-site location that is staffed by school personnel.

Exception: Carbon monoxide alarm signals shall not be required to be automatically transmitted to an on-site location that is staffed by school personnel in Group E occupancies with an occupant load of 30 or less.

311.3 Carbon monoxide detection. Carbon monoxide detection required by Sections 311.1 through 311.2.3 shall be provided by carbon monoxide alarms complying with Section 311.4 or carbon monoxide detection systems complying with Section 311.5.

311.4 Carbon monoxide alarms. Carbon monoxide alarms shall comply with Sections 311.4.1 through 311.4.4.

311.4.1 Power source. Carbon monoxide alarms shall receive their primary power from the building wiring where such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than that required for overcurrent protection.

Exceptions:

1. Where installed in buildings without commercial power, battery-powered carbon monoxide alarms shall be an acceptable alternative.
2. In A-2 occupancies the carbon monoxide detector shall be permitted to be battery-powered.

311.4.2 Listings. Carbon monoxide alarms shall be listed in accordance with UL 2034.

311.4.3 Locations. Carbon monoxide alarms shall only be installed in dwelling units and in sleeping units. They shall not be installed in locations where the code requires carbon monoxide detectors to be used.

311.4.4 Combination alarms. Combination carbon monoxide/smoke alarms shall be an acceptable alternative to carbon monoxide alarms. Combination carbon monoxide/smoke alarms shall be listed in accordance with UL 217 and UL 2034.

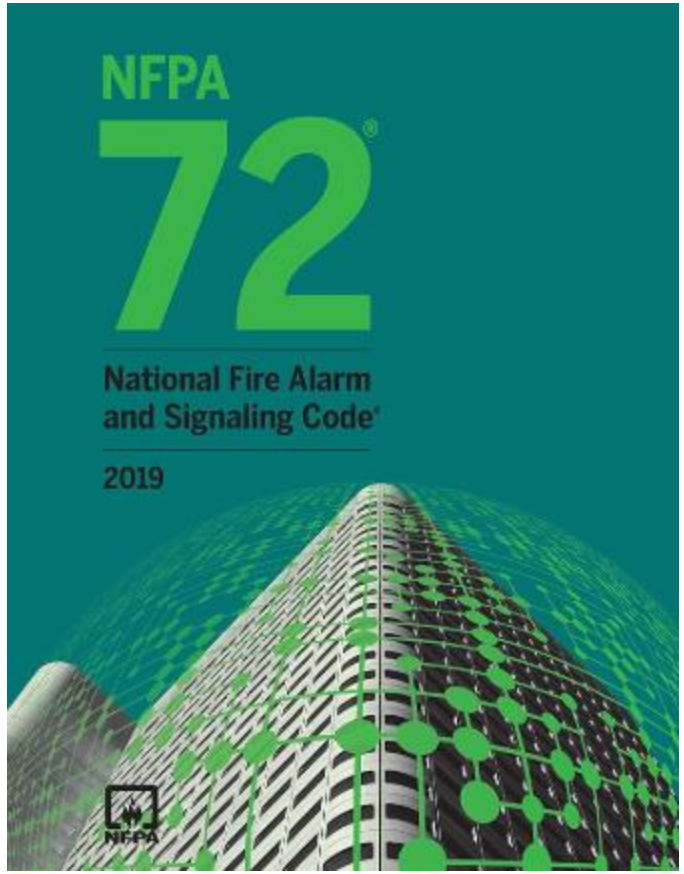
311.5 Carbon monoxide detection systems. Carbon monoxide detection systems shall be an acceptable alternative to carbon monoxide alarms and shall comply with Sections 311.5.1 through 311.5.3.

311.5.1 General. Carbon monoxide detection systems shall comply with NFPA 72. Carbon monoxide detectors shall be listed in accordance with UL 2075.

311.5.2 Locations. Carbon monoxide detectors shall be installed in the locations specified in Section 311.2. These locations supersede the locations specified in NFPA 72.

311.5.3 Combination detectors. Combination carbon monoxide/smoke detectors installed in carbon monoxide detection systems shall be an acceptable alternative to carbon monoxide detectors, provided that they are listed in accordance with UL 268 and UL 2075.

311.6 Maintenance. Carbon monoxide alarms and carbon monoxide detection systems shall be maintained in accordance with NFPA 72. Carbon monoxide alarms and carbon monoxide detectors that become inoperable or begin producing end-of-life signals shall be replaced.



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311.6.1 Enclosed parking garages. Carbon monoxide and nitrogen dioxide detectors installed in enclosed parking garages in accordance with Section 404.1 of the International Mechanical Code shall be maintained in accordance with the manufacturer's instructions and their listing. Detectors that become inoperable or begin producing end-of-life signals shall be replaced.

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CHAPTER 4

GAS PIPING INSTALLATIONS

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401.5 Identification. For other than steel pipe and CSST, exposed piping shall be identified by a yellow label marked “Gas” in black letters. The marking shall be spaced at intervals not exceeding 5 feet (1524 mm). The marking shall not be required on piping located in the same room as the appliance served. CSST shall be identified as required by ANSI LC 1/CSA 6.26.

~~**401.5 Identification.** Exposed piping shall be identified by a yellow label marked “Gas” in black letters. The marking shall be spaced at intervals not exceeding 5 feet (1524 mm). All piping and tubing systems, greater than 0.5 pounds per square inch (3.45 kPa) service pressure, shall be identified by a yellow label with black letters indicating the piping system pressure. The system shall be marked at the beginning, all ends and at intervals not exceeding 5 feet (1524 mm) along its exposed length.~~

~~Exceptions:~~

~~1. Gas lines extending from the undiluted liquefied petroleum gas storage tanks to the building are not required to be labeled.~~

~~2. Black steel piping, 0.5 pounds per square inch (3.45 kPa) or less, located at dwelling units shall not be required to be labeled.~~

NC MECHANICAL INSPECTORS ASSOC.

New Sections

401.9 Piping manufacturer identification. Each length of pipe and tubing and each pipe fitting, utilized in a fuel gas system, shall bear the identification of the manufacturer.

Exceptions:

1. Steel pipe sections that are 2 feet (610 mm) and less in length and are cut from longer sections of pipe.
2. Steel pipe fittings 2 inches and less in size.
3. Where identification is provided on the product packaging or crating
4. Where other approved documentation is provided.

401.10 Piping materials standards. Piping, tubing and fittings shall be manufactured to the applicable referenced standards, specifications and performance criteria listed in Section 403 and shall be identified in accordance with Section 401.9.

402.2 Maximum gas demand. The volumetric flow rate of gas to be provided shall be the sum of the maximum input of the appliances served.

The total connected hourly load shall be used as the basis for pipe sizing, assuming that all appliances could be operating at full capacity simultaneously. Where a diversity of load can be established, pipe sizing shall be permitted to be based on such loads.

The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2,000 feet (610 m) in elevation.

402.4 Sizing tables and equations. This section applies to piping materials other than noncorrugated stainless steel tubing. Where Tables 402.4(1) through 402.4(39) are used to size piping or tubing, the pipe length shall be determined in accordance with Section 402.4.1, 402.4.2 or 402.4.3.

402.5 Noncorrugated stainless steel tubing. Noncorrugated stainless steel tubing shall be sized in accordance with Equations 4-1 and 4-2 of Section 402.4 in conjunction with Section 402.4.1, 402.4.2 or 402.4.3.

1. Low-pressure gas equation [Less than $1^1/_2$ pounds per square inch (psi) (10.3 kPa)]:

$$D = \frac{Q^{0.381}}{19.17\left(\frac{\Delta H}{C_r \times L}\right)^{0.206}} \qquad \textbf{(Equation 4-1)}$$

2. High-pressure gas equation [$1^1/_2$ psi (10.3 kPa) and above]:

$$D = \frac{Q^{0.381}}{18.93\left[\frac{(P_1^2 - P_2^2) \times Y}{C_r \times L}\right]^{0.206}} \qquad \textbf{(Equation 4-2)}$$

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402.7 Maximum operating pressure. The maximum operating pressure for piping systems located inside buildings shall not exceed 5 pounds per square inch gauge (psig) (34 kPa gauge) except where one or more of the following conditions are met:

1. The piping joints are welded or brazed.
2. The piping is joined by fittings listed to ANSI LC-4/CSA 6.32 and installed in accordance with the manufacturer's instructions.
3. The piping joints are flanged and pipe-to-flange connections are made by welding or brazing.
4. The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
5. The piping is located inside buildings or separate areas of buildings used exclusively for any of the following:
   - 5.1. Industrial processing or heating.
   - 5.2. Research.
   - 5.3. Warehousing.
   - 5.4. Boiler or mechanical rooms.
6. The piping is a temporary installation for buildings under construction.
7. The piping serves appliances or equipment used for agricultural purposes.
8. The piping system is an LP-gas piping system with an operating pressure greater than 20 psi (137.9 kPa) and complies with NFPA 58.

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403.3.2 Steel. Steel, stainless steel and wrought-iron pipe shall be not lighter than Schedule 10 and shall comply with the dimensional standards of ASME B36.10M and one of the following standards:

1. ASTM A53/A53M.
2. ASTM A106.
3. ASTM A312.

403.4.2 Stainless steel. Stainless steel tubing shall comply with ASTM A268 or ASTM A269.

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403.5 Plastic pipe, tubing and fittings. Polyethylene plastic pipe, tubing and fittings used to supply fuel gas shall conform to ASTM D2513. Such pipe shall be marked “Gas” and “ASTM D2513.”

Polyamide pipe, tubing and fittings, shall be identified and conform to ASTM F2945. Such pipe shall be marked “Gas” and “ASTM F2945.”

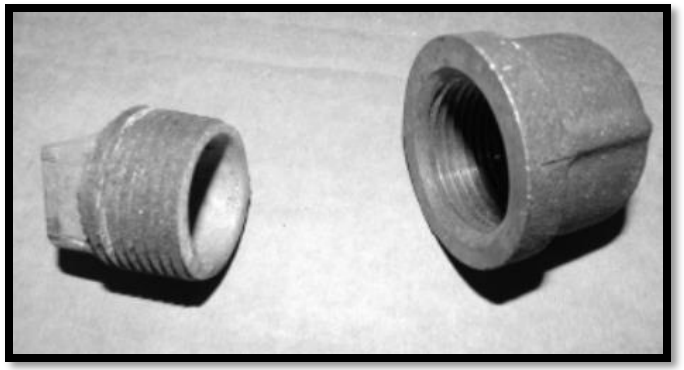
Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) plastic pipe, tubing and fittings shall not be used to supply fuel gas.

?

A "polyamide gas pipe" refers to a type of gas pipe made from polyamide material, a plastic commonly known as nylon, specifically used for transporting natural gas due to its high pressure resistance and chemical stability; most commonly, this type of pipe is made from polyamide 11 (PA11) or polyamide 12 (PA12) which are considered suitable for high-pressure gas applications.

404.5 Fittings in concealed locations. Fittings installed in concealed locations shall be limited to the following types:

1. Threaded elbows, tees, couplings, plugs and caps.
2. Brazed fittings.
3. Welded fittings.
4. Fittings listed to ANSI LC-1/CSA 6.26 or ANSI LC-4/CSA 6.32



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404.11 Protection against corrosion. ~~Metallic~~ Steel pipe or tubing exposed to corrosive action, such as soil conditions or moisture, shall be protected in accordance with Sections 404.11.1 through 404.11.4.

404.11.1 Galvanizing. Zinc coating shall not be deemed adequate protection for underground gas piping.

404.11.2 Protection methods. Underground piping shall comply with one or more of the following:

1. The piping shall be made of corrosion-resistant material that is suitable for the environment in which it will be installed.
2. Pipe shall have a factory-applied, electrically-insulating coating. Fittings and joints between sections of coated pipe shall be coated in accordance with the coating manufacturer's instructions.
3. The piping shall have a cathodic protection system installed and the system shall be monitored and maintained in accordance with an approved program.

~~**Exception:** Where installed in accordance with the manufacturer's instructions, field application of coatings and wrappings shall be permitted~~

404.11.3 Dissimilar metals. Where dissimilar metals are joined underground, an insulating coupling or fitting shall be used.

404.11.4 Protection of risers. Steel risers connected to plastic piping shall be cathodically protected by means of a welded anode, except where such risers are anodeless risers.

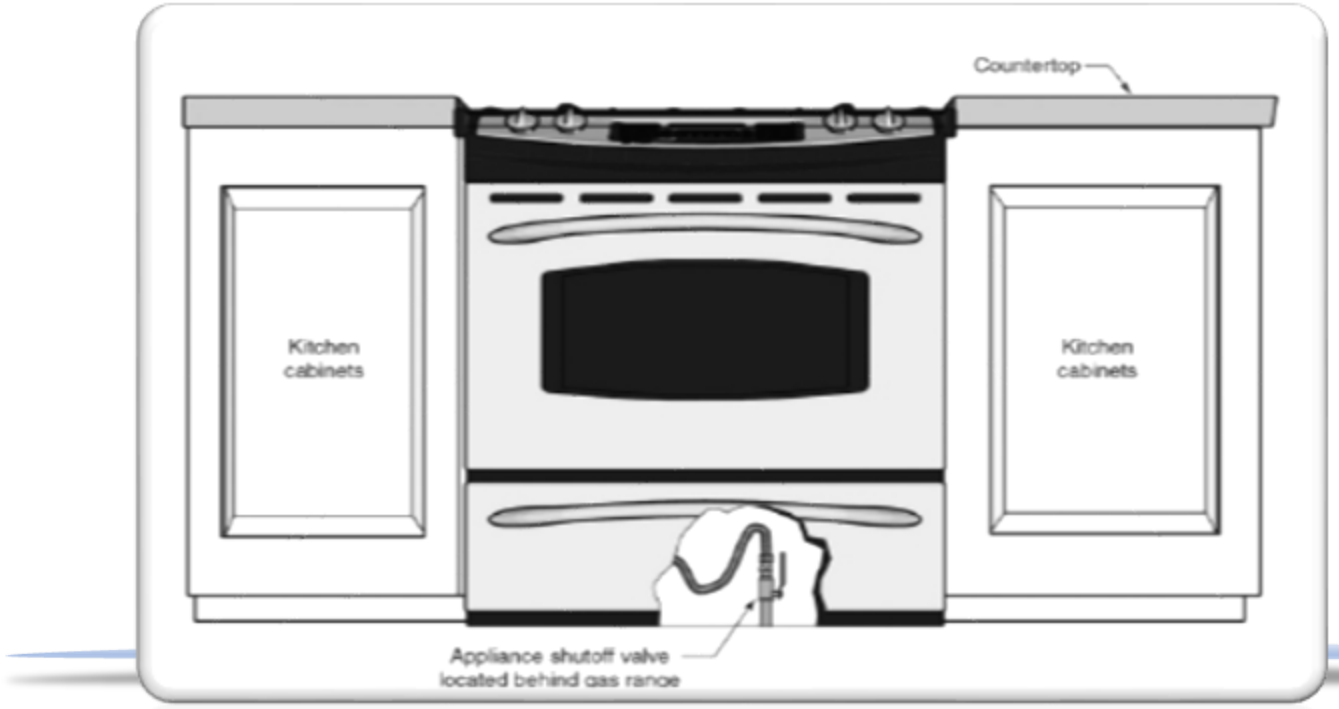
404.14 Piping underground beneath buildings. Piping installed underground beneath buildings is prohibited except where the piping is encased in a conduit of wrought iron, plastic pipe, steel pipe, a piping or encasement system listed for installation beneath buildings, or other approved conduit material designed to withstand the superimposed loads. The conduit shall be protected from corrosion in accordance with Section 404.11 and shall be installed in accordance with Section 404.14.1 or 404.14.2.

Gas Piping Listed for Installation Beneath Building

NC MECHANICAL INSPECTORS ASSOC.

409.5 Appliance shutoff valve. Each appliance shall be provided with a shutoff valve in accordance with Section 409.5.1, 409.5.2 or 409.5.3.

409.5.1 Located within same room. The shutoff valve shall be located in the same room as the appliance. The shutoff valve shall be within 6 feet (1829 mm) of the appliance, and shall be installed upstream of the union, connector or quick disconnect device it serves. Such shutoff valves shall be provided with access. Shutoff valves serving movable appliances, such as cooking appliances and clothes dryers, shall be considered to be provided with access where installed behind such appliances. Appliance shutoff valves located in the firebox of a fireplace shall be installed in accordance with the appliance manufacturer's instructions. This section shall not prohibit the use or the installation of gas shutoff valves in the firebox of fireplaces serving listed gas appliances.



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410.2 MP regulators. (1-6)

#6. A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the MP regulator outlet. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument. The tee fitting is not required where the MP regulator serves an appliance that has a pressure test port on the gas control inlet side and the appliance is located in the same room as the MP regulator.

410.3 Venting of regulators. Pressure regulators that require a vent shall be vented directly to the outdoors. The vent shall be designed to prevent the entry of insects, water and foreign objects. Vents shall terminate not less than 3 feet (914 mm) from a possible source of ignition.

Exception: A vent to the outdoors is not required for regulators equipped with and labeled for utilization with an approved vent-limiting device installed in accordance with the manufacturer's instructions.

~~1. Regulator vent outlets serving propane piping shall be located 3 feet (914 mm) horizontally from openings and operable openings that are below the vent, and 5 feet (1525 mm) in any direction from direct vent appliance intakes and mechanical ventilation intakes or 1 foot (305 mm) below openings and operable openings, and 3 feet (914 mm) below direct vent and mechanical vent intakes.~~

~~2. Regulator vent outlets serving natural gas piping shall be located 3 feet (914 mm) horizontally from operable openings above the vent, and 5 feet (1525 mm) horizontally from direct vent appliance intakes and mechanical ventilation air intakes located above the vent, or 1 foot (305 mm) above openings and operable openings, and 3 feet (914 mm) above direct vent and mechanical vent intakes.~~

~~3. The ignition source on appliances shall be maintained at 3 feet (914 mm) horizontally from regulator vents, including utility regulator vents. If manufacturer's installation instructions or the product listing allows closer locations, those distances can be followed.~~

INSPECTORS ASSOC.

CHAPTER 5

CHIMNEYS AND VENTS

NC MECHANICAL INSPECTORS ASSOC.

503.4.1 Plastic piping. Where plastic piping is used to vent an appliance, the appliance shall be listed for use with such venting materials and the appliance manufacturer's installation instructions shall identify the specific plastic piping material. The plastic pipe venting materials shall be labeled in accordance with the product standards specified by the appliance manufacturer or shall be listed and labeled in accordance with UL 1738.

503.4.1.1 Plastic vent joints. Plastic pipe and fittings used to vent appliances shall be installed in accordance with the appliance manufacturer's instructions. Plastic pipe venting materials listed and labeled in accordance with UL 1738 shall be installed in accordance with the vent manufacturer's instructions. Where a primer is required, it shall be of a contrasting color~~, on an ultraviolet primer in accordance with the North Carolina Plumbing Code, Chapter 7~~.

503.4.2 Special gas vent. Special gas vent shall be listed and labeled in accordance with UL 1738 and installed in accordance with the special gas vent manufacturer's instructions.

TABLE 503.8
THROUGH-THE-WALL VENT TERMINAL CLEARANCE

FIGURE CLEARANCE	CLEARANCE LOCATION	MINIMUM CLEARANCE FOR DIRECT-VENT TERMINALS	MINIMUM CLEARANCE FOR NONDIRECT-VENT TERMINALS
A	Clearance above finished grade level, veranda, porch, deck, or balcony	12 inches	
B	Clearance to window or door that is openable	6 inches: Appliances ≤ 10,000 Btu/h 9 inches: Appliances > 10,000 Btu/h ≤ 50,000 Btu/h 12 inches: Appliances > 50,000 Btu/h ≤ 150,000 Btu/h Appliances > 150,000 Btu/h, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for nondirect-vent terminals in Row B	4 feet below or to side of opening or 1 foot above opening
C	Clearance to nonopenable window	None unless otherwise specified by the appliance manufacturer	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the centerline of the terminal	None unless otherwise specified by the appliance manufacturer	
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
H	Clearance to each side of centerline extended above regulator vent outlet	3 feet up to a height of 15 feet above the regulator vent outlet	
I	Clearance to service regulator vent outlet in all directions	3 feet for gas pressures up to 2 psi; 10 feet for gas pressures above 2 psi	
J	Clearance to nonmechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for Row B	
K	Clearance to a mechanical air supply inlet	10 feet horizontally from inlet or 3 feet above inlet	
L	Clearance above paved sidewalk or paved drive-way located on public property	7 feet and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard	
M	Clearance to underside of veranda, porch, deck, or balcony	12 inches where the area beneath the veranda, porch, deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.	

503.8 Venting system terminal clearances. The clearances for through-the-wall direct-vent and nondirect-vent terminals shall be in accordance with Table 503.8 and Figure 503.8.

Exceptions:

1. The clearances in Table 503.8 shall not apply to the combustion air intake of a direct-vent appliance.
2. If manufacturer's installation instructions allow closer clearances, those instructions can be followed.

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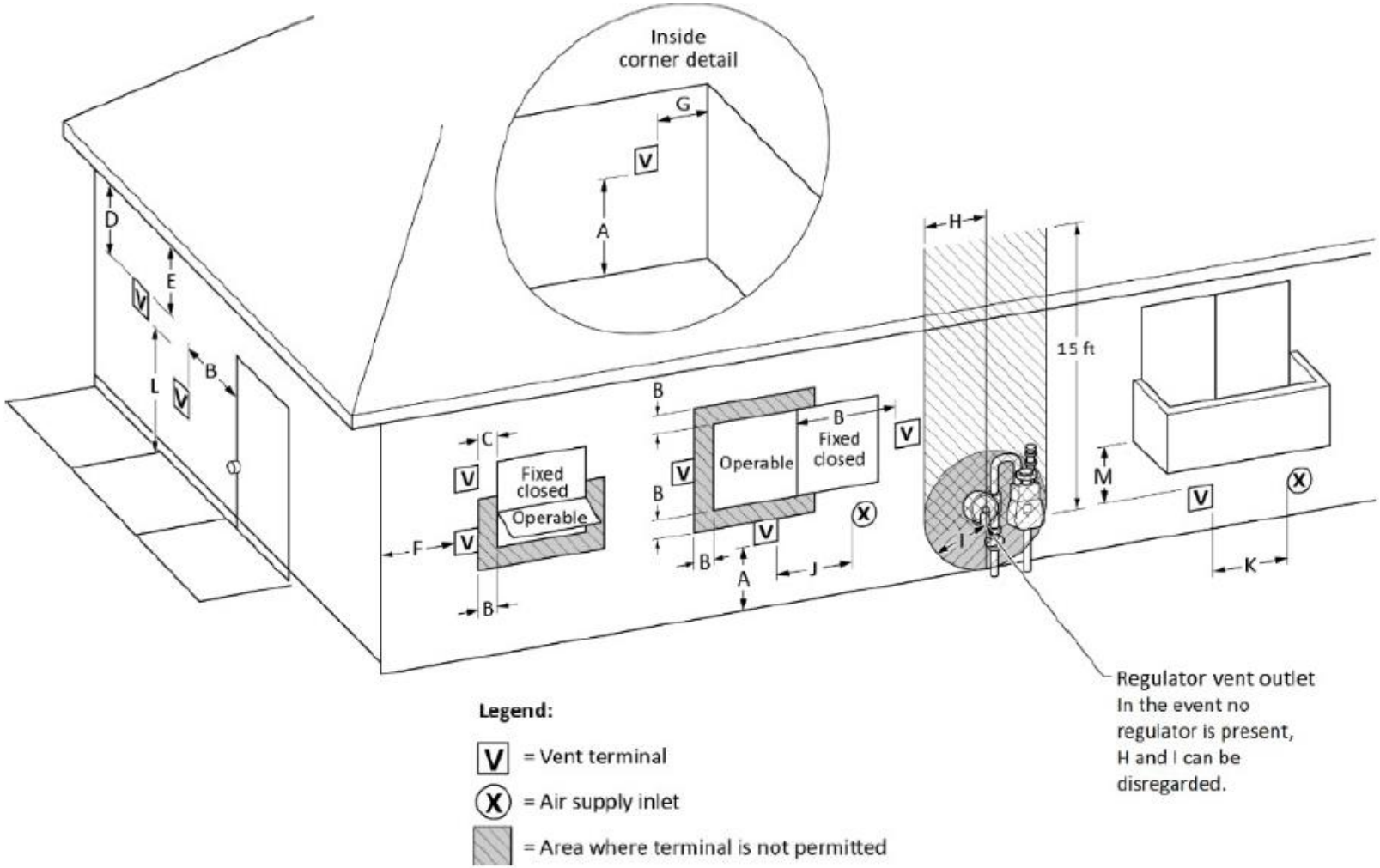

FIGURE 503.8
THROUGH-THE-WALL VENT TERMINAL CLEARANCE

TABLE 503.8
THROUGH-THE-WALL VENT TERMINAL CLEARANCE

FIGURE CLEARANCE	CLEARANCE LOCATION	MINIMUM CLEARANCE FOR DIRECT-VENT TERMINALS	MINIMUM CLEARANCE FOR NONDIRECT-VENT TERMINALS
A	Clearance above finished grade level, veranda, porch, deck, or balcony	12 inches	
B	Clearance to window or door that is openable	6 inches: Appliances ≤ 10,000 Btu/hr 9 inches: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr 12 inches: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for nondirect-vent terminals in Row B	4 feet below or to side of opening or 1 foot above opening
C	Clearance to nonopenable window	None unless otherwise specified by the appliance manufacturer	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the center line of the terminal	None unless otherwise specified by the appliance manufacturer	
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
H	Clearance to each side of center line extended above regulator vent outlet	3 feet up to a height of 15 feet above the regulator vent outlet	
I	Clearance to service regulator vent outlet in all directions	3 feet for gas pressures up to 2 psi; 10 feet for gas pressures above 2 psi	
J	Clearance to nonmechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for Row B	
K	Clearance to a mechanical air supply inlet	10 feet horizontally from inlet or 3 feet above inlet	
L	Clearance above paved sidewalk or paved driveway located on public property	7 feet and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard	
M	Clearance to underside of veranda, porch, deck, or balcony	12 inches where the area beneath the veranda, porch, deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.	

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CHAPTER 6

SPECIFIC APPLIANCES

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New Sections

614.4.2 Exhaust termination outlet and passageway. 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 (8065 mm2).

614.6 Booster fans prohibited. Domestic booster fans shall not be installed in dryer exhaust systems.

614.7 Makeup air. Where an enclosed space is less than 70 square feet and is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (645 mm2) for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.

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614.9.2 Duct installation. Exhaust ducts shall be supported at 4-foot (1219 mm) intervals and secured in place. The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow. Ducts shall not be joined with screws or similar fasteners that protrude into the inside of the duct. Ducts shall be sealed in accordance with Section 603.9 of the International Mechanical Code. Ducts shall be mechanically fastened by one of the following methods.

a. Nonmetallic mechanical fasteners (tie-straps) shall be listed to UL 181B.
b. Metal band duct clamps are not required to be listed.

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

[M] ~~614.8.5~~614.9.5 Length identification. Where the exhaust duct equivalent length exceeds 35 feet (10 668 mm), the equivalent length of the exhaust duct shall be identified on a permanent label or tag. The label or tag shall be located within 6 feet (1829 mm) of the exhaust duct connection.

1. Labels shall be permanently stenciled, laminated, or commercially available plastic or metal tags.
2. Labels shall state, at a minimum (fill in the blank):

   Caution: Equivalent length of _____ ~~feet~~ feet including _____ 45 deg. elbows and _____ 90 deg. elbows. Any installed dryer must be equipped with an exhaust system that meets or exceeds this equivalent length requirement.
3. Labels can be attached to wall or vent receptor.

614.9.6 Exhaust duct required. Where space for a clothes dryer is provided, an exhaust duct system shall be installed.

Where the clothes dryer is not installed at the time of occupancy, the exhaust duct shall be capped at the location of the future dryer.

Exception: Where a listed condensing clothes dryer is installed prior to occupancy of the structure.

618.7 (IFGS) Furnace plenums and air ducts. Where a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside of the space containing the furnace, the return air shall be handled by a duct(s) sealed to the furnace casing and terminating outside of the space containing the furnace. Return air shall not be taken from the mechanical room containing the furnace.

PROHIBITED INSTALLATION

618.9 Return air intake (nonengineered systems). If only one central return air grille is installed, it shall be of a size sufficient to return a volume of air compatible with the cubic foot per minute requirements and the temperature rise limitations specified by the equipment manufacturer. The face velocity of return air grilles shall not exceed 450 feet per minute (fpm) (2.3 m/s). At least one separate return shall be installed on each level of a multilevel structure. For split level and split foyer structures, one return may serve more than one level if located within the split area and the total area of the levels does not exceed 1,600 square feet (148.6 m2). Return air grilles shall not be located in bathrooms. The return air from one residential living unit shall not be mixed with the return air from other living units. In dwellings with 1,600 square feet (148.6 m2) or less of conditioned area, a central return is permitted. When the dwelling contains more than 1,600 square feet (148.6 m2) of conditioned area, additional returns shall be provided. Each return shall serve not more than 1,600 square feet (148.6 m2) of area and shall be located in the area it serves. Return air may travel through the living space to the return-air intake if there are no restrictions, such as solid doors, to the air movement. Undercut doors are allowed. When panned joists are used for return air, the structural integrity shall be maintained. Air capacity for joists 16 inches (406 mm) on center shall be a maximum of 375 cubic feet per minute (0.177 m3/s) for 8-inch (203 mm) joists and 525 cubic feet per minute (0.248 m3/s) for 10-inch (254 mm) joists. Wiring located in spaces used for return air ducts shall comply with the *North Carolina Electrical Code*.

CHAPTER 7

GASEOUS HYDROGEN SYSTEMS

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703.1 Hydrogen-generating and refueling operations. Hydrogen-generating and refueling appliances shall be installed and located in accordance with their listing and the manufacturer's instructions. Exhaust ventilation shall be required in public garages, private garages, repair garages, automotive motor fuel-dispensing facilities and parking garages that contain hydrogen-generating appliances or refueling systems in accordance with NFPA 2. For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

~~**703.1.1 Natural ventilation.**~~

~~**703.1.1.1 Two openings**~~.

~~**703.1.1.2 Louvers and grilles.**~~

~~**703.1.2 Mechanical ventilation.**~~

~~**703.1.3 Specially engineered installations.**~~

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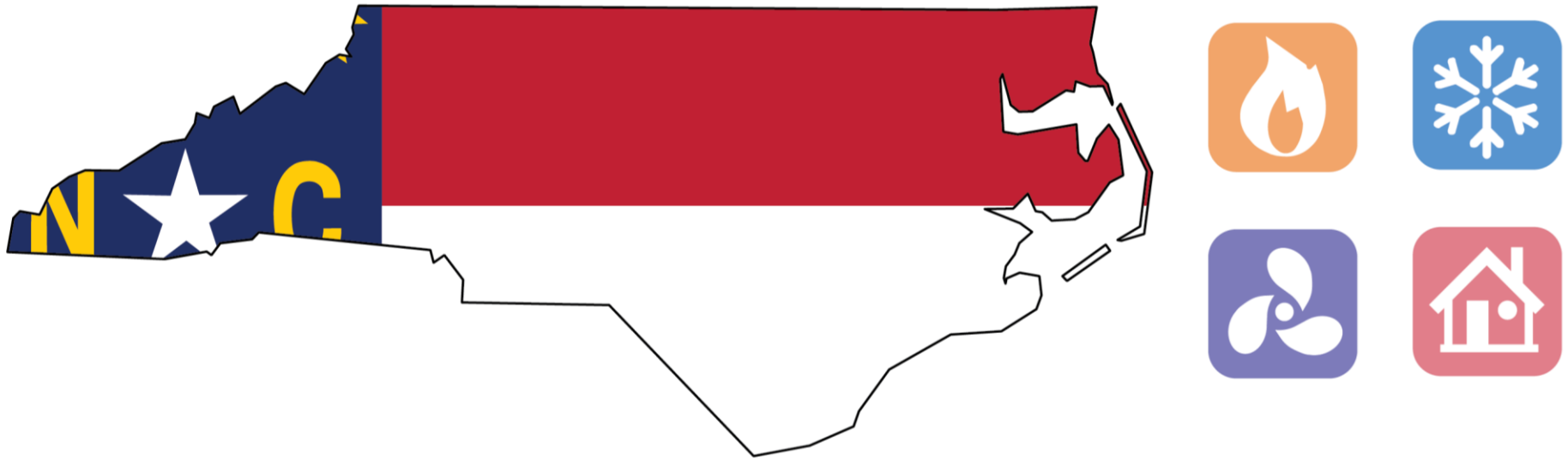
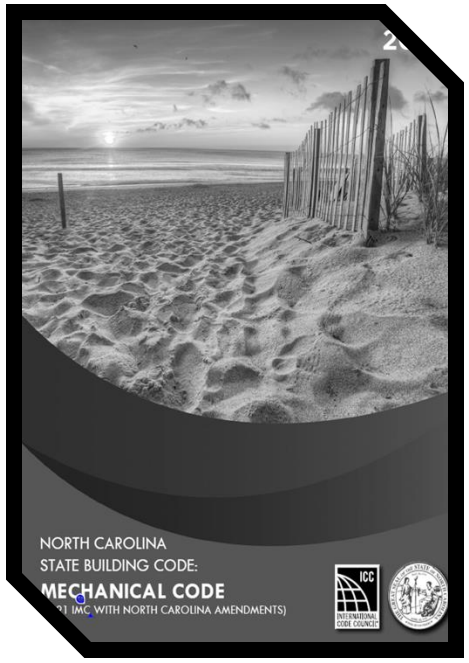


Significant Changes in the 2024 Mechanical Code

Course# CS-5040:

Sponsored by NCMIA



2024 North Carolina Mechanical Code

NC MECHANICAL INSPECTORS ASSOC.

CHAPTER 1 SCOPE AND ADMINISTRATION

101.2 Scope.

Exception: Detached one- and two- family dwellings and ~~multiple single-family dwellings (townhouses)~~ **townhouses** not more than three stories ~~high~~ **above grade plane in height** with **a** separate means of egress and their accessory structures **not more than three stories above grade plane in height** shall comply with the *International Residential Code.*

102.2.1 Existing buildings. Additions, alterations, renovations or repairs related to building or structural issues shall be regulated by the International Existing Building Code

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104.2 Permits not required. Permits shall not be required for the following:

1. Portable heating appliances
2. Portable ventilation appliances and equipment.
3. Portable cooling units.
4. Steam, hot water or chilled water piping within any heating or cooling equipment or appliances regulated by this code.
5. The replacement of any minor part that does not alter the approval of equipment or an appliance or make such equipment or appliance unsafe.
6. Portable evaporative coolers.
7. Self-contained refrigeration systems that contain 10 pounds (4.5 kg) or less of refrigerant, or that are actuated by motors of 1 horsepower (0.75 kW) or less.
8. Portable fuel cell appliance that are not connected to a fixed piping system and are not interconnected to a power grid.

Exemption from the permit requirements of this code shall not be deemed to grant authorization for work to be done in violation of the provisions of this code or other laws or ordinances of this jurisdiction.

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CHAPTER 2 DEFINITIONS

AIR, EXHAUST. Air being removed from any space, appliance or piece of equipment and conveyed directly to the atmosphere by means of openings or ducts. **Relief air is classified as exhaust air.**

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.

(*see reference link - https://www.ncosfm.gov/third-party-testing-agencies/open)

BALANCED VENTILATION. Any combination of concurrently operating mechanical exhaust and mechanical supply whereby the total mechanical exhaust airflow rate is within 10 percent of the total mechanical supply airflow rate.

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CEILING RADIATION DAMPER. A listed device installed in a ceiling membrane of a fire-resistance-rated floor/ceiling or roof/ceiling assembly to limit automatically the radiative heat transfer through an air inlet/outlet opening. Ceiling radiation dampers are classified for use in either static systems that will automatically shut down in the event of a fire or in dynamic systems that continue to operate during a fire. A dynamic ceiling radiation damper is tested and rated for closure under elevated temperature airflow.

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 EVAPORATIVE COOLING. The evaporative cooling process where water evaporates directly into the air stream, reducing the air's dry-bulb temperature and raising its humidity level.

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.

FLAMMABILITY CLASSIFICATION (REFRIGERANT). The alphabetical/numerical designation used to identify the flammability of refrigerants.

Class 1. Indicates a refrigerant with no flame propagation.

Class 2. Indicates a refrigerant with low flammability.

Class 2L. Indicates a refrigerant with low flammability and low burning velocity**.** (Burning velocity is the speed at which a flame moves relative to unburned gas. The burning velocity of A2L refrigerants is less than 10 centimeters per second (3.9 inches per second).

Class 3. Indicates a refrigerant with high flammability.

FLEXIBLE AIR CONNECTOR. A conduit for transferring air between an air duct or plenum and an air terminal unit or between an air duct or plenum and an air inlet or air outlet. Such conduit is limited in its use, length and location.

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

INDIRECT EVAPORATIVE COOLING. The evaporative cooling process where water evaporates into a secondary air stream, removing heat from a primary air stream utilizing a heat exchanger.

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.

LARGE-DIAMETER CEILING FAN. A ceiling fan that is greater than 7 feet (2134 mm) in diameter. These fans are also referred to as high-volume, low-speed (HVLS) fans.

LOW-PROBABILITY PUMP. A pump that is designed to prevent atmospheric release of the pumped fluid by one of the following methods:

1. The pump is permanently sealed.
2. The pump incorporates a static seal.
3. The pump incorporates not less than two sequential dynamic shaft seals to isolate the pumped fluid from atmosphere at shaft penetrations and automatically shuts down upon failure of any seal.

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

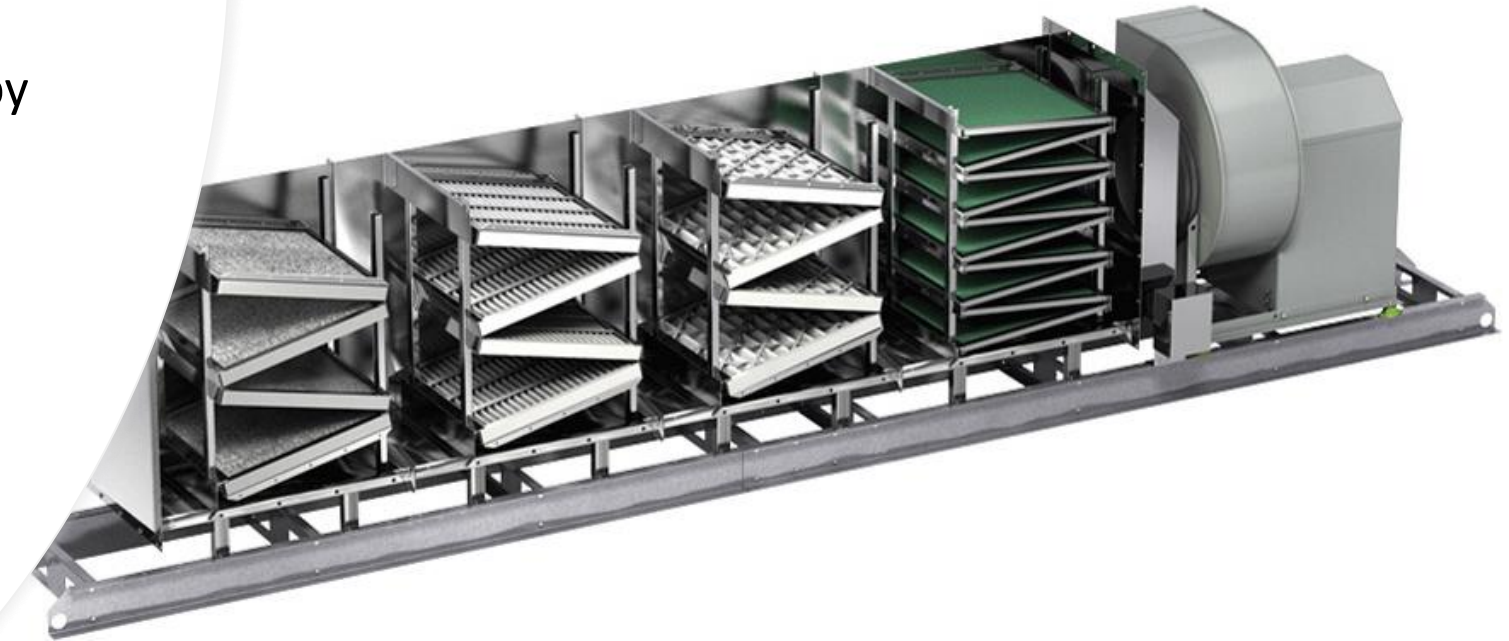
NO-FLOW CONDITION (SOLAR). A condition where thermal energy is not transferred from a solar thermal collector by means of flow of a heat transfer fluid.

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

PIPING. - *note: The term “brass” has been replaced throughout the 2024 Code with the term **copper alloy**.

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.



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

TOXICITY CLASSIFICATION (REFRIGERANT). An alphabetical designation used to identify the toxicity of refrigerants. Class A indications a refrigerant with low toxicity. Class B indicates a refrigerant with high toxicity.

UNVENTED ALCOHOL FUEL-BURNING DECORATIVE APPLIANCE. A stationary, self-contained appliance intended to be directly or indirectly secured to a wall or floor and not intended for duct connection. Such appliance burns alcohol and is made in a manufacturing facility for subsequent delivery to the installation site.

CHAPTER 3 GENERAL REGULATIONS

301.19 Pipe and duct penetrations. Openings for pipe and duct penetrations in walls, floors or ceilings shall be larger than the penetrating pipe or duct. Openings through concrete or masonry building elements shall be sleeved. The annular space surrounding pipe and duct penetrations shall be protected in an approved manner in accordance with the International Building Code.

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303.4 Protection from damage. Appliances shall not be installed in a location where subject to mechanical damage unless protected by approved barriers. ~~Protection is not required for appliances located out of the vehicle's normal travel path.~~

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 2 inches above the pit floor. The sides of the pit or excavation shall be held back not less than 12" from the appliance. Where the depth exceeds 12 inches (305 mm) below adjoining grade, the walls of the pit or excavation shall be lined with concrete or masonry. Such concrete or masonry shall extend not less than 4" (102 mm) above adjoining grade and shall have sufficient lateral load-bearing capacity to resist collapse. Excavation on the control side of the appliance shall extend no less than 30 inches (762 mm) horizontally. The appliance shall be protected from flooding in an approved manner.

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.

304.10 Clearances from grade. Equipment and appliances installed at grade level shall be supported on a level concrete slab or other approved material extending not less than 2 inches (76 mm) above adjoining grade or shall be suspended not less than 6 inches (152 mm) above adjoining grade. Such support shall be in accordance with the manufacturer's installation instructions.

10 FEET!

304.11 Guards. Guards shall be provided where various appliances, equipment, fans or other components that require service and roof hatch openings are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof, or grade below. The guard shall extend not less than 30 inches (762 mm) beyond each end of components, appliances, equipment and fans that require service and each end of the roof hatch parallel to the roof edge. The top of the guard shall be located not less than 42 inches (1067 mm) above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 20-inch-diameter (533mm) sphere and shall comply with the loading requirements for guards specified in the *International Building Code*.

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Table 305.4 PIPING SUPPORT SPACING

Copper or copper-alloy tubing MAXIMUM HORIZONTAL SPACING (feet) changed from ~~6~~ to **8**

307.2.1 Condensate disposal. Condensate from all condensing furnaces, cooling coils and evaporators shall be conveyed from the drain pan outlet to an approved place of disposal. Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope). Where pumps are used, they shall be installed with a factory-equipped auxiliary high-level switch and shall shut off equipment served upon activation of the auxiliary high-level switch. Condensate shall not discharge into a street, alley or other areas so as to cause a nuisance.

307.2.1.1 Condensate discharge. Condensate drains shall not directly connect to any plumbing drain, waste or vent pipe. Condensate drains shall not discharge into a plumbing fixture other than a floor sink, floor drain, trench drain, mop sink, hub drain, standpipe, utility sink or laundry sink. Condensate drain connections to a lavatory wye branch tailpiece or to a bathtub overflow pipe are prohibited. Except where discharging to grade outdoors, the point of discharge of condensate drains shall be located within the same occupancy, tenant space or dwelling unit as the source of the condensate.

*PLAN REVIEWERS NEEDS TO BE ESPECIALLY AWARE OF THIS!!!

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307.2.2 Drainpipe materials and sizes. Components of the condensate disposal system shall be ABS, cast iron, copper and copper alloy, CPVC, cross-linked polyethylene, galvanized steel, PE-RT, polyethylene, polypropylene, PVC or PVDF pipe or tubing. Components shall be selected for the pressure and temperature rating of the installation. Joints and connections shall be made in accordance with the applicable provisions of Chapter 7 of the International Plumbing Code relative to the material type. Condensate waste and drain line size shall be not less than ¾-inch pipe size and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drainpipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with an approved method. Condensate piping shall be insulated to an R-value of not less than R-3.

307.2.3 Auxiliary and secondary drain systems.

….

To prevent condensate migrating through the appliance, whenever cooling coils are located above the auxiliary drain pan, a secondary drain shall be piped from the overflow drain of the equipment-supplied drain pan to the auxiliary drain pan.

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**313.1 – 313.4.6 (These sections have been completely stricken and rewritten with the deletion of requirements for one- and two- family dwellings and townhouses, and the addition of previous amendments to the 2018 NCMC)

*Notable changes include, but are not limited to:

313.1 General. Carbon monoxide detection shall be installed in new buildings in accordance with Sections 313.1.1 through 313.6. Carbon monoxide detection shall be installed in existing buildings in accordance with NCGS 143-138(b2) and applicable sections of the International Existing Building Code.

313.1.1 Where required. Carbon monoxide detection shall be provided in Group A-2, I, and R occupancies and in classrooms in Group E occupancies in the locations specified in Section 313.2 where any of the conditions in Sections 313.2 through 313.1.6 exist.

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313.2.2 Sleeping units. …

Exceptions:

2. In Group I-3, carbon monoxide detection shall be allowed to be installed outside of each separate sleeping area in the immediate vicinity of the sleeping unit.

313.4.1 Power Source. …

Exceptions:

2. In A-2 occupancies the carbon monoxide detector shall be permitted to be battery-powered.

313.6.1 Enclosed parking garages. Carbon monoxide and nitrogen dioxide detectors installed in enclosed parking garages in accordance with Section 404.1 of the International Mechanical Code shall be maintained in accordance with the manufacturer's instructions and their listing. Detectors that become inoperable or begin producing end-of-life signals shall be replaced.

CHAPTER 4 VENTILATION

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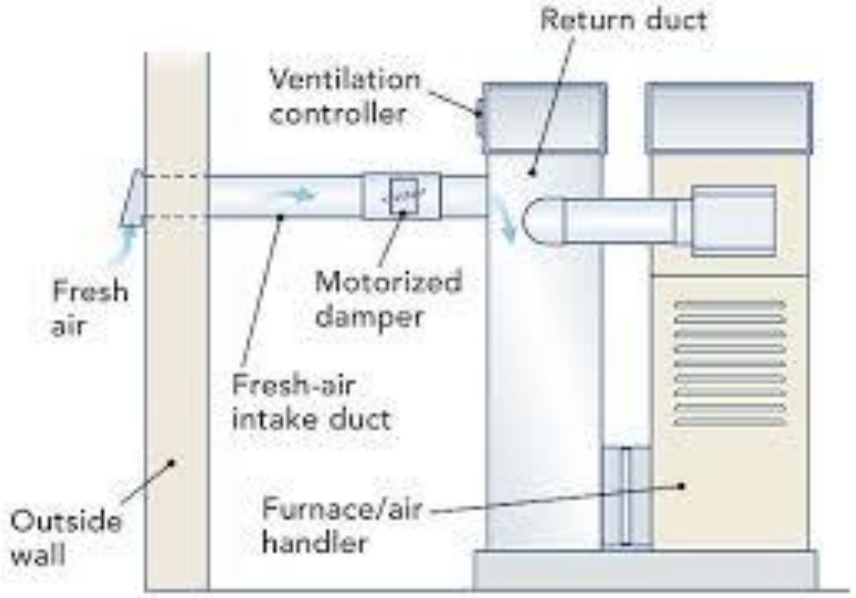
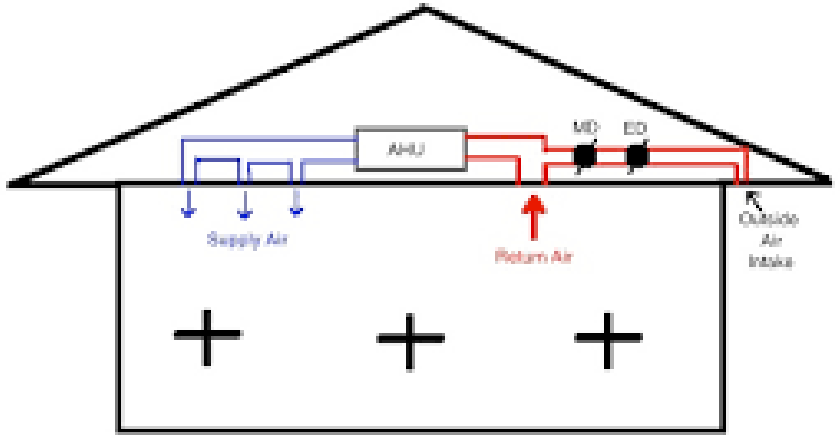
401.2 Ventilation required. Every occupied space shall be ventilated by natural means in accordance with Section 402 or by mechanical means in accordance with Section 403. Dwelling units complying with the air leakage requirements of the International Energy Conservation Code shall be ventilated by mechanical means in accordance with Section 403. Ambulatory care facilities and Group I-2 occupancies shall be ventilated by mechanical means in accordance with Section 407.





Positive Pressure
Mechanical Ventilation System

AHU = air handler unit, the blower unit in the heating & cooling system

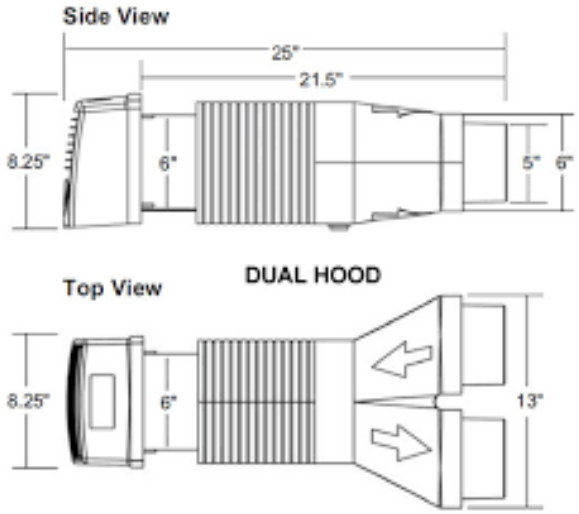
MD = mechanical damper, for controlling air flow rate
ED = electronic damper, for controlling when mech. ventilation system operates

401.4 Intake opening location. Air intake openings shall comply with all of the following:

1. (No changes)

2. (No changes)

3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening. Separation is not required between intake air openings and living space exhaust air openings of an individual dwelling unit or sleeping unit where an approved factory-built intake/exhaust combination *termination fitting is used to separate the air streams in accordance with the manufacturer's* installation instructions.



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401.5 Intake opening protection. Air intake openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles. Openings in louvers, grilles and screens shall be sized in accordance with Table 401.5 and shall be protected against local weather conditions. Louvers that protect air intake openings in structures located in hurricane-prone regions, as defined in the *International Building Code*, shall comply with AMCA 550. Outdoor air intake openings located in exterior walls shall meet the provisions for exterior wall protectives in accordance with the *International Building Code*.

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return air or exhaust air except that mechanical ventilation air requirements for Group R-2, R-3 and R-4 occupancies ~~three stories and less in height above grade plane~~ shall be provided by an exhaust system, supply system or combination thereof. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey ventilation air shall be designed and installed in accordance with Chapter 6.

403.2.1 Recirculation of air. (no changes)

1. (no changes)
2. Supply air to a swimming pool and associated deck areas shall not be recirculated unless such air is dehumidified to maintain the relative humidity of the area at 60 percent or less. Air from this area shall not be recirculated to other spaces where more than 10 percent of the resulting supply airstream consists of air recirculated from these spaces. The design and installation of dehumidification systems shall comply with ANSI/ACCA 10 Manual SPS or other approved methodologies.
3. (no changes)
4. (changed “10 percent or more” to **more than** 10 percent)

403.3.1.3 System operation. The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3.1.1 and the actual number of occupants present. Where demand-controlled ventilation is employed to adjust the outdoor airflow rate based on the actual number of occupants present, the minimum quantity of outdoor air shall not fall below that determined from the are outdoor airflow rate column of Table 403.3.1.1 during periods when the building is expected to be occupied.

403.3.2.1 **Outdoor air for dwelling units.**

Exceptions:

1. (no changes)
2. The minimum mechanical ventilation rate determined in accordance with Equation 4-9 shall be reduced by 30 percent provided that both of the following conditions apply:

    2.1. A ducted system supplies ventilation air directly to each bedroom and to one or more of the following rooms:

        2.1.1. Living room.

        2.1.2. Dining room.

        2.1.3. Kitchen.

    2.2. The whole-house ventilation system is a balanced ventilation system.

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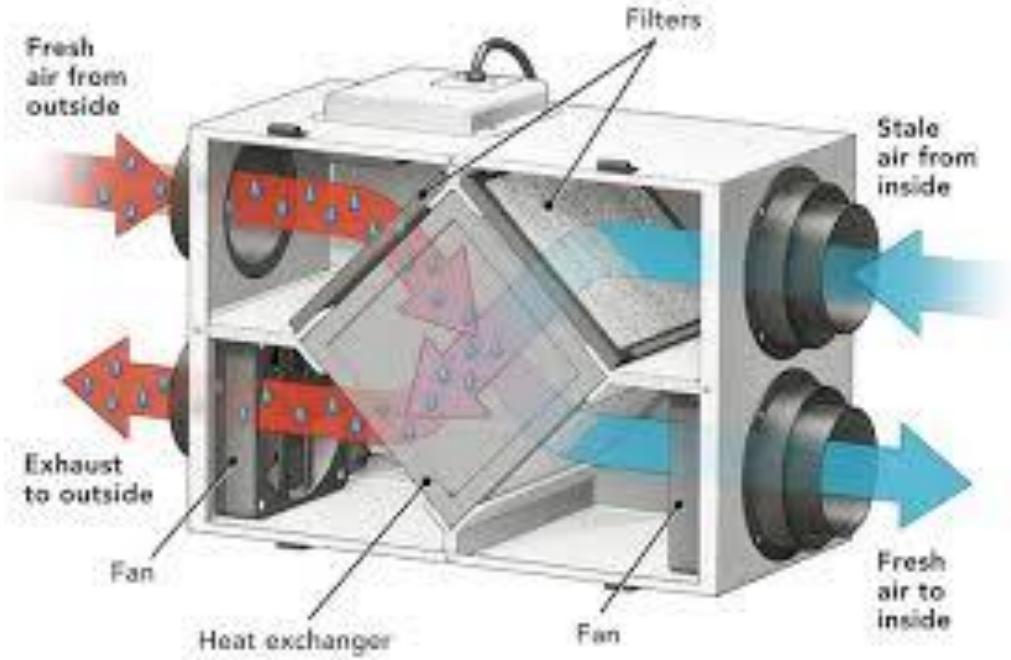
403.3.2.4 System controls. Where provided within a dwelling unit, controls for outdoor air ventilation systems shall include text or a symbol indicating the system's function.

403.3.2.5 Ventilating equipment. Fans providing exhaust or outdoor air shall be listed and labeled to provide the minimum required air flow in accordance with ANSI/AMCA 210-ANSI/ASHRAE 51.



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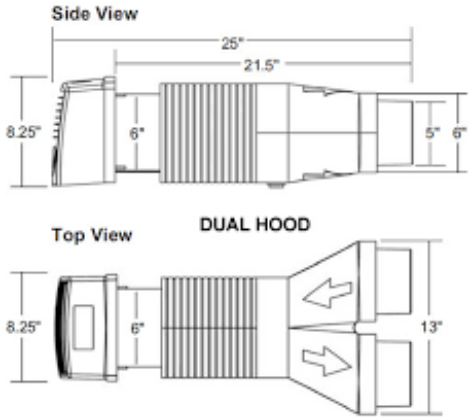
CHAPTER 5 EXHAUST SYSTEMS

501.2 Independent system required. Single or combined mechanical exhaust systems for environmental air shall be independent of all other exhaust systems. Dryer, domestic kitchen and hazardous exhaust shall be independent of all other systems. Type I exhaust systems shall be independent of all other exhaust systems except as provided in Section 506.3.5. Single or combined Type II exhaust systems for food-processing operations shall be independent of all other exhaust systems. Commercial kitchen exhaust systems shall be constructed in accordance with Sections 506 through 509.

501.3 Exhaust discharge. The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a public nuisance and not less than the distances specified in Section 501.3.1. The air shall be discharged to a location from which it cannot again be readily drawn in by a ventilating system. Air shall not be exhausted into an attic or crawl space, or be directed onto walkways. (~~balconies, decks, breezeways, covered walkways and similar horizontal projections.~~)

501.3.1 Location of exhaust outlets. The termination point of exhaust outlets and ducts discharging to the outdoors shall be located with the following minimum distances:

1. (no changes).
2. (no changes).
3. For all environmental air exhaust: 3 feet (914 mm) from property lines; 3 feet (914 mm) from operable openings into buildings for all occupancies other than Group U; and 10 feet (3048 mm) from mechanical air intakes. Such exhaust shall not be considered hazardous or noxious. Separation is not required between intake air openings and living space exhaust air openings of an individual dwelling unit or sleeping unit where an approved factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the manufacturer's instructions.
4. (no changes).
5. (no changes).



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502.4 Stationary storage battery systems. Stationary storage battery systems shall be regulated and ventilated in accordance with 1207.6.1 of the *International Fire Code,* and the requirements of this chapter.

502.5 Ventilation of battery systems in cabinets. Stationary storage battery systems installed in cabinets shall be provided with ventilation in accordance with Section 502.4.

502.9.5 Flammable and combustible liquids. (no changes)

Exceptions:

1. This section shall not apply to flammable and combustible liquids that are exempt from the *International Fire Code.*
2. The storage of beer, distilled spirits and wine in barrels and casks conforming to the requirements of the *International Fire Code.*

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

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, liquified 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 ($5.6m^3$).

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

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.

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 (0.03 m^3/min) per 12 cubic feet (0.34 m^3) of room volume.

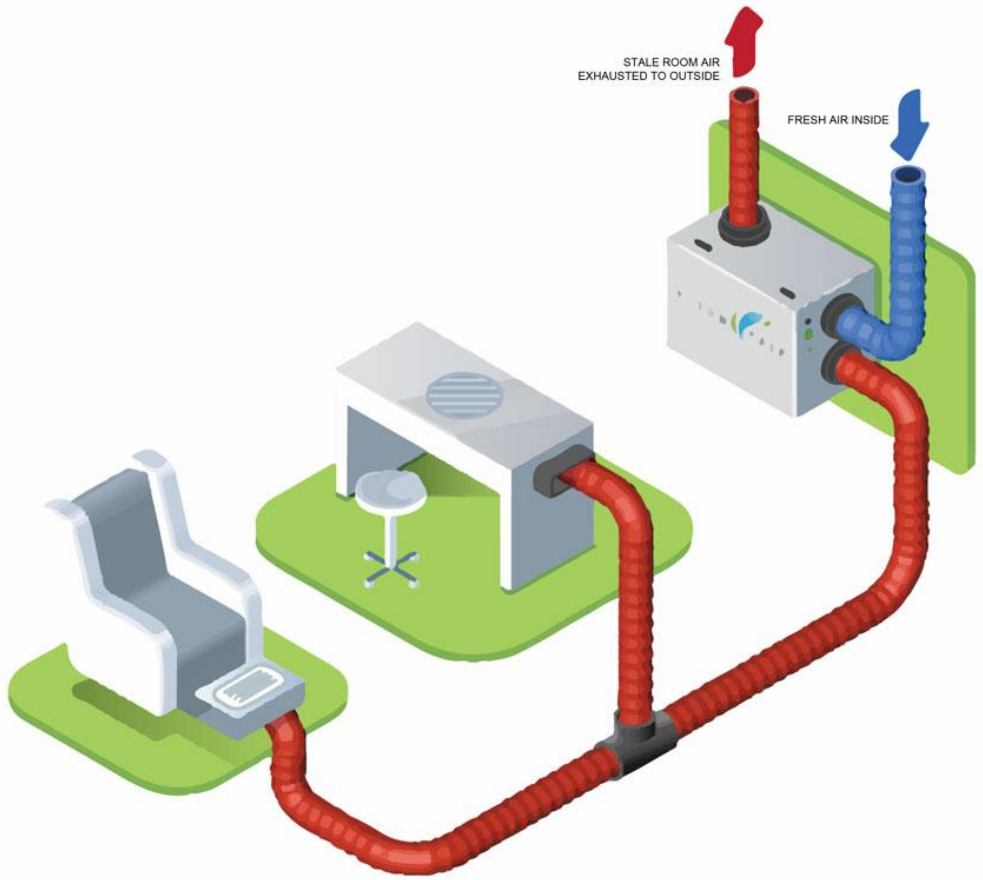
502.16.2.2 Operation. The mechanical exhaust ventilation system shall operate continuously.

Exceptions:

1. Mechanical exhaust ventilation systems that are interlocked with a gas detection system designed in accordance with the *International Fire Code.*
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.

502.20 Manicure and pedicure stations. (no changes)

502.20.1 Operation. The exhaust system for manicure and pedicure stations shall have controls that operate the system continuously when the space is occupied.



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504.4.1 Termination location. Exhaust duct terminations shall be in accordance with the dryer manufacturer's installation instructions. Where the manufacturer's instructions do not specify a termination location, the exhaust duct shall terminate not less than 3 feet (914 mm) in any direction from openings into buildings, including openings in ventilated soffits. The exhaust duct terminations shall not discharge onto walkways, balconies, decks, breezeways, covered walkways and similar horizontal projections. Exhaust ducts shall terminate not less than 12 inches (305 mm) above finished grade.

Exception: (no change)

504.4.2 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 (8065 mm^2).

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504.7 Makeup air. Where an enclosed space is less than 70 square feet and is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (0.0645 m^2) shall be provided in the enclosure or makeup air shall be provided by other approved means.

504.9.2 Duct installation. Exhaust ducts shall be supported at 4-foot (1219 mm) intervals and secured in place. The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow. Ducts shall not be joined with screws or similar fasteners that protrude into the inside of the duct. Ducts shall be sealed in accordance with Section 603.9. Ducts shall be mechanically fastened by one of the following methods.

a. Nonmetallic mechanical fasteners (tie-straps) shall be listed to UL 181B.

b. Metal band duct clamps area not required to be listed.

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

504.9.5 Length identification. (no changes)

1. (no changes)
2. Labels shall state, at a minimum (fill in the blank):

   Caution: Equivalent length **of _____ feet including _____ 45 deg. elbows and _____ 90 deg. elbows.** Any installed dryer must be equipped with an exhaust system that meets or exceeds this equivalent length requirement.

SECTION 505
DOMESTIC COOKING EXHAUST EQUIPMENT

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 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.

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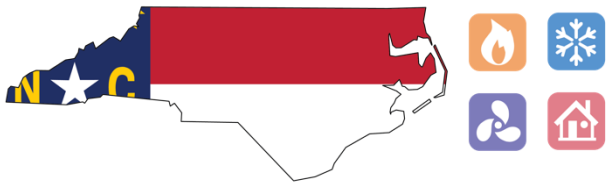

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505.3 Exhaust ducts. Domestic cooking exhaust equipment shall discharge to the outdoors through sheet metal ducts constructed of galvanized steel, stainless steel, aluminum or copper. Such ducts shall have smooth inner walls, shall be airtight and shall be equipped with a backdraft damper. Installations in Group I-1 and I-2 occupancies shall be in accordance with the *International Building Code* and Section 904.14 of the *International Fire Code.*

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.

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506.3.2.5 Grease duct test. Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed in the presence of the code official or shall be witnessed by a professional engineer who shall provide certification of performance to the code official. Ducts shall be considered to be concealed where installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides. The permit holder shall be responsible to provide the necessary equipment and perform the grease duct leakage test. A light test shall be performed to determine that all welded and brazed joints are liquid tight.

506.3.7 Prevention of grease accumulation in grease ducts. (body of this requirement has not changed, only adding an exception)

Exception: Factory-built grease ducts shall be installed at a slope that is in accordance with the listing and manufacturer's installation instructions.

506.3.9 Grease duct horizontal cleanouts. Cleanouts serving horizontal sections of grease ducts shall:

1-6 (no changes – requirement 7 has been added in the 2024 NCMC)

7. Be located within 3 feet (914 mm) of horizontal discharge fans.

506.3.13 Exhaust outlets serving Type I hoods. (no change)

506.3.13.1 Termination above the roof. (no change)

506.3.13.2 Termination through an exterior wall. Exhaust outlets shall be permitted to terminate through exterior walls where the smoke, grease, gases, vapors and odors in the discharge from such terminations do not create a public nuisance or a fire hazard. Such terminations shall not be located where protected openings are required by the *International Building Code*. Such terminations shall be located in accordance with Section 506.3.13.3 and shall not be located with 3 feet (914 mm) of any opening in the exterior wall.

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506.5.2 Pollution-control units. The installation of pollution-control units shall be in accordance with all of the following:

1. Pollution-control units shall be listed and labeled in accordance with UL 8782.
2. Fans serving pollution-control units shall be listed and labeled in accordance with UL 762.
3. Bracing and supports for pollution-control units shall be of noncombustible material securely attached to the structure and designed to carry gravity and seismic loads within the stress limitations of the *International Building Code.*
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 listed and labeled, in accordance with UL 2221 or ASTM E2336, for location in an enclosure 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. Clearances shall be maintained between the pollution-control unit and combustible material in accordance with the listing.

506.5.2 Pollution-control units. (continued)

…

6. Roof-mounted pollution-control units shall be listed for outdoor installation and shall be mounted not less than 18 inches (457 mm) above the roof.
7. Exhaust outlets for pollution-control units shall be in accordance with Section 506.3.13. (code sees the outlet in the same way as a typical grease duct termination.)
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.

506.5.2 Pollution-control units. (continued)

…

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 (457 mm). 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.

507.1 General. (no changes to the intent; minor wording changes)

Exceptions:

1. (no changes)
2. (no changes)
3. (no changes)
4. Smoker ovens with integral exhaust systems, provided that the appliance is installed in accordance with the manufacturer's installation instructions, is listed and tested for the application, and complies with Chapter 5.

507.2 Type I hoods. Type I hoods shall be installed where cooking appliances produce grease or smoke as a result of the cooking process. Type I hoods shall be installed over medium-duty, heavy-duty and extra-heavy-duty cooking appliances.

507.3 Type II hoods. Type II hoods shall be installed above dishwashers and **appliances** that produce heat or moisture and do not produce grease or smoke as a result of the cooking process, except where the heat and moisture loads from such appliances are incorporated into the HVAC system design or into the design of a separate removal system. Type II hoods shall be installed above all that produce products of combustion and do not produce grease or smoke as a result of the cooking process. Spaces containing cooking appliances that do not require Type II hoods shall be provided with exhaust at a rate of 0.70 cfm per square foot (0.00356 $m^3/(s \cdot m^2)$). For the purpose of determining the floor area required to be exhausted, each individual appliance that is not required to be installed under a Type II hood shall be considered as occupying not less than 100 square feet (9.3 m^2). Such additional square footage shall be provided with exhaust at a rate of 0.70 cfm per square foot [0.00356 $m^3/(s \cdot m^2)$].

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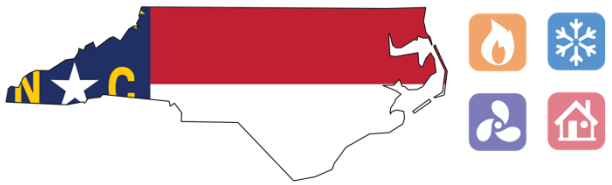

CHAPTER 6
DUCT SYSTEMS

601.5 Return air openings. Return air openings for heating, ventilation and air-conditioning systems shall comply with all of the following:

1. Openings shall not be located less than 10 feet (3048 mm) measured in any direction from an open combustion chamber, including factory-built and masonry fireplaces or draft hood of another appliance located in the same room or space.
2. (no change)
3. (no change)
4. (no change)
5. (no change)
6. Return air shall not be taken from a closet, bathroom, toilet room, kitchen, garage, boiler room, furnace room**,** crawl space or unconditioned attic.
7. Return air shall not be taken from indoor swimming pool enclosures and associated deck areas.

Exceptions: (to #7)

1. Where the air from such spaces is dehumidified in accordance with Section 403.2.1, Item 2.
2. Dedicated HVAC systems serving only such spaces.

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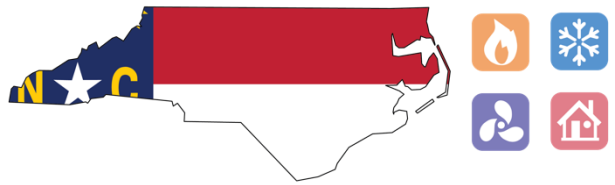

601.5 Return air openings. (Continued)…

Exceptions: (to 601.5)

1. Taking return air from a kitchen is not prohibited where such return air openings serve the kitchen and are located not less than 10 feet (3048 mm) from the cooking appliances.
2. Taking return air from a kitchen is not prohibited in a dwelling unit where the kitchen and living spaces are in a single room and the cooking appliance is electric and located not less than 5 feet (1524 mm) in any direction from the return air intake opening.
3. Dedicated forced air systems serving only the garage shall not be prohibited from obtaining return air from the garage.

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602.2.1 Materials within plenums. (no changes)
Exceptions:

1. (no change)
2. (no change)
3. This section shall not apply to materials exposed within plenums or mechanical equipment rooms used as plenums in dwelling units.
4. (no change)
5. Combustible materials fully enclosed within one of the following:
    - 5.1 Continuous noncombustible raceways or enclosures.
    - 5.2 Approved gypsum board assemblies.
    - 5.3 Materials listed and labeled for installation within a plenum and listed for the application.

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603.4 Metallic ducts. Metallic ducts shall be constructed as specified in the SMACNA HVAC Duct Construction Standards— Metal and Flexible.

Exception:

1. Ducts installed within single dwelling units shall have a minimum thickness as specified in Table 603.4.
2. Domestic clothes dryer exhausts shall have a minimum thickness as specified in Section 504.9.1.

TABLE 603.4
DUCT CONSTRUCTION MINIMUM SHEET METAL THICKNESS FOR SINGLE DWELLING UNITS[a]

ROUND DUCT DIAMETER (inches)	STATIC PRESSURE			
	½-inch water gauge		1-inch water gauge	
	Thickness (inches)		Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
≤ 12	0.013 (30 ga.)	0.018 (24 ga.)	0.013 (30 ga.)	0.018 (24 ga.)
12 to14	0.013 (30 ga.)	0.018 (24 ga.)	0.016 (28 ga.)	0.023 (22 ga.)
15 to 17	0.016 (28 ga.)	0.023 (22 ga.)	0.019 (26 ga.)	0.027 (20 ga.)
19 to 20	0.019 (26 ga.)	0.027 (20 ga.)	0.024 (24 ga.)	0.034 (18 ga.)
RECTANGULAR DUCT DIMENSION (inches)	**STATIC PRESSURE**			
	½-inch water gauge		1-inch water gauge	
	Thickness (inches)		Thickness (inches)	
	Galvanized	Aluminum	Galvanized	Aluminum
≤ 8	0.013 (30 ga.)	0.018 (24 ga.)	0.013 (30 ga.)	0.018 (24 ga.)
9 to 10	0.013 (30 ga.)	0.018 (24 ga.)	0.016 (28 ga.)	0.023 (22 ga.)
11 to 12	0.016 (28 ga.)	0.023 (22 ga.)	0.019 (26 ga.)	0.027 (20 ga.)
13 to 16	0.019 (26 ga.)	0.027 (20 ga.)	0.019 (26 ga.)	0.027 (20 ga.)
17 to 18	0.019 (26 ga.)	0.027 (20 ga.)	0.024 (24 ga.)	0.034 (18 ga.)
19 to 20	0.024 (24 ga.)	0.034 (18 ga.)	0.024 (24 ga.)	0.034 (18 ga.)

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~~603.19 Return air intake (nonengineered systems).~~ **DELETED (NO MORE 1600SQFT RULE)**

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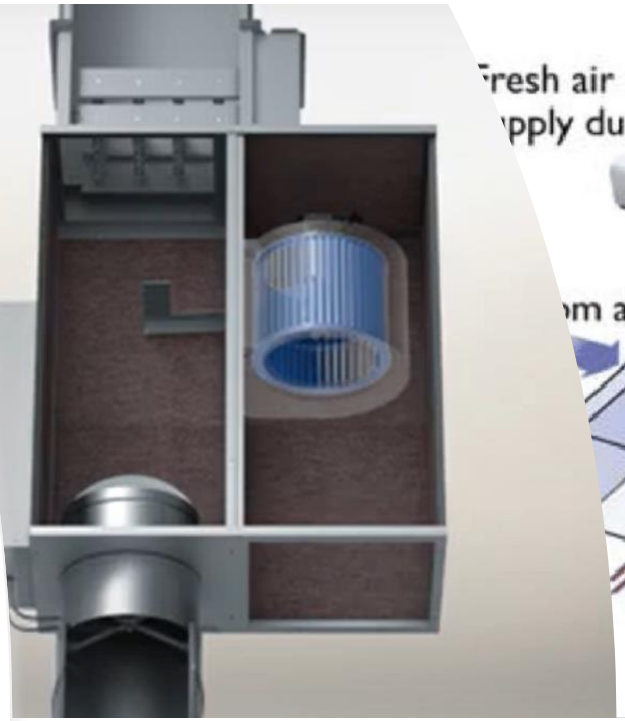
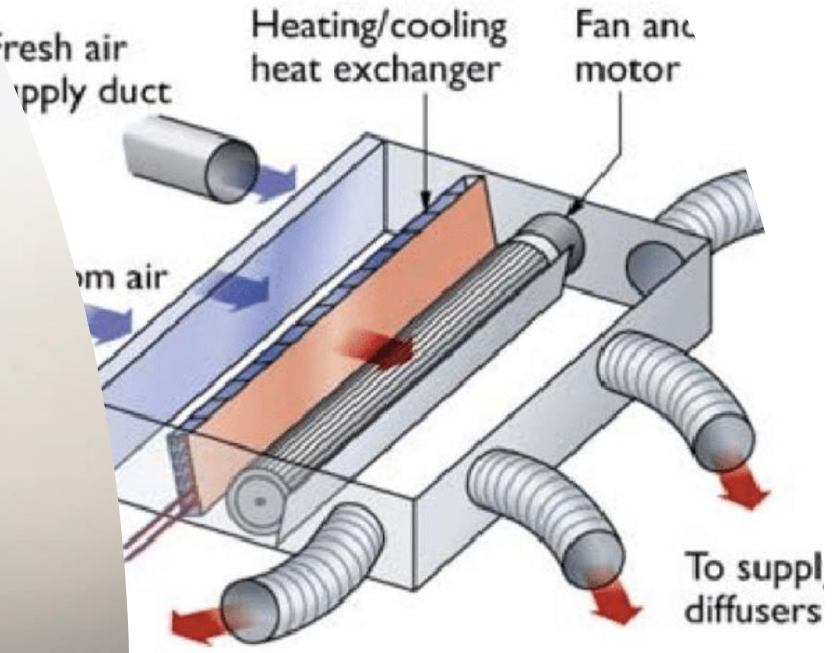
606.2.2 Common supply and return air systems. (no change) *Note: the exceptions have been condensed but the requirements remain the same.

A **fan-powered terminal unit**, commonly referred to as a <u>fan powered box (FPB)</u>, is an air terminal unit which contains both a primary air inlet, as well as a local motor and blower assembly. Fan powered terminals generally come in either a parallel or series arrangement, determined by the location of the fan in the assembly. (Source: Price Industries)





FPB ≠ FCU

A fan-powered terminal unit is <u>NOT</u> the same as a fan coil unit!

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[BF] 607.2 Installation. Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers located within air distribution and smoke control systems shall be installed in accordance with the manufacturer's instructions, the dampers' listing and Sections 607.2.1 through 607.2.3.

[BF] 607.2.1 Smoke control system (no changes)

607.2.2 Hazardous exhaust ducts (no changes)

[BF] 607.2.3 Static dampers. Fire dampers and ceiling radiation dampers that are listed for use in static systems shall be installed only in heating, ventilation and air-conditioning systems that are automatically shut down in the event of a fire.

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[BF] 607.4 Access and identification. Access and identification of fire and smoke dampers shall comply with Sections 607.4.1 through 607.4.2

[BF] 607.4.1 Access. Fire and smoke dampers shall be provided with an approved means of access that is large enough to permit inspection and maintenance of the damper and its operating parts. Dampers equipped with fusible links, internal operators or both shall be provided with an access door that is not less than 12 inches (305 mm) square or provided with a removable duct section.

[BF] 607.4.1.1 Fire-resistance rating. The access shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly. Access doors in ducts shall be tight fitting and suitable for the required duct construction.

[BF] 607.4.1.2 Restricted access. Where space constraints or physical barriers restrict access to a damper for periodic inspection and testing, the damper shall be a single- or multi-blade damper and shall comply with the remote inspection requirements of NFPA 80 or NFPA 105.

[BF] 607.4.2 Identification. Access points shall be permanently identified on the exterior by a label having letters not less than 1/2 inch (12.7 mm) in height reading: FIRE/SMOKE DAMPER, SMOKE DAMPER or FIRE DAMPER.

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[BF] 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.

Exceptions:

1. Fire dampers are not required at penetrations of shafts where any of the following apply:
   1.1 Steel exhaust subducts having a wall thickness of not less than 0.0187 inch (0.4712 mm) extend not less than 22 inches (559 mm) vertically in exhaust shafts and an exhaust fan is installed at the upper terminus of the shaft that is powered continuously, in accordance with Section 909.11 of the International Building Code, so as to maintain a continuous airflow upward to the outdoors.
   1.2 – 1.4 (No changes)
2. (no changes)
3. (no changes)
4. (no changes)
5. Fire dampers and combination fire/smoke dampers are not required in kitchen and clothes dryer exhaust systems where dampers are prohibited by this code.

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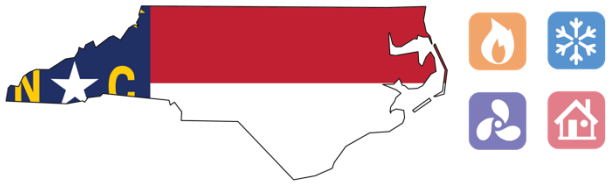

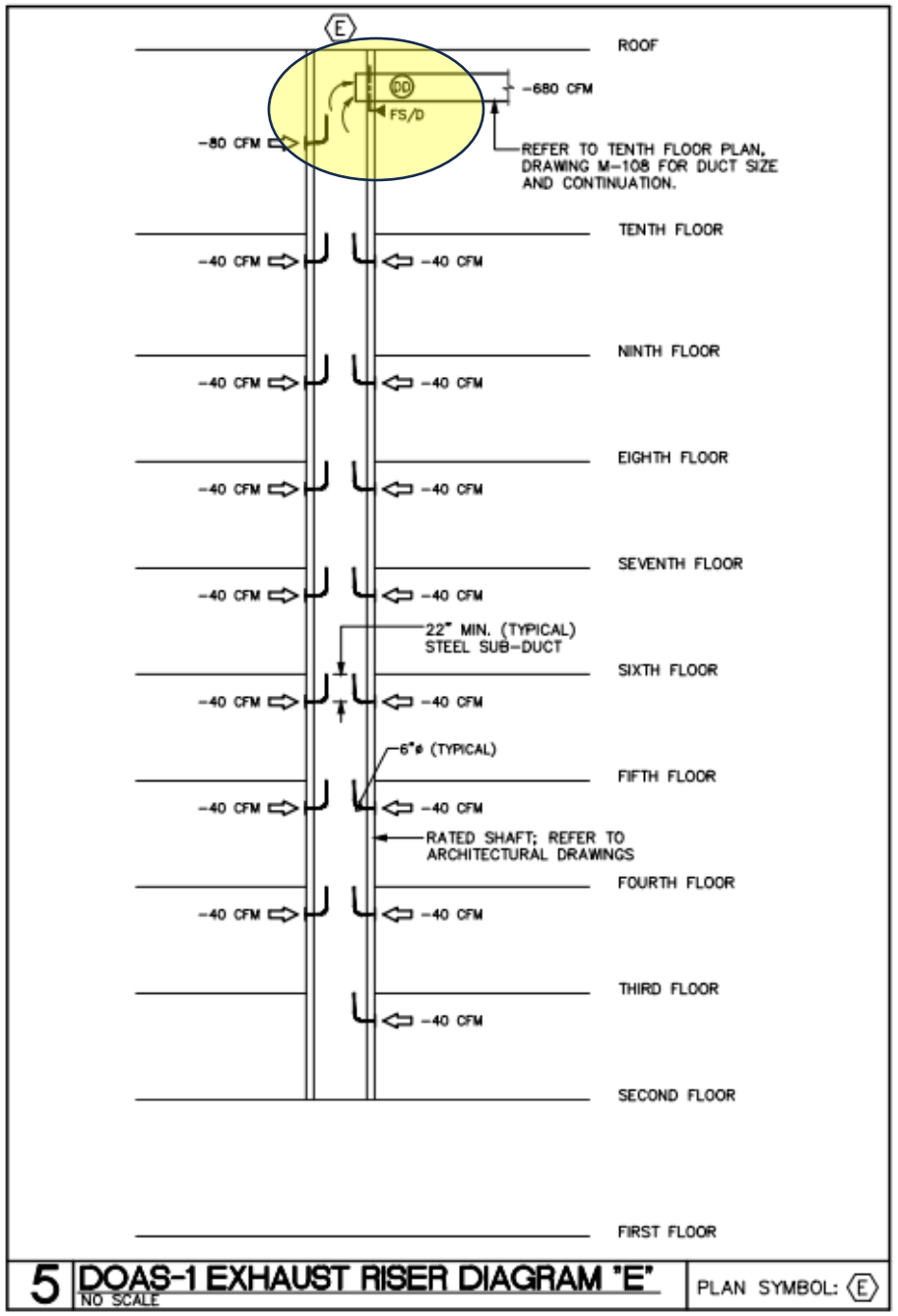

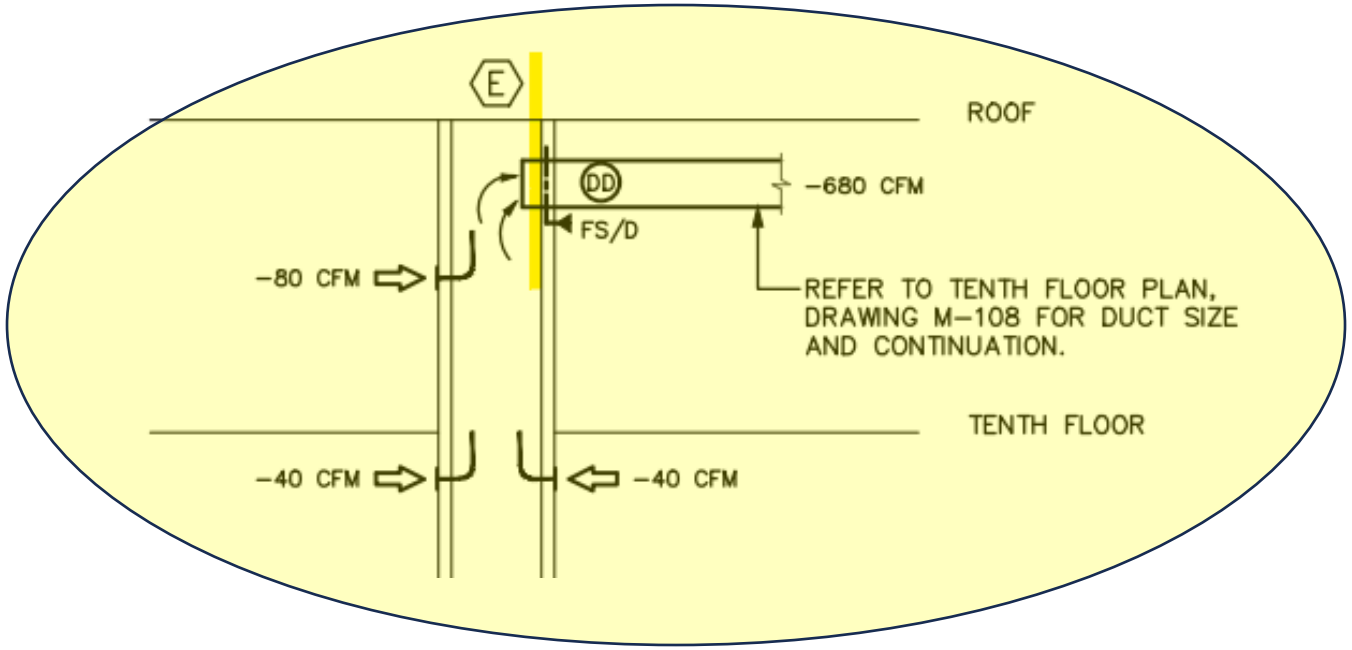

[BF] 607.5.5.1 Continuous upward flow. Fire dampers and smoke dampers shall not be installed in shafts that are required to maintain continuous airflow upward where closure of the damper would result in the loss of airflow

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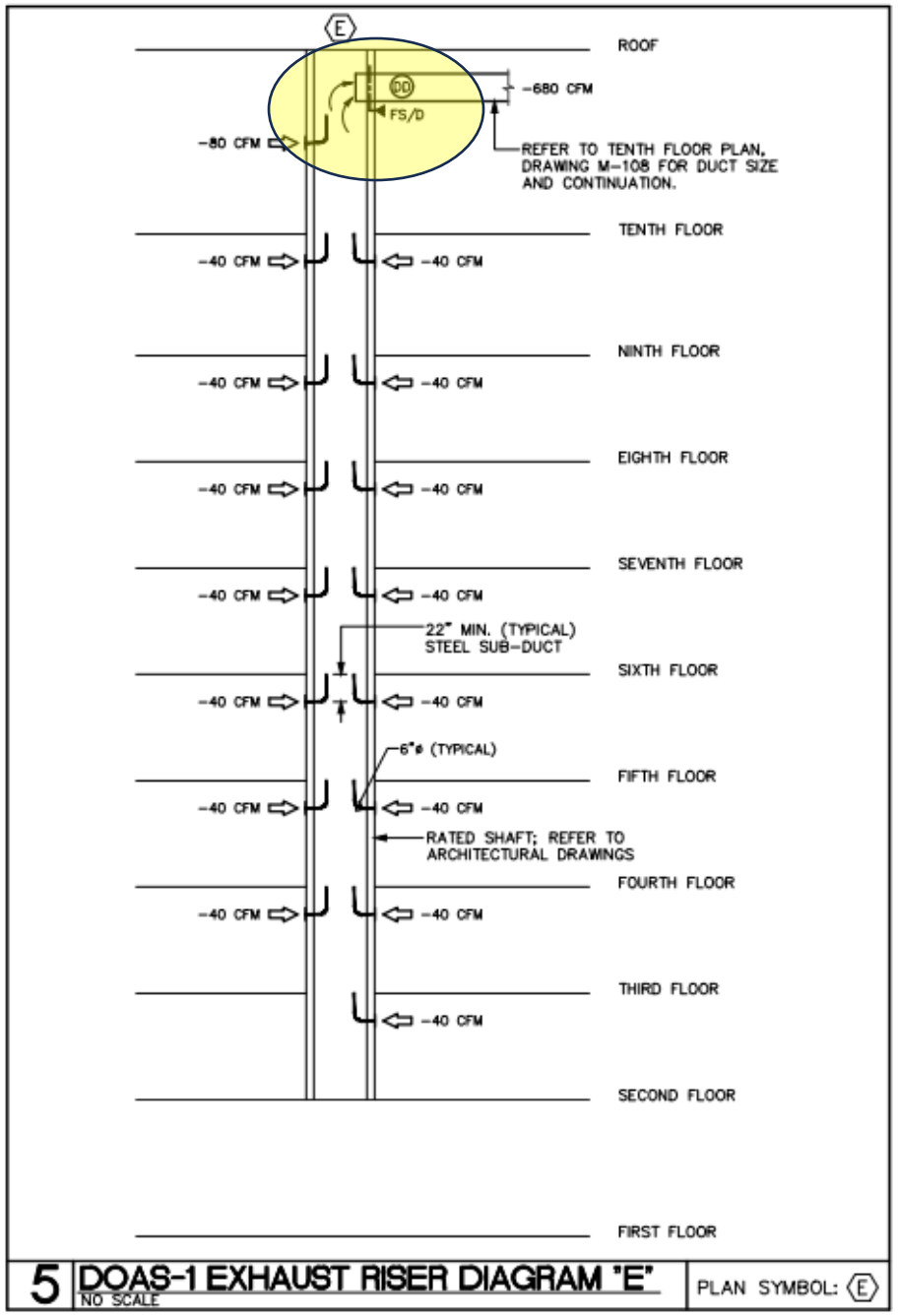

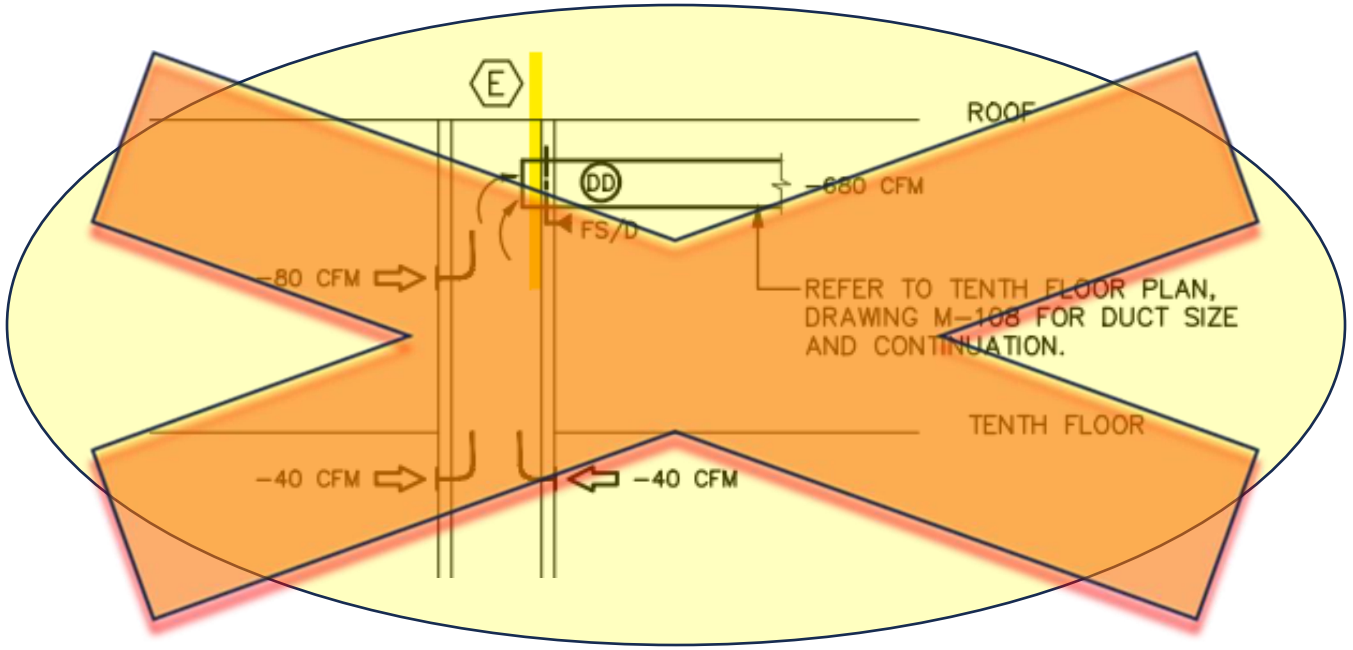

[BF] 607.5.5.1 Continuous upward flow. Fire dampers and smoke dampers shall not be installed in shafts that are required to maintain continuous airflow upward where closure of the damper would result in the loss of airflow

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[BF] 607.6.2.1 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.

[BF] 607.6.2.1.1 Dynamic systems. Ceiling radiation dampers installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire shall be labelled for use in dynamic systems.

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[BF] 607.6.2.1.2 Static systems. Static ceiling radiation dampers shall be installed only in systems that are not designed to operate during a fire

Exceptions:

1. Where a static ceiling radiation damper is installed at the opening of a duct, a smoke detector shall be installed inside the duct or outside the duct with sampling tubes protruding into the duct. The detector or tubes within the duct shall be within 5 feet (1524 mm) of the damper. Air outlets and inlets shall not be located between the detector or tubes and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed. Other than in mechanical smoke control systems, dampers shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
2. Where a static ceiling radiation damper is installed in a ceiling, the ceiling radiation damper shall be permitted to be controlled by a smoke detection system installed within the same room or area as the ceiling radiation damper
3. A static ceiling radiation damper shall be permitted to be installed within a room where an occupant sensor is provided within the room that will shut down the system

SECTION 608
BALANCING

608.1 Balancing. Air distribution, ventilation and exhaust systems shall be provided with means to adjust the system to achieve the design airflow rates and shall be balanced by an approved method. Ventilation air distribution shall be balanced by an approved method and such balancing shall verify that the air distribution system is capable of supplying and exhausting the airflow rates required by Chapter 4.

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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.

SECTION 929
UNVENTED ALCOHOL FUEL-BURNING DECORATIVE APPLIANCES

929.1 General. Unvented alcohol fuel-burning decorative appliances shall be listed and labeled in accordance with UL 1370 and shall be installed in accordance with the conditions of the listing, manufacturer's installation instructions and Chapter 3.

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SECTION 930
LARGE-DIAMETER CEILING FANS

930.1 General. Where provided, large-diameter ceiling 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.

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CHAPTER 10

BOILERS, WATER HEATERS AND PRESSURE VESSELS

SECTION 1006
SAFETY AND PRESSURE
RELIEF VALVES AND CONTROLS

1006.6 Safety and relief valve discharge. Safety and relief valve discharge pipes shall be of rigid pipe that is approved for the temperature of the system. High-pressure-steam safety valves shall be vented to the outside of the structure. 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.

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1006.6 Safety and relief valve discharge. (continued)

…… shall:

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 (152 mm) above the floor or waste receptor.
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.

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CHAPTER 11
REFRIGERATION

SECTION 1101
GENERAL

1101.1.1 Refrigerants other than ammonia. Refrigerant piping design and installation for systems containing a refrigerant other than ammonia, including pressure vessels and pressure relief devices, shall comply with this chapter and ASHRAE 15.

1101.1.2 Ammonia refrigerant. 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.

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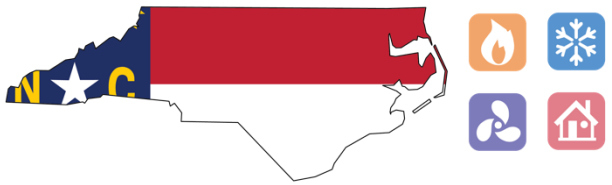

1101.2 Factory-built equipment and appliances. Listed and labeled self-contained, factory-built equipment and appliances shall be tested in accordance with the applicable standards specified in Table 1101.2. Such equipment and appliances are deemed to meet the design, manufacture and factory test requirements of this code if installed in accordance with their listing and the manufacturer's instructions.

TABLE 1101.2
FACTORY-BUILT EQUIPMENT AND APPLIANCES

EQUIPMENT	STANDARDS
Refrigeration fittings, including press-connect, flared and threaded	UL 109 and UL 207
Air-conditioning equipment	UL 1995 or UL/CSA 60335-2-40
Packaged terminal air conditioners and heat pumps	UL 484 or UL/CSA 60335-2-40
Split-system air conditioners and heat pumps	UL 1995 or UL/CSA 60335-2-40
Dehumidifiers	UL 474 or UL/CSA 60335-2-40
Unit coolers	UL 412 or UL/CSA 60335-2-89
Commercial refrigerators, freezers, beverage coolers and walk-in coolers	UL 471 or UL/CSA 60335-2-89
Refrigerating units and walk-in coolers	UL 427 or UL 60335-2-89
Refrigerant-containing components and accessories	UL 207

1101.2.1 Group A2L, A2, A3 and B1 high-probability equipment. High-probability equipment using Group A2L, A2, A3, or B1 refrigerant shall comply with UL 484, UL/CSA 60335-2-40, or UL/CSA 60335-2-89.

SECTION 1103
REFRIGERATION SYSTEM CLASSIFICATION

1103.1 Refrigerant classification. Refrigerants shall be classified in accordance with ASHRAE 34 as listed in Table 1103.1.

*NOTE: Table 1103.1 has been updated with current classifications per ASHRAE 34.

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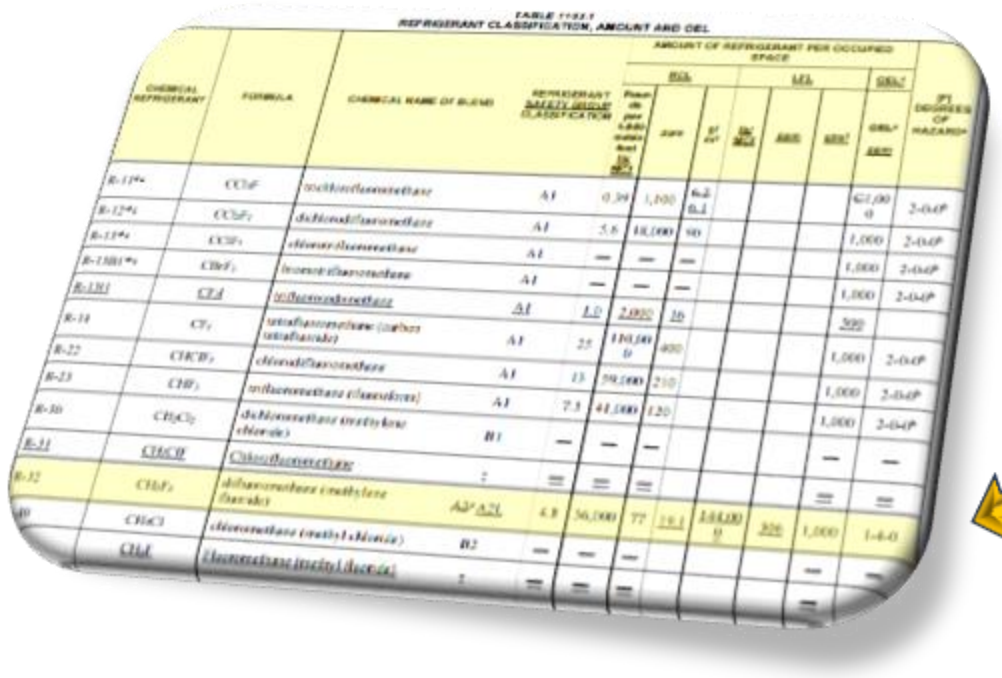
TABLE 1103.1
REFRIGERANT CLASSIFICATION, AMOUNT AND OEL

CHEMICAL REFRIGERANT	FORMULA	CHEMICAL NAME OF BLEND	REFRIGERANT SAFETY GROUP CLASSIFICATION	AMOUNT OF REFRIGERANT PER OCCUPIED SPACE							[F] DEGREES OF HAZARD[a]
				RCL			LFL			OEL[d]	
				~~Pounds per 1,000 cubic~~	ppm	g/m³	lb/MCf	ppm	g/m³	~~OEL[c]~~ ___	
R-32	CH_2F_2	difluoromethane (methylene fluoride)	~~A2[c]~~ A2L	4.8	36,000	77	19.1	144,000	306	1,000	1-4-0



lb/MCf

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1104.3.1 Air conditioning for human comfort.

High-probability systems used for human comfort shall use Group A1 or A2L refrigerant.

Exceptions:

1. Equipment listed for and used in residential occupancies containing a maximum of 6.6 pounds (3 kg) of refrigerant.
2. Equipment listed for and used in commercial occupancies containing a maximum of 22 pounds (10 kg) of refrigerant.
3. Industrial occupancies.

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7.6 Group A2L Refrigerants for Human Comfort. *High-probability systems* using Group A2L *ants* for human comfort applications *shall* comply with this section.

7.6.1 Refrigerant Quantity Limits. The maximum *refrigerant* charge of any *independent circui* refrigeration system *shall* be as *specified* in Sections 7.6.1.1 and 7.6.1.2.

7.6.1.1* Refrigeration Systems with Air Circulation. Where a *high-probability system* for hum fort using Group A2L *refrigerants* has either

a. *air circulation* initiated by a *refrigerant detector* in compliance with Section 7.6.2.4 or
b. continuous *air circulation*,

the *refrigerant* charge quantity *shall* be limited per Equation 7-8. Control of continuous *air circulat* be performed by the *listed* equipment and *shall* operate continuously other than short periods for nance and service:

$$EDVC = V_{eff} \times LFL \times \mathrm{CF} \times F_{occ}$$

where

$EDVC$ = *effective dispersal volume charge*, lb (kg)
V_{eff} = *effective dispersal volume*, ft^3 (m^3)
LFL = *lower flammability limit*, lb/ft^3 (kg/m^3)
CF = concentration factor, value of 0.5
F_{occ} = *occupancy* adjustment factor; (For all *occupancies* other than *institutional occupancies*, a value of 1. For *institutional occupancies*, F_{occ} has a value of 0.5.)

7.6.1.2* Other Refrigeration Systems. For any refrigeration system not meeting the requirer Section 7.6.1.1, the *refrigerant* charge of the largest *independent circuit* of the system (m_s) *shall no* the value from Equation 7-9:

$$EDVC = M_{def} \times F_{LFL} \times F_{occ}$$

where

$EDVC$ = *effective dispersal volume charge*, ft^3 (m^3)
M_{def} = *refrigerant* charge from Table 7-1 (lb) or Table 7-2 (kg)
F_{LFL} = *LFL* conversion factor from Table 7-3
F_{occ} = *occupancy* adjustment factor; (For all *occupancies* other than *institutional occupancies*, a value of 1. For *institutional occupancies*, F_{occ} has a value of 0.5.)

1104.3.2 Group A2, A3, B2 and B3 refrigerants. Group A2 and B2 refrigerants shall not be used in high-probability systems. Group A3 and B3 refrigerants shall not be used except where approved.

Exceptions: This section does not apply to:

1. Laboratories where the floor area per occupant is not less than 100 square feet (9.3 m2).
2. Listed self-contained systems having a maximum of 0.331 pounds (150 g) of Group A3 refrigerant.
3. Industrial occupancies.
4. Equipment listed for and used in residential occupancies containing a maximum of 6.6 pounds (3 kg) of Group A2 or B2 refrigerant.
5. Equipment listed for and used in commercial occupancies containing a maximum of 22 pounds (10 kg) of Group A2 or B2 refrigerant.

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SECTION 1105
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.

[BE] 1105.9 Means of egress. Machinery rooms larger than 1,000 square feet (93 m2) shall have not less than two exits or exit access doorways. Where two exit access doorways are required, one such doorway is permitted to be served by a fixed ladder or an alternating tread device. Exit access doorways shall be separated by a horizontal distance equal to one-half the maximum horizontal dimension of the room. All portions of machinery rooms shall be within 150 feet (45 720 mm) of an exit or exit access doorway. An increase in exit access travel distance is permitted in accordance with Section 1017.1 of the International Building Code. Exit and exit access doorways shall swing in the direction of egress travel and shall be equipped with panic hardware, regardless of the occupant load served. Exit and exit access doorways shall be tight fitting and self-closing.

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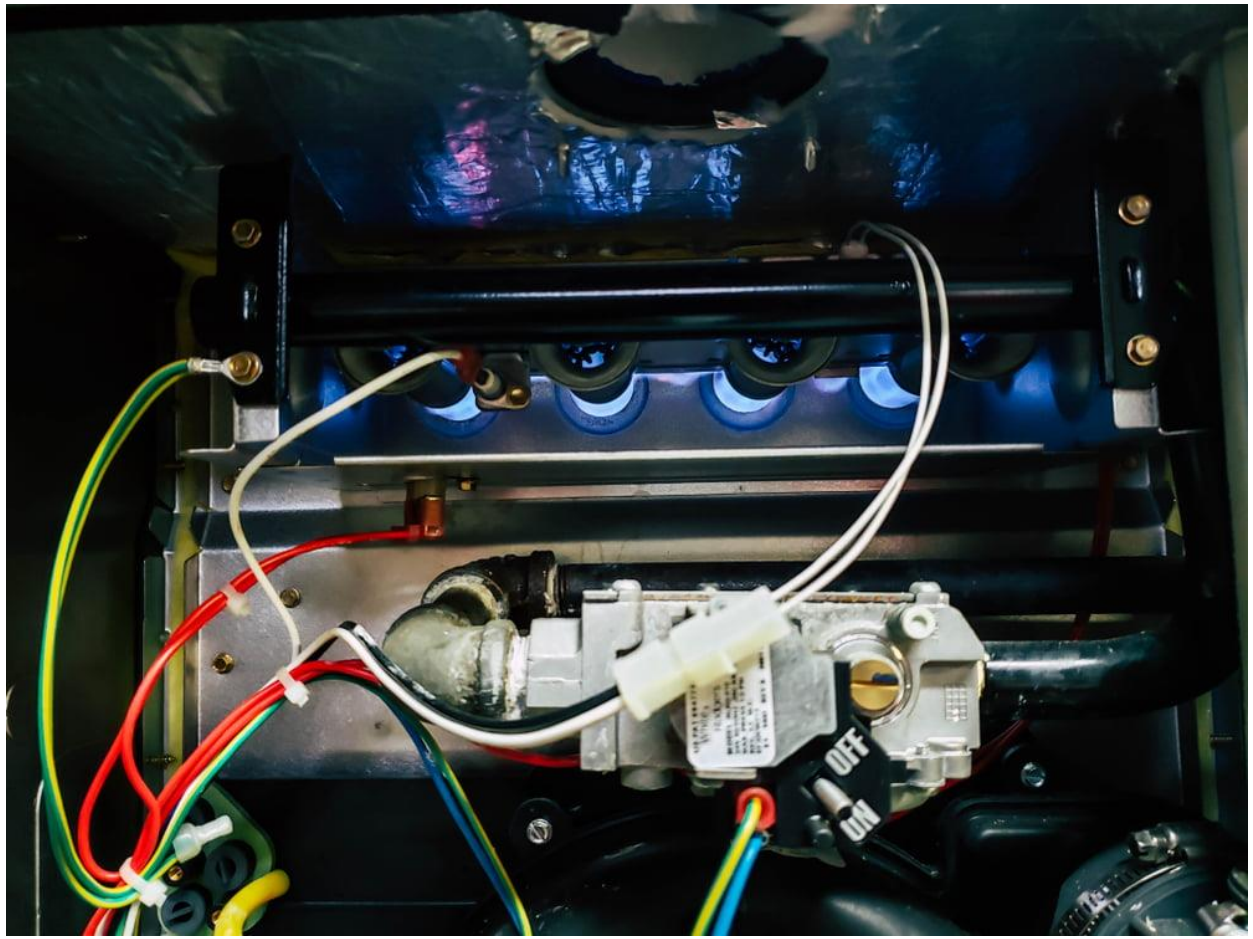

1106.3 Class 2 and 3 refrigerants. Where refrigerants of Groups A2, A3, B2 and B3 are used, the machinery room shall conform to the Class I, Division 2, hazardous location classification requirements of NFPA 70.

1106.4 Group A2L and B2L refrigerant. Machinery rooms for Group A2L and B2L refrigerant shall comply with Sections1106.4.1 through Section 1106.4.3.

1106.4.1 Elevated temperatures. Open flame-producing devices or continuously operating hot surfaces over 1290°F (700°C) shall not be permanently installed in the room.

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1106.4.2 Refrigerant detector. In addition to the requirements of Section 1105.3, refrigerant detectors shall signal an alarm and activate the ventilation system in accordance with the response time specified in Table 1106.4.2.

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1106.4.3 Mechanical ventilation. The machinery room shall have a mechanical ventilation system complying with ASHRAE 15.

8.11.11 Ventilation. Machinery rooms, in accordance with Section 8.11, shall be vented to the outdoors using mechanical ventilation in accordance with Sections 8.11.11.1 through 8.11.11.3.

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SECTION 1107
PIPING MATERIAL

1107.1 Piping. Refrigerant piping material for other than R-717 (ammonia) systems shall conform to the requirements in this section. Piping material and installations for R-717 (ammonia) refrigeration systems shall comply with IIAR 2.

1107.2 Used materials. Used pipe, fittings, valves and other materials that are to be reused shall be clean and free from foreign materials and shall be approved for reuse.

1107.3 Materials rating. Materials, joints and connections shall be rated for the operating temperature and pressure of the refrigerant system. Materials shall be suitable for the type of refrigerant and type of lubricant in the refrigerant system. Magnesium alloys shall not be used in contact with any halogenated refrigerants. Aluminum, zinc, magnesium and their alloys shall not be used in contact with R-40 (methyl chloride).

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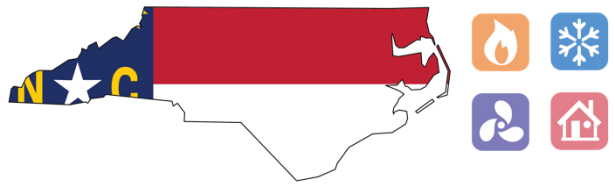

1107.4 Piping materials standards. Refrigerant pipe shall conform to one or more of the standards listed in Table 1107.4. The exterior of the pipe shall be protected from corrosion and degradation.

TABLE 1107.4
REFRIGERANT PIPE

PIPING MATERIAL	STANDARD
Aluminum tube	ASTM B210/ASTM B210M, ASTM B491/B491M
Brass (copper alloy) pipe	ASTM B43
Copper linesets	ASTM B280, ASTM B1003
Copper pipe	ASTM B42, ASTM B302
Copper tube[a]	ASTM B68, ASTM B75, ASTM B88, ASTM B280, ASTM B819
Steel pipe[b]	ASTM A53, ASTM A106, ASTM A333
Steel tube	ASTM A254, ASTM A334

a. Soft annealed copper tubing larger than 1 3/8-inch (35 mm) O.D. shall not be used for field-assembled refrigerant piping unless it is protected from mechanical damage.
b. ASTM A53, Type F steel pipe shall only be permitted for discharge lines in pressure relief systems.

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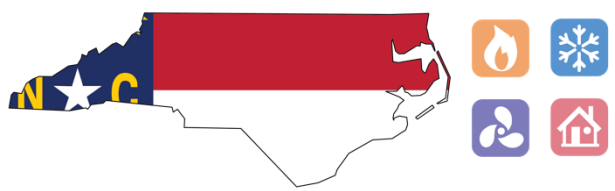

1107.4.1 Steel pipe Groups A2, A3, B2, and B3. The minimum weight of steel pipe for Group A2, A3, B2 and B3 refrigerants shall be Schedule 80 for sizes 1-1/2 inches or less in diameter.

1107.5 Pipe fittings. Refrigerant pipe fittings shall be approved for installation with the piping materials to be installed and shall conform to one of more of the standards listed in Table 1107.5 or shall be listed and labeled as complying with UL 207.

1107.5.1 Copper brazed field swaged. The minimum and maximum cup depth of field-fabricated copper brazed swaged fitting connections shall comply with Table 1107.5.1.

1107.6 Valves. Valves shall be of materials that are compatible with the type of piping material, refrigerants and oils in the system. Valves shall be listed and labeled and rated for the temperatures and pressures of the refrigerant systems in which the valves are installed.

1107.7 Flexible connectors, expansion and vibration compensators. Flexible connectors and expansion and vibration control devices shall be listed and labeled for use in refrigerant systems and pressures for which the components are installed.

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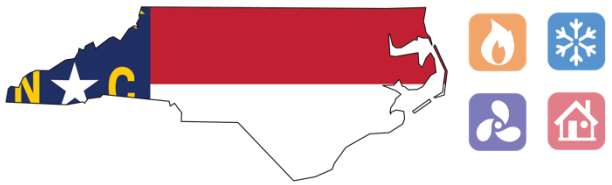

SECTION 1108
JOINTS AND CONNECTIONS

1108.1 Approval. Joints and connections shall be of an approved type. Joints and connections shall be tight for the pressure of the refrigerant system when tested in accordance with Section 1110.

> **1108.1.1 Joints between different piping materials.** Joints between different piping materials shall be made with approved adapter fittings. Joints between dissimilar metallic piping materials shall be made with a dielectric fitting or a dielectric union conforming to dielectric tests of ASSE 1079. Adapter fittings with threaded ends between different materials shall be joined with thread lubricant in accordance with Section 1108.3.4.

1108.2 Preparation of pipe ends. Pipe shall be cut square, reamed and chamfered, and shall be free from burrs and obstructions. Pipe ends shall have full-bore openings and shall not be undercut.

1108.3 Joint preparation and installation. Where required by Sections 1108.4 through 1108.9, the preparation and installation of brazed, flared, mechanical, press-connect, soldered, threaded and welded joints shall comply with Sections 1108.3.1 through 1108.3.5.

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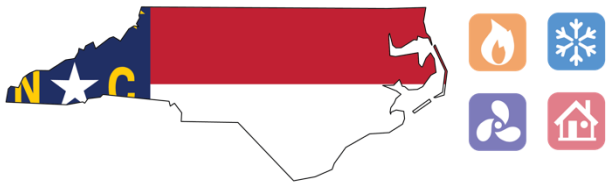

1108.3.1 Brazed joints. Joint surfaces shall be cleaned. An approved flux shall be applied where required by the braze filler metal manufacturer. The piping being brazed shall be purged of air to remove the oxygen and filled with one of the following inert gases: oxygen-free nitrogen, helium or argon. The piping system shall be pre-purged with an inert gas for a minimum time corresponding to five volume changes through the piping system prior to brazing. The pre-purge rate shall be at a minimum velocity of 100 feet per minute (0.508 m/s). The inert gas shall be directly connected to the tube system being brazed to prevent the entrainment of ambient air. After the pre-purge, the inert gas supply shall be maintained through the piping during the brazing operation at a minimum pressure of 1.0 psi (6.89 kPa) and a maximum pressure of 3.0 psi (20.67 kPa). The joint shall be brazed with a filler metal conforming to AWS A5.8.

1108.3.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

1108.3.2.1 Flared joints. Flared fittings shall be installed in accordance with the manufacturer’s instructions. The flared fitting shall be used with the tube material specified by the fitting manufacturer. The flared tube end shall be made by a tool designed for that operation.

1108.3.2.2 Press-connect joints. Press-connect joints shall be installed in accordance with the manufacturer’s instructions.

1108.3.3 Soldered joints. Joint surfaces to be soldered shall be cleaned and a flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32. Solder joints shall be limited to refrigerant systems using Group A1 refrigerant and having a pressure of less than or equal to 200 psi (1378 kPa).

1108.3.4 Threaded joints.

1108.3.5 Welded joints.

1108.4 Aluminum tube.

1108.5 Brass (copper alloy) pipe.

1108.6 Copper pipe.

1108.7 Copper tube.

1108.8 Steel pipe.

1108.9 Steel tube.

* **All sections are new and give standards for joints on these materials.**

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SECTION 1109
REFRIGERANT PIPE INSTALLATION

1109.1 General. Refrigerant piping installations, other than R-717 (ammonia) refrigeration systems, shall comply with the requirements of this section. The design of refrigerant piping shall be in accordance with ASME B31.5.

1109.2 Piping location. Refrigerant piping shall comply with the installation location requirements of Sections 1109.2.1 through 1109.2.7. Refrigerant piping for Groups A2L and B2L shall also comply with the requirements of Section 1109.3. Refrigerant piping for Groups A2, A3, B2 and B3 shall also comply with the requirements of Section 1109.4.

1109.2.1 Minimum height. Exposed refrigerant piping installed in open spaces that afford passage shall be not less than 7 feet 3 inches (2210 mm) above the finished floor.

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1109.2.2 Refrigerant pipe enclosure. Refrigerant piping shall be protected by locating it within the building elements or within protective enclosures.

Exception: Piping protection within the building elements or protective enclosure shall not be required in any of the following locations:

1. Where installed without ready access or located more than 7 feet 3 inches (2210 mm) above the finished floor.
2. Where located within 6 feet (1829 mm) of the refrigerant unit or appliance.
3. Where located in a machinery room complying with Section 1105.
4. Outside the building:

    4.1 Protected from damage from the weather, including, but not limited to, hail, ice, and snow loads and
    4.2 Protected from damage within the expected foot or traffic path or
    4.3 Outside, underground, installed not less than 8 inches (200 mm) below finished grade and protected against
    corrosion.

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1109.2.3 Prohibited locations. Refrigerant piping shall not be installed in any of the following locations:

1. Exposed within a fire-resistance-rated exit access corridor.
2. Exposed within an interior exit stairway.
3. Within an interior exit ramp.
4. Within an exit passageway.
5. Within an elevator, dumbwaiter or other shaft containing a moving object.

1109.2.4 Piping in concrete floors ….

1109.2.5 Refrigerant pipe shafts. Refrigerant piping that penetrates two or more floor/ceiling assemblies shall be enclosed in a fire-resistance-rated shaft enclosure. The fire-resistance-rated shaft enclosure shall comply with Section 713 of the International Building Code.

Exceptions:

1. Systems using R-718 refrigerant (water).
2. Piping in a direct system using Group A1 refrigerant where the refrigerant quantity does not exceed the limits of Table 1103.1 for the smallest occupied space through which the piping passes.
3. Piping located on the exterior of the building where vented to the outdoors.

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1109.2.7 Pipe identification. Refrigerant pipe located in areas other than the room or space where the refrigerating equipment is located shall be identified. The pipe identification shall be located at intervals not exceeding 20 feet (6096 mm) on the refrigerant piping or pipe insulation. The minimum height of lettering of the identification label shall be 1/2 inch (12.7 mm). The identification shall indicate the refrigerant designation and safety group classification of refrigerant used in the piping system. For Group A2L and B2L refrigerants, the identification shall also include the following statement: “WARNING – Risk of Fire. Flammable Refrigerant.” For Group A2, A3, B2 and B3 refrigerants, the identification shall also include the following statement: “DANGER—Risk of Fire or Explosion. Flammable Refrigerant.” For any Group B refrigerant, the identification shall also include the following statement: “DANGER—Toxic Refrigerant.”

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1109.2.7 Pipe identification. Refrigerant pipe located in areas other than the room or space where the refrigerating equipment is located shall be identified. The pipe identification shall be located at intervals not exceeding 20 feet (6096 mm) on the refrigerant piping or pipe insulation. The minimum height of lettering of the identification label shall be 1/2 inch (12.7 mm). The identification shall indicate the refrigerant designation and safety group classification of refrigerant used in the piping system. For Group A2L and B2L refrigerants, **the identification shall also include the following statement: "WARNING – Risk of Fire. Flammable Refrigerant."** For Group A2, A3, B2 and B3 refrigerants, the identification shall also include the following statement: "DANGER—Risk of Fire or Explosion. Flammable Refrigerant." For any Group B refrigerant, the identification shall also include the following statement: "DANGER—Toxic Refrigerant."

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1109.3 Installation requirements for Group A2L, A2, A3, B2L, B2, or B3 refrigerant. Piping systems using Group A2L, A2, A3 or B2L, B2, or B3 refrigerant shall comply with the requirements of Sections 1109.3.1 and 1109.3.2.

1109.3.1 Pipe protection. (summary: protect in accordance with section 305 – “nail” plates)

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1109.3.2 Shaft ventilation. Refrigerant pipe shafts with systems using Group A2L or B2L refrigerant shall be naturally or mechanically ventilated. Refrigerant pipe shafts with one or more systems using any Group A2, A3, B2, or B3 refrigerant shall be continuously mechanically ventilated and shall include a refrigerant detector. The shaft ventilation exhaust outlet shall comply with Section 501.3.1. Naturally ventilated shafts shall have a pipe, duct or conduit not less than 4 inches (102 mm) in diameter that connects to the lowest point of the shaft and extends to the outdoors. The pipe, duct or conduit shall be level or pitched downward to the outdoors. Mechanically ventilated shafts shall have a minimum airflow velocity in accordance with Table 1109.3.2. The mechanical ventilation shall be continuously operated or activated by a refrigerant detector. Systems utilizing a refrigerant detector shall activate the mechanical ventilation at a maximum refrigerant concentration of 25 percent of the lower flammable limit of the refrigerant. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The shaft shall not be required to be ventilated for double-wall refrigerant pipe where the interstitial space of the double-wall pipe is vented to the outdoors.

TABLE 1109.3.2
SHAFT VENTILATION VELOCITY

CROSS-SECTIONAL AREA OF SHAFT (square inches)	MINIMUM VENTILATION VELOCITY (feet per minute)
≤ 20	100
> 20 ≤ 250	200
> 250 ≤ 1,250	300
> 1,250	400

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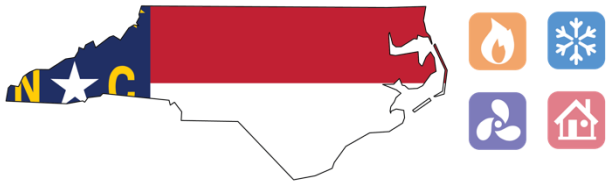

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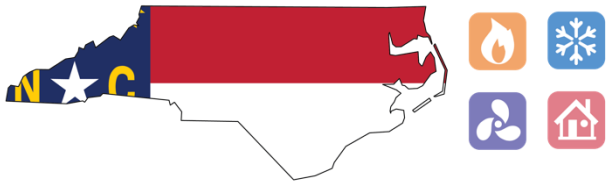

1109.4 Refrigerant pipe penetrations. The annular space between the outside of a refrigerant pipe and the inside of a pipe sleeve or opening in a building envelope wall, floor or ceiling assembly penetrated by a refrigerant pipe shall be sealed in an approved manner with caulking material or foam sealant or closed with a gasketing system. The caulking material, foam sealant or gasketing system shall be designed for the conditions at the penetration location and shall be compatible with the pipe, sleeve and building materials in contact with the sealing materials. Refrigerant pipes penetrating fire-resistance-rated assemblies or membranes of fire-resistance-rated assemblies shall be sealed or closed in accordance with Section 714 of the International Building Code.

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1109.6 Stop valves. Stop valves shall be installed in specified locations in accordance with Sections 1109.6.1 and 1109.6.2. Stop valves shall be supported in accordance with Section 1109.6.3 and identified in accordance with Section 1109.6.4.

Exceptions:

1. Systems that have a refrigerant pump out function capable of storing the entire refrigerant charge in a receiver or heat exchanger.
2. Systems that are equipped with provisions for pumping out the refrigerant using either portable or permanently installed refrigerant recovery equipment.
3. Self-contained listed and labeled systems.

***DEFINITION: stop valve:** a device used to shut off the flow of refrigerant.

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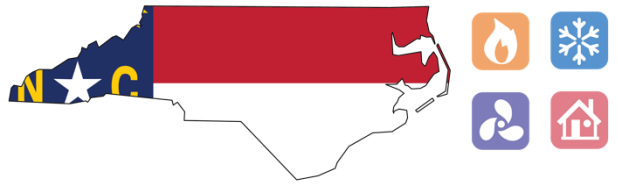

1109.6.1 Refrigerating systems containing more than 6.6 pounds (3.0 kg) of refrigerant. Stop valves shall be installed in the following locations on refrigerating systems containing more than 6.6 pounds (3.0 kg) of refrigerant:

1. The suction inlet of each compressor, compressor unit or condensing unit.
2. The discharge outlet of each compressor, compressor unit or condensing unit.
3. The outlet of each liquid receiver.

1109.6.2 Refrigerating systems containing more than 100 pounds (45 kg) of refrigerant. In addition to stop valves required by Section 1109.6.1, systems containing more than 100 pounds (45 kg) of refrigerant shall have stop valves installed in the following locations:

1. Each inlet of each liquid receiver.
2. Each inlet and each outlet of each condenser where more than one condenser is used in parallel.

Exceptions:

1. Stop valves shall not be required at the inlet of a receiver in a condensing unit nor at the inlet of a receiver that is an integral part of the condenser.
2. Systems utilizing nonpositive displacement compressors.

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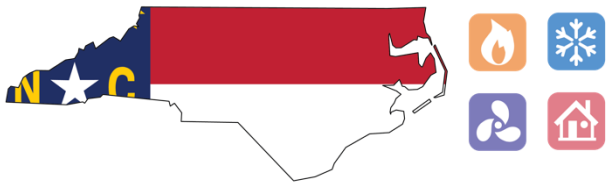

1110.2 Exposure of refrigerant piping system. Refrigerant pipe and joints installed in the field shall be exposed for visual inspection and testing prior to being covered or enclosed.

1110.3.1 Test gases not permitted. Oxygen, air, refrigerants other than those identified in Section 1110.3, combustible gases and mixtures containing such gases shall not be used as the pressure test medium.

1110.6 Contractor or engineer declaration. The installing contractor or registered design professional of record shall issue a certificate of test to the code official for all systems containing 55 pounds (25 kg) or more of refrigerant. The certificate shall give the test date, name of the refrigerant, test medium and the field test pressure applied to the high-pressure side and the low-pressure side of the system. The certification of test shall be signed by the installing contractor or registered design professional and shall be made part of the public record.

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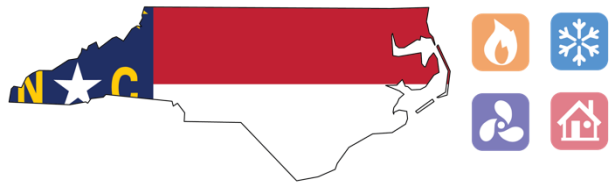

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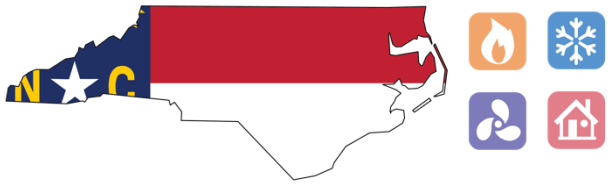

1111.1 Testing required. The following emergency devices and systems shall be periodically tested in accordance with the manufacturer's instructions and as required by the code official:

1. Treatment and flaring systems.
2. Valves and appurtenances necessary to the operation of emergency refrigeration control boxes.
3. Fans and associated equipment intended to operate emergency ventilation systems.
4. Detection and alarm systems.

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CHAPTER 12
HYDRONIC PIPING

**minimal changes only

CHAPTER 13
FUEL OIL PIPING AND STORAGE

**minimal changes only

DELETED

SECTION 1309: OIL TANKS FOR ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES

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CHAPTER 14
SOLAR THERMAL SYSTEMS

Multiple changes **1401-1404**

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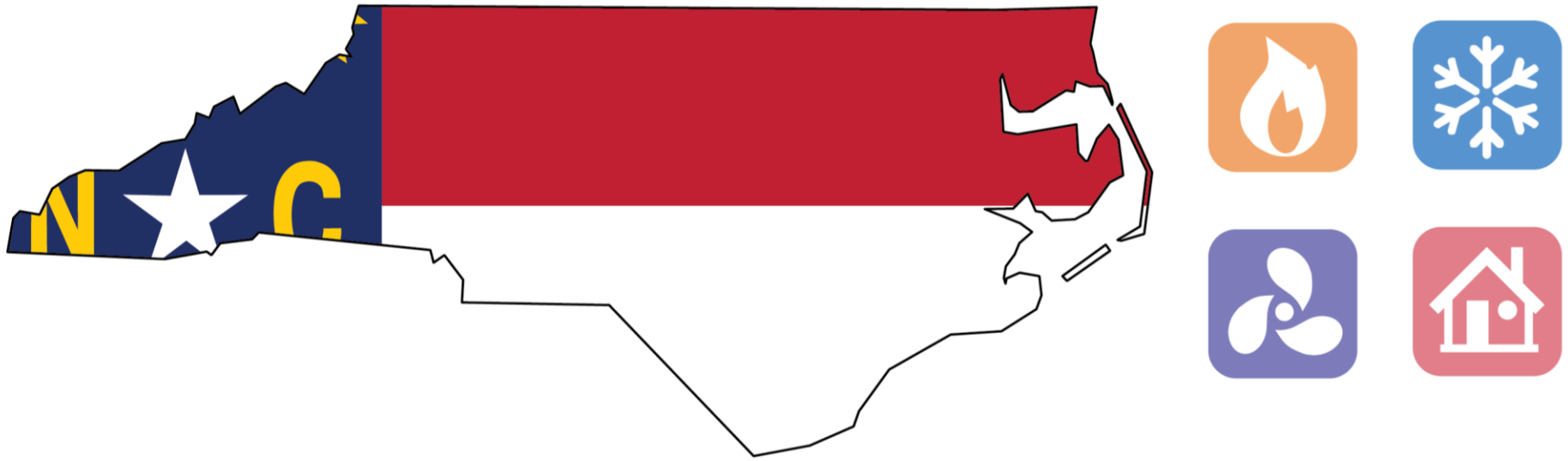

The IMPACT of A2L Refrigerants and the 2024 Mechanical Code

Course# CS-5040:
Instructor: Chris Mobley (UL)
Sponsored by NCMIA

Introduction to Low GWP Refrigerants - Codes and Standards

Practical Information for Code Officials

Chris Mobley
2025 NCMIA Continuing Education

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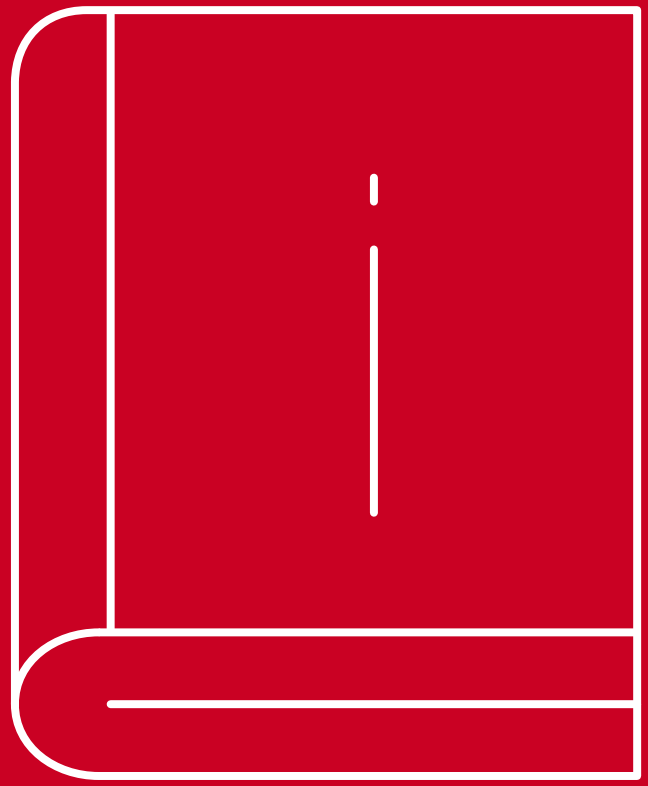

Brief Bio – Chris Mobley

- Lead Regulatory Engineer in UL Solutions Codes and Regulatory Services department. 2022-present.
- Project Engineer, UL Solutions Testing, Inspection, Certification, (Industrial Control Equipment, Power Distribution Equipment, Pool and Spa Equipment, Components, Functional Safety.) 1998-2005.
- Sixteen years of industry experience with a major manufacturer of HVAC, gas appliances, and water heaters.
- For 2027 code cycle serving on ICC International Residential Code Mechanical/Plumbing development committee, and NFPA Technical Committee for NFPA 54 and NFPA 211.
- Participate on behalf of UL Solutions in all the ICC Committee Action Hearings and Public Comment Hearings for Plumbing, Mechanical and Gas (PMG).
- BS in Electrical Engineering from Clemson.

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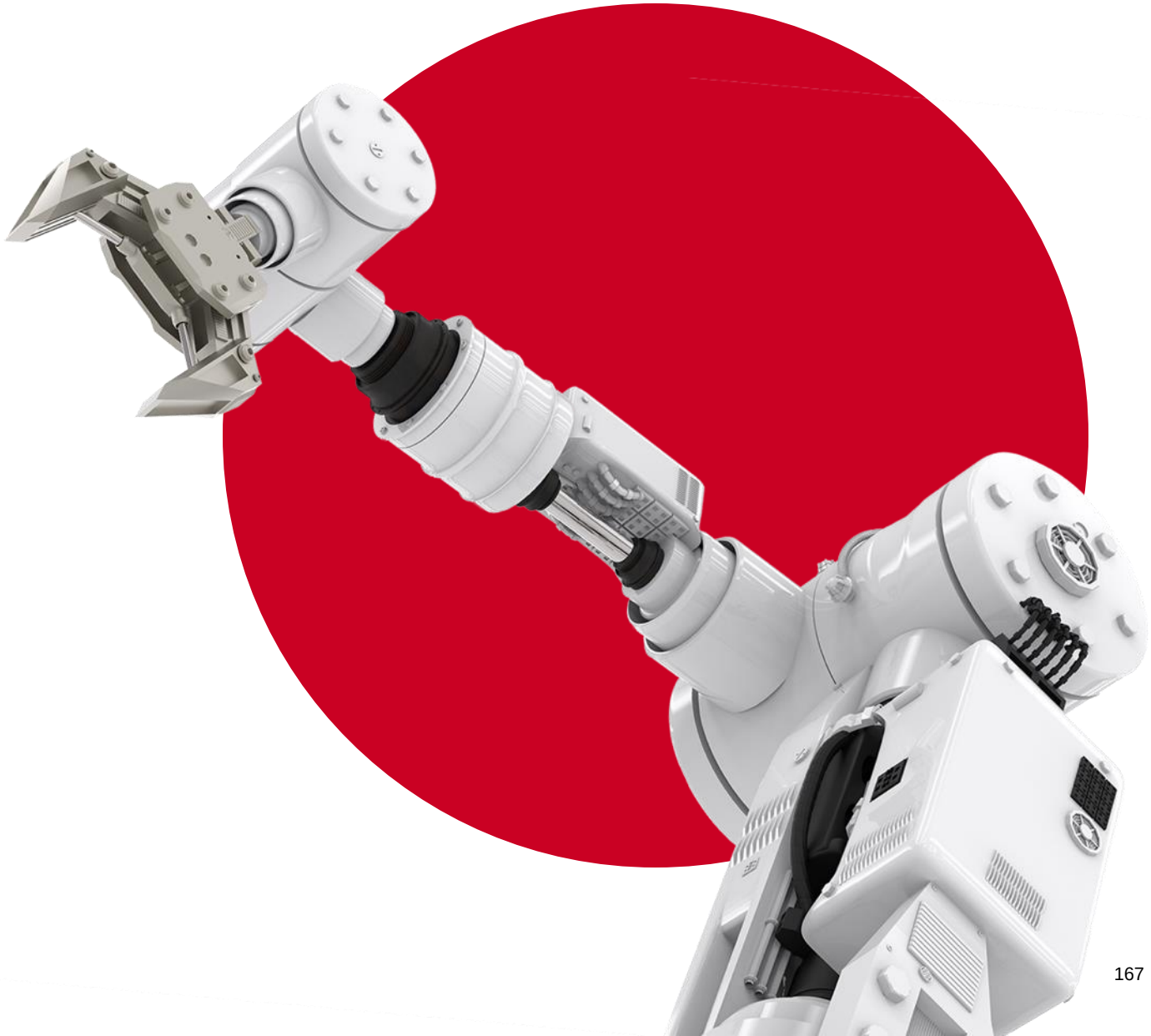

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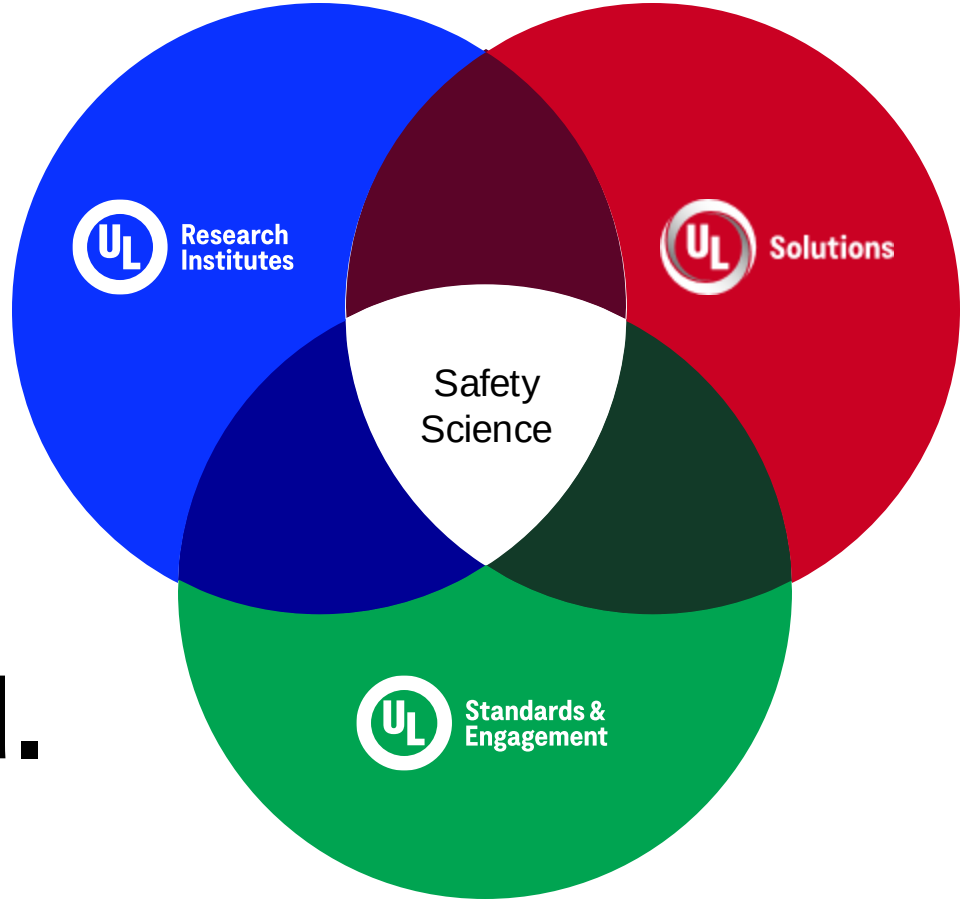


Agenda

Refrigerant Changes are coming

- Low GWP transition - EPA rules
- Time-frame for various product types
- Flammable refrigerants will become common
- Understanding refrigerant safety classifications (A1, A2L, A3)
- Research projects
- Updated codes and standards

Principles of Mitigation (High-level)

- Limiting concentrations
- Circulation and ventilation to reduce concentrations
- Limiting ignition sources
- Refrigerant leak detection
- Piping installation and protection
- Controls

Implementing Mitigation

- Listing Requirements
- Marking and Instructions
- Engineering Designs (ASHRAE 15/15.2)
- Machinery Rooms
- Shafts for Refrigerant Piping

Additional Topics

- A3 Refrigerants (including Commercial Refrigeration)
- Additional resources
- Discussion and Questions

1

International agreements drive the use of low Global Warming Potential (GWP) refrigerants.

2

American Innovation and Manufacturing (AIM) Act signed into law in December 2020.

It gives U.S.EPA the authority to regulate refrigerant production and use.

3

Research drives new product standards, installation standards, and model code updates.

EPA SNAP

The Significant New Alternatives Policy is a program of the EPA to determine acceptable chemical substitutes and establish which are prohibited or regulated by the EPA. It also establishes a program by which new alternatives may be accepted and promulgates timelines to the industry regarding phase-outs of substitutes.

Summary of EPA SNAP RULE EFFECTIVE DATES

Refrigeration, Air Conditioning, and Heat Pump Systems*			
Subsector	**Systems**	**Global Warming Potential Limit or Prohibited Substances**	**Installation Compliance Date[5]**
Stationary air conditioning and heat pumps	Residential and light commercial air conditioning and heat pump systems	700	January 1, 2025[5]
	Variable refrigerant flow systems	700	January 1, 2026
Chillers	Industrial process refrigeration with exiting fluid below -50 °C (-58 °F)	Not covered	Not covered
	Industrial process refrigeration with exiting fluid from -50 °C (-58 °F) to -30 °C (-22 °F)	700	January 1, 2028
	Industrial process refrigeration with exiting fluid above -30 °C (-22 °F)	700	January 1, 2026
	Comfort cooling	700	January 1, 2025
Ice rinks	Ice rinks	700	January 1, 2025

Source: AHRI

[5]EPA is restricting the installation of new field-assembled systems. Components used to repair existing systems are not subject to these restrictions.

Summary of EPA SNAP RULE EFFECTIVE DATES

Refrigeration, Air Conditioning, and Heat Pump Systems*			
Subsector	**Systems**	**Global Warming Potential Limit or Prohibited Substances**	**Installation Compliance Date[5]**
Cold storage warehouses	With 200 or more lb refrigerant charge, excluding high temperature side of cascade system	150	January 1, 2026
	With less than 200 lb refrigerant charge	300	January 1, 2026
	High temperature side of cascade system	300	January 1, 2026
Retail food - supermarkets	With 200 or more lb refrigerant charge, excluding high temperature side of cascade system	150	January 1, 2027
	With less than 200 lb refrigerant charge	300	January 1, 2027
	High temperature side of cascade systems	300	January 1, 2027
Retail food - remote condensing units	With 200 or more lb refrigerant charge, excluding high temperature side of cascade system	150	January 1, 2026
	With less than 200 lb refrigerant charge	300	January 1, 2026
	High temperature side of cascade system	300	January 1, 2026

Source: AHRI

EPA SNAP rules allow sell-through of HVAC equipment manufactured before 1/1/2025

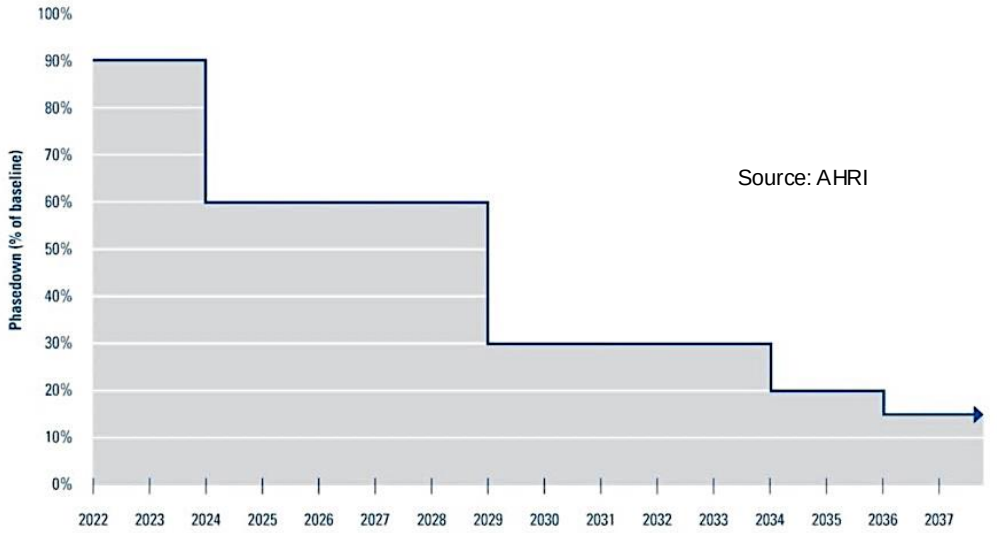
HVAC equipment utilizing R-410A which was manufactured (or imported) prior to 1/1/2025 can be sold and installed as follows:

- One year for split systems.
- Three years for package systems.

EPA SNAP rules allow repair of existing equipment

Manufacturers can produce repair components, such as replacement evaporator coils or compressors, but not complete systems.

Quotas which will be placed on the production of legacy refrigerants. Use of reclaimed refrigerant may increase.

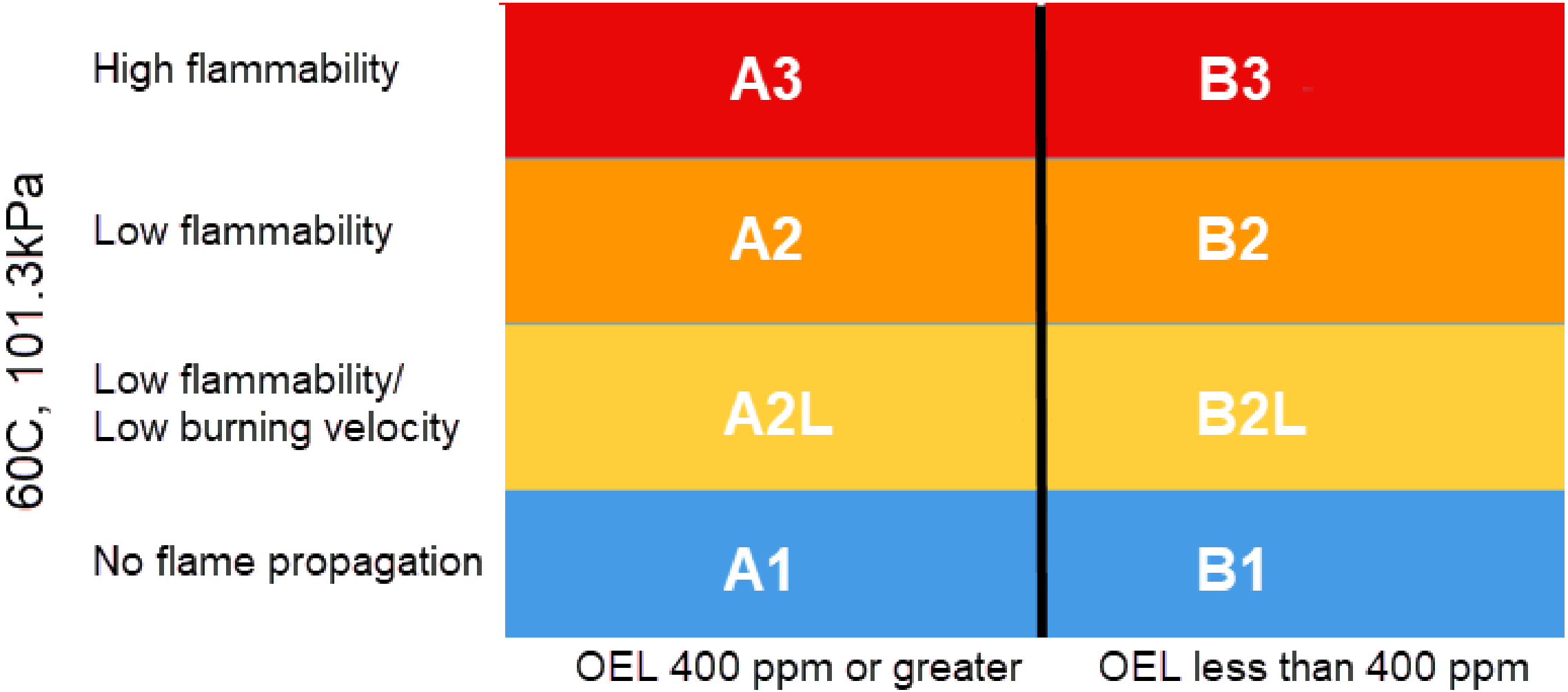


Source: AHRI

EPA SNAP rules do NOT allow retrofit of existing refrigeration systems with a refrigerant of a different safety class.

Some commercial refrigeration rules may be revisited in the future due to industry feedback.

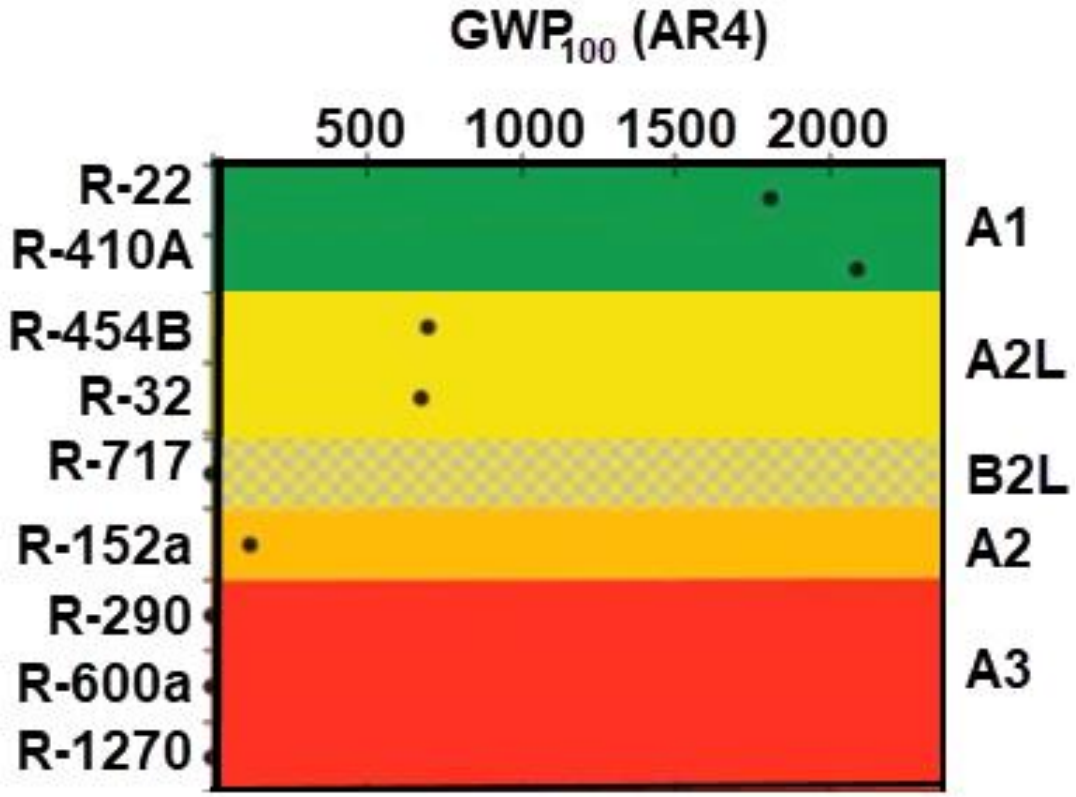
Refrigerant Safety Group Classifications



Low GWP Refrigerants

Refrigerants are assigned a 100-year Global Warming Potential (GWP) value

- R-744 (CO_2) has a GWP index of 1
- EPA SNAP Rules define the maximum GWP of the refrigerants used for each application
- EPA SNAP Rules list the specific refrigerants approved for each application



Starting in the 2019 edition of ASHRAE 34, Class 2L was designated as a flammability classification from Class 2

For prior editions (and model codes which reference these editions) A2L was a sub-classification of A2 refrigerants. A model code requirement applicable to A2 also applied to A2L unless specifically exempted. (This no longer applies to new model codes)

DEFINITION (IMC 2024 / ASHRAE 15-2022

Refrigerant Safety Group Classification

The alphanumeric designation that indicates both the toxicity and flammability classifications of refrigerants in accordance with ASHRAE 34.

Flammability classification (refrigerant). The alphanumeric designation used to identify the flammability of refrigerants.

Class 1. Indicates a refrigerant with no flame propagation.

Class 2. Indicates a refrigerant with low flammability.

Class 2L. Indicates a refrigerant with low flammability and low burning velocity.

Class 3. Indicates a refrigerant with high flammability.

Toxicity classification (refrigerant). An alphabetical designation used to identify the toxicity of refrigerants. Class A indicates a refrigerant with low toxicity. Class B indicates a refrigerant with high toxicity.

IFC (2024)

Chapter 2: Definitions

FLAMMABLE GAS. A material that is a gas at 68°F (20°C) or less at 14.7 pounds per square inch atmosphere (psia) (101 kPa) of pressure [a material that has a *boiling point* of 68°F (20°C) or less at 14.7 psia (101 kPa)] subdivided as follows:

1. **Category 1A**. A gas that meets either of the following:

    1.1. Ignitable at 14.7 psia (101 kPa) when in a mixture of 13 percent or less by volume with air.

    1.2. A flammable range at 14.7 psia (101 kPa) with air of not less than 12 percent, regardless of the lower limit, unless data shows compliance with Category 1B.

2. **Category 1B**. A gas that meets the flammability criteria for Category 1A, is not pyrophoric or chemically unstable, and meets one of more of the following:

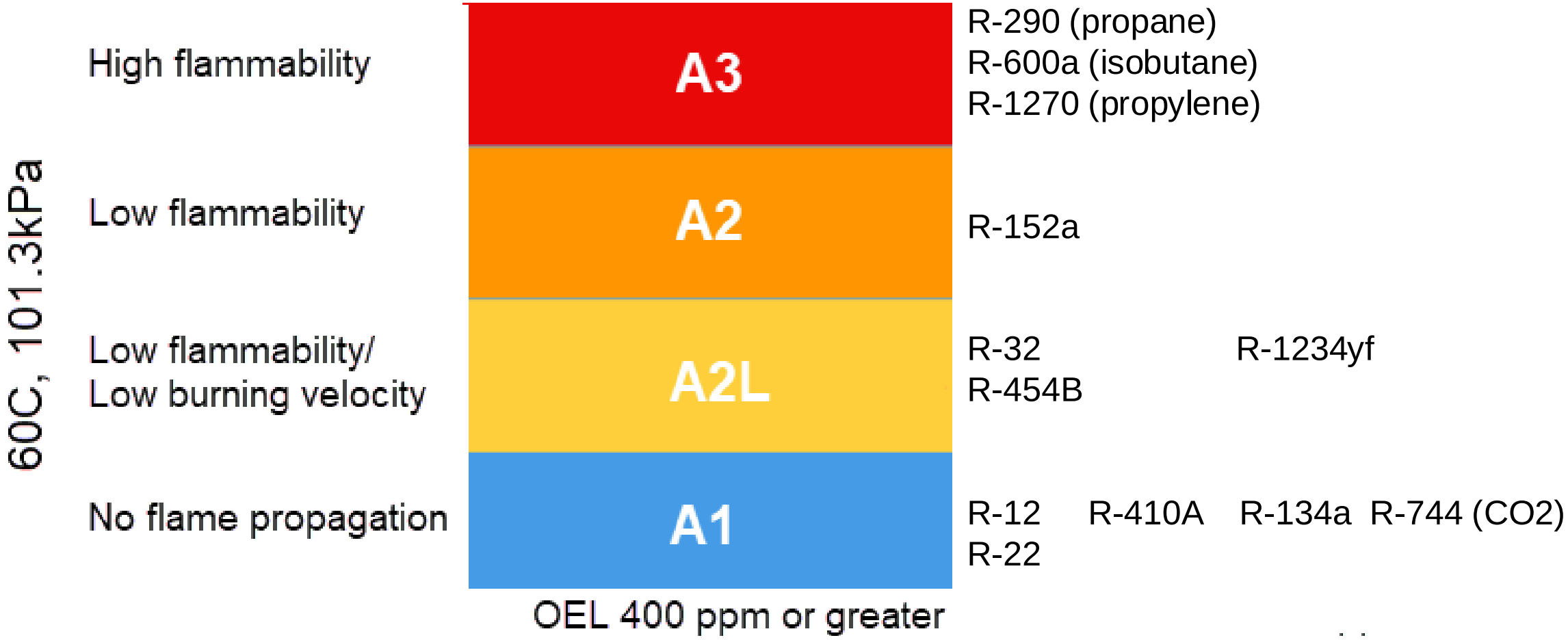
    2.1. A lower flammability limit of more than 6 percent by volume of air.

    2.2. A fundamental burning velocity of less than 3.9 inches/second (99 mm/s).

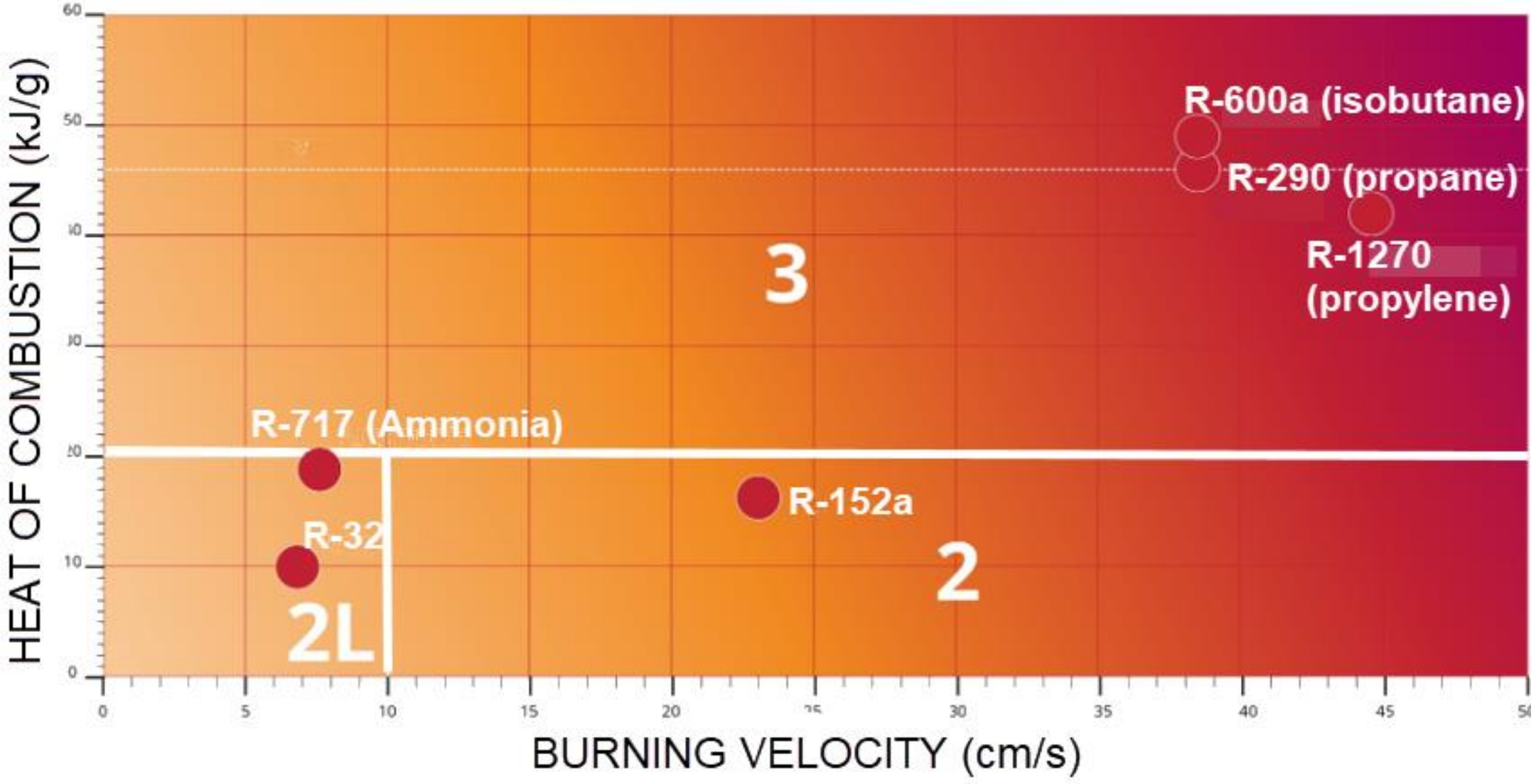
The term “flammable refrigerant” refers to Classes A2L, A2, A3, B2L, B2, B3

This undefined term is sometimes used in model codes without reference to specific classes. Its meaning can be determined by context in ASHRAE 15.

Common Class A Refrigerants



Heat of Combustion and Burning Velocity



Industry Refrigerant Research
Large Fire Lab – UL Solutions
Northbrook, IL

Industry Refrigerant Research
Large Fire Lab – UL Solutions
Northbrook, IL

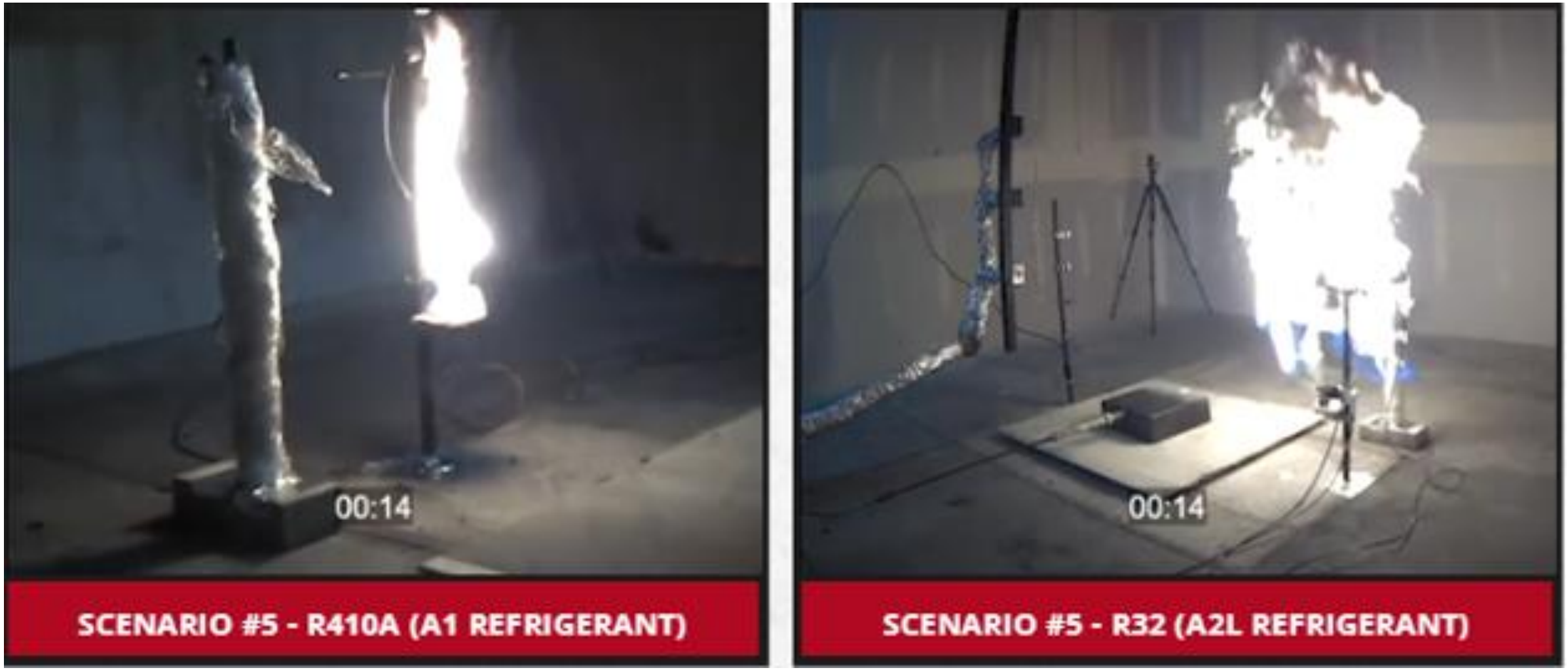
Comparison of flame propagation of a Class an A1 (R-410A) and Class A2L (R-32) refrigerant under ideal combustion conditions

The next slides show a comparison of the ignition and flame spread of these two refrigerant classes with a pool of refrigerant.

For systems with mitigation in place, this scenario represents an unrealistic volume of refrigerant, along with an ideal combustion ratio and ignition source.

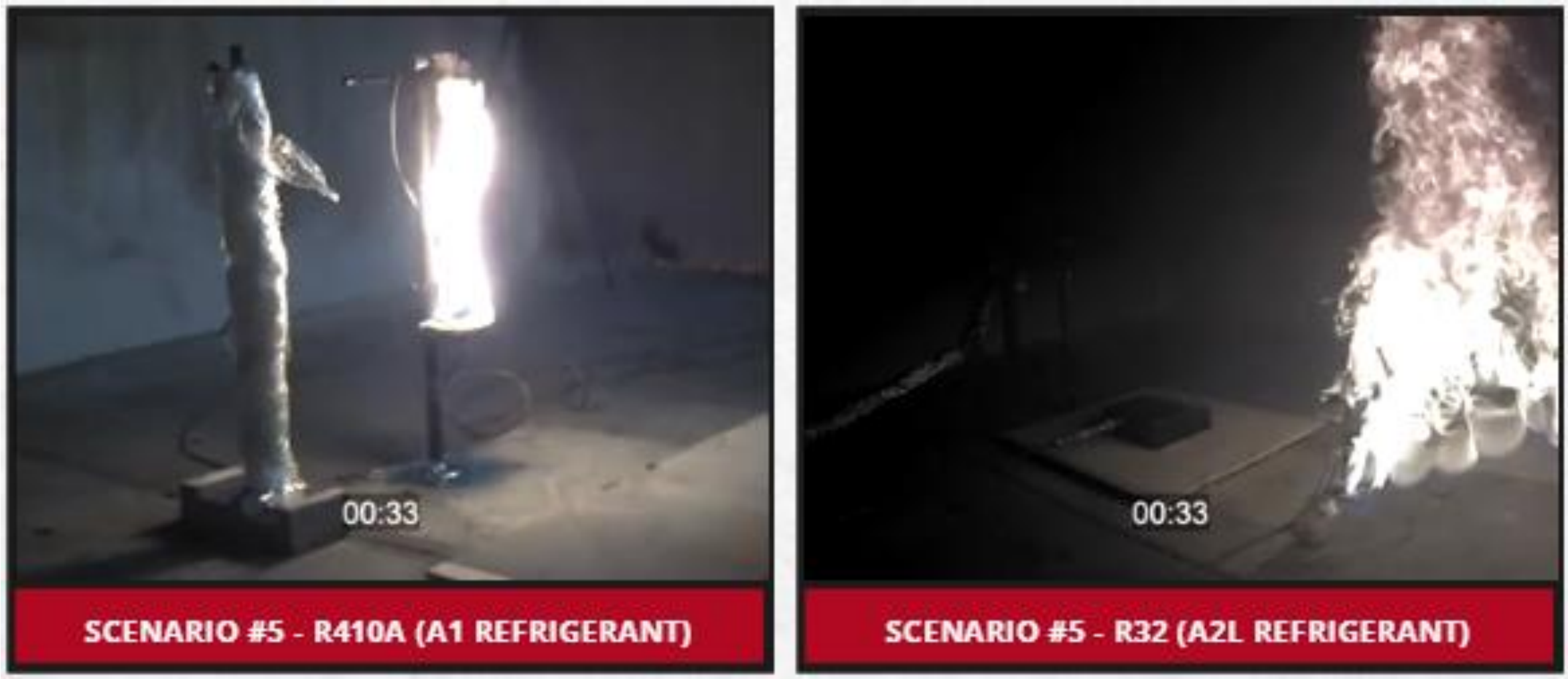
A1 VS. A2L IGNITION AND FLAME SPREAD COMPARISON – 4 SECONDS AFTER IGNITION

A1 VS. A2L IGNITION AND FLAME SPREAD COMPARISON – 14 SECONDS AFTER IGNITION



A1 VS. A2L IGNITION AND FLAME SPREAD COMPARISON – 23 SECONDS AFTER IGNITION

A1 VS. A2L IGNITION AND FLAME SPREAD COMPARISON – 33 SECONDS AFTER IGNITION



A1 VS. A2L IGNITION AND FLAME SPREAD COMPARISON – 46 SECONDS AFTER IGNITION

Select Industry Refrigerant Research

Project #s	Project Description
AHRI 8017	Investigation of residential ignition sources with A2Ls
AHRTI 9007-01 & 02	Leak and ignition testing under whole room scale conditions
AHRTI 9008	Hot surface ignition temperature (HSIT) testing of A2Ls
AHRTI 9013	Leak and ignition behavior of an A2L vs. an A3
AHRTI 9014	Sensor / detector performance for flammable refrigerants
AHRTI 9015	Effectiveness of refrigerant leakage mitigation
ASHRAE-1807	Flammable refrigerant handling, transport, storage, servicing
ASHRAE-1808	Assessment of field-made mechanical joints with flammable refrigerants

https://www.ahrinet.org/analytics/research/ahri-flammable-refrigerants-research-initiative

UL 60335-2-40 and UL 60335-2-89

UL 60335-2-40 STANDARD FOR SAFETY

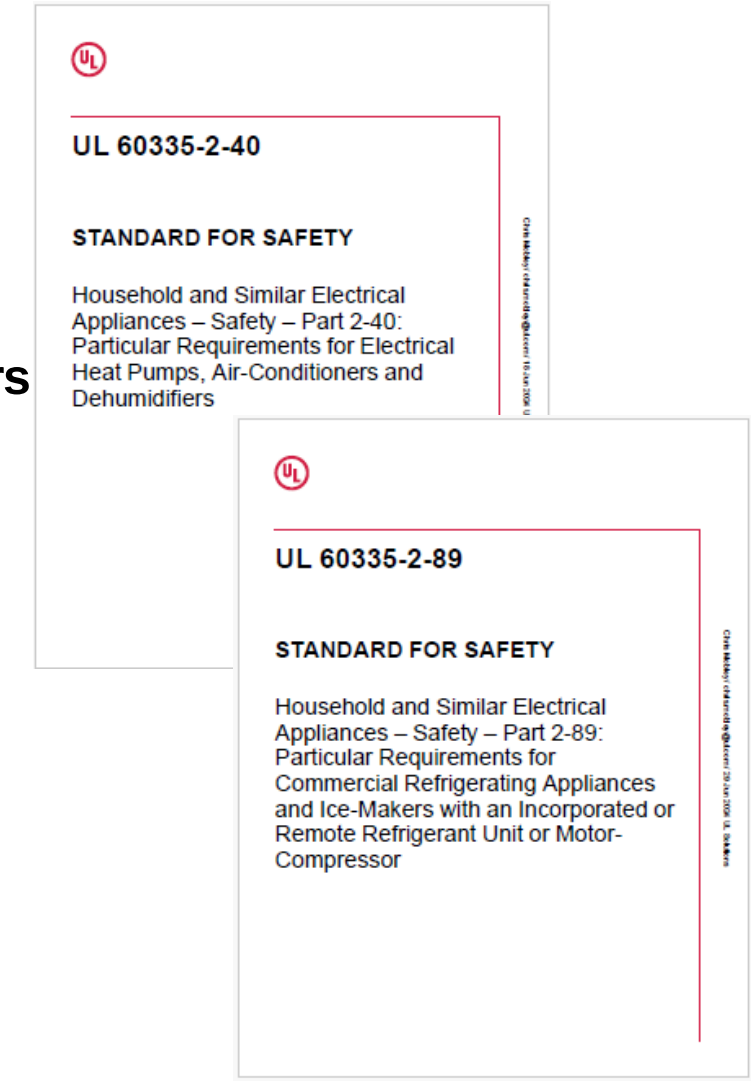
Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers

Fourth Edition, Dated December 15, 2022

UL 60335-2-89 STANDARD FOR SAFETY

Household and Similar Electrical Appliances – Safety – Part 2-89: Particular Requirements for Commercial Refrigerating Appliances and Ice-Makers with an Incorporated or Remote Refrigerant Unit or Motor-Compressor

Second Edition, Dated October 27, 2021



ASHRAE Standards

Safety Standard for Refrigeration Systems

ANSI/ASHRAE Standard 15-2022

Safety Standard for Refrigeration Systems in Residential Applications

ANSI/ASHRAE Standard 15.2-2022

Designation and Safety Classification of Refrigerants

ANSI/ASHRAE Standard 34-2022

Codes, Installation Standards, Product Standards

ICC
Model Codes

3-year revision cycle

Local adoption

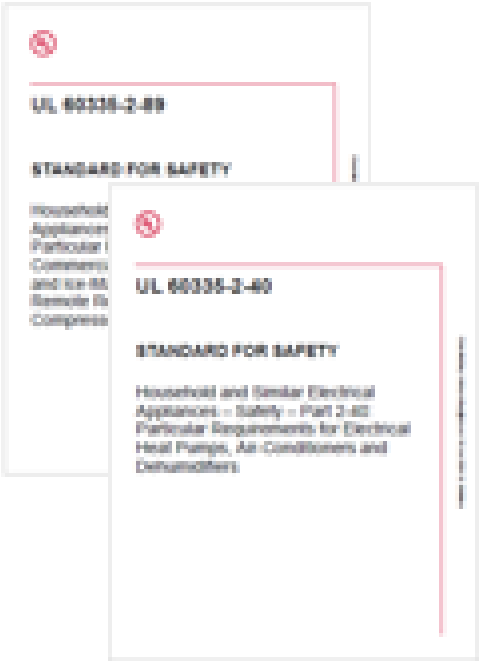
ASHRAE 15, 15.2
Installation Standards

2-year revision cycle

Addendums between editions

UL 60335-2-40 and
UL 60335-2-89
Product Standards

Continuous maintenance



ASHRAE 15 & ASHRAE 15.2 Installation Standards

ASHRAE 15-2022 Scope

2.1 This standard establishes safeguards for life, limb, health, and property and prescribes safety requirements.

2.2 This standard applies to

a. the design, construction, test, installation, operation, and inspection of mechanical and absorption refrigeration systems, including *heat-pump* systems used in stationary applications;

b. modifications, including replacement of parts or components if they are not identical in function and capacity; and

c. substitutions of *refrigerants* having a different designation

2.3 This standard *shall not* apply to refrigeration systems using ammonia (R-717) as the *refrigerant*.

2.4 This standard does not apply to residential refrigeration systems serving only a single dwelling unit or sleeping unit complying with ASHRAE 15.2

ASHRAE 15.2-2022 Scope

2.1 This standard applies to *listed direct refrigeration systems* in the following residential applications that are limited to serving only a single *dwelling unit* or *sleeping unit*:

a. One- and two-family *dwellings* and townhouses

b. Detached outbuildings associated with a one- or two-family *dwelling* or townhouse and located on the same property included in Section 2.1(a)

c. Individual *dwelling units* and *sleeping units* located in a *multifamily dwelling*

ANSI/ASHRAE Standard 15-2022, Safety Standard for Refrigerated Systems

- Addendum a to Standard 15-2022 (March 13, 2024)
- Addendum b to Standard 15-2022 (June 28, 2024)
- Addendum e to Standard 15-2022 (September 29, 2023)
- Addendum f to Standard 15-2022 (September 29, 2023)
- Addendum g to Standard 15-2022 (September 29, 2023)
- Addendum h to Standard 15-2022 (September 29, 2023)
- Addendum i to Standard 15-2022 (February 21, 2024)
- Addendum l to Standard 15-2022 (May 1, 2024)
- Addendum m to Standard 15-2022 (May 1, 2024)
- Addendum t to Standard 15-2022 (May 31, 2024)

https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda

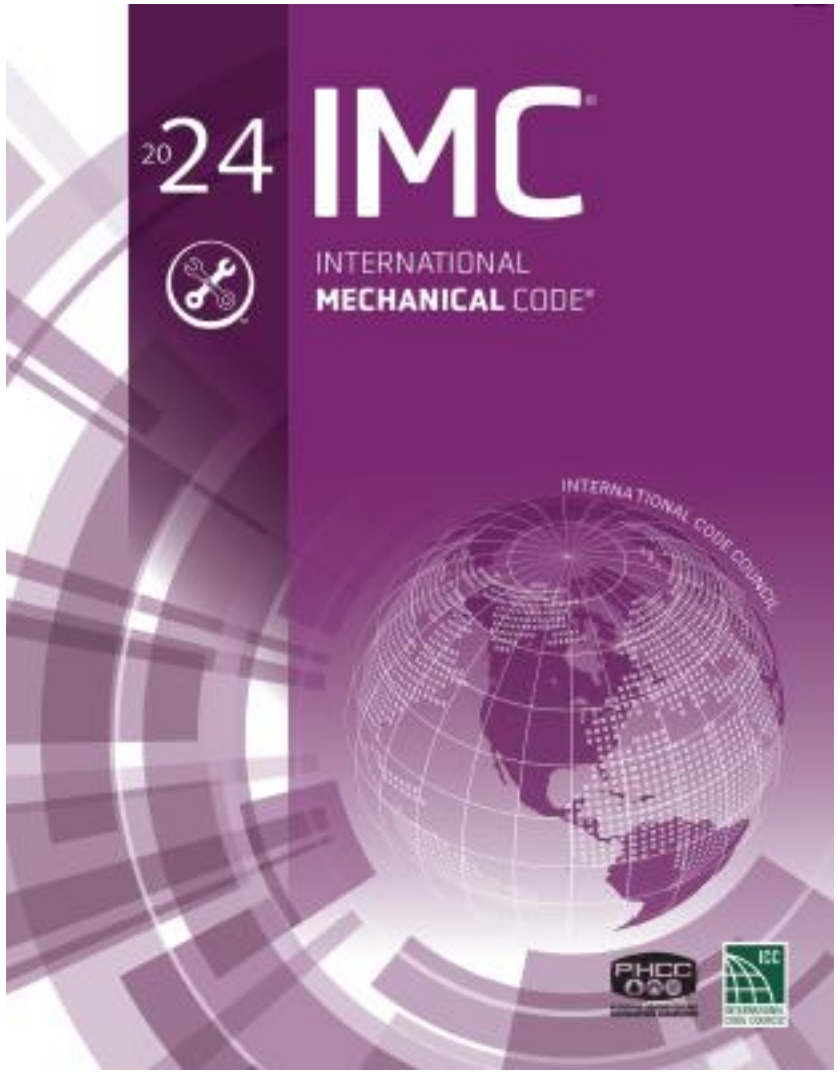
UL 60335-2-40 4th Edition update

The fourth edition of UL 60335-2-40 was published on December 15, 2022. These updated requirements will be mandatory for all new certifications of these products by UL Solutions after Jan. 1, 2025. Includes the following updates:

- Definition and test method for releasable charge with relation of refrigerant leaks into the occupied space
- Refinement of leak detection system requirements to accommodate various methods, increase robustness and reliability, and account for deviation and drift over system lifecycle
- Clarification of potential leak point definition and requirements, and leak sensor location requirements
- New combined flame symbol markings for fire service identification
- Leakage current requirements for permanently connected appliances
- Safety shutoff valve requirements for limiting the releasable charge
- Audible alarm guidance

UL Solutions

International Mechanical Code (IMC - 2024)



IMC (2024)

SECTION 1101 - GENERAL

1101.1 Scope. This chapter shall govern the design, installation, construction and repair of *refrigeration systems*. Permanently installed refrigerant storage systems and other components shall be considered as part of the *refrigeration system* to which they are attached.

1101.1.1 Refrigerants other than ammonia. *Refrigeration systems* using a refrigerant other than ammonia shall comply with this chapter, ASHRAE 15 and the *International Fire Code*. *Refrigeration systems* containing carbon dioxide as the refrigerant shall also comply with IIAR CO2.

1101.1.2 Ammonia refrigerant. *Refrigeration systems* using ammonia refrigerant shall comply with IIAR 2 for system design, IIAR 3 for valves, IIAR 4 for installation, IIAR 5 for start-up, and IIAR 6 and shall not be required to comply with this chapter.

IMC (2024)

SECTION 102—APPLICABILITY

[A] 102.8 Referenced codes and standards. The codes and standards referenced herein shall be those that are listed in Chapter 15 and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections 102.8.1 and 102.8.2.

> **Exception:** Where enforcement of a code provision would violate the conditions of the listing of the *equipment* or *appliance*, the conditions of the listing and the manufacturer's installation instructions shall apply.

[A] 102.8.1 Conflicts. Where conflicts occur between provisions of this code and the referenced standards, the provisions of this code shall apply.

[A] 102.8.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

ASHRAE 15-2022 / IMC-2024 Table of Contents

ASHRAE 15-2022

IMC-2024

IMC (2024)

SECTION 1101 – GENERAL (CONTINUED)

1101.2 Factory-built equipment and appliances. *Listed* and *labeled* self-contained, factory-built *equipment* and *appliances* shall be tested in accordance with the applicable standards specified in Table 1101.2. Such *equipment* and *appliances* are deemed to meet the design, manufacture and factory test requirements of this code if installed in accordance with their listing and the manufacturer's instructions.

TABLE 1101.2—FACTORY-BUILT EQUIPMENT AND APPLIANCES

EQUIPMENT	STANDARDS
Air-conditioning equipment	UL 1995 or UL/CSA 60335-2-40
Packaged terminal air conditioners and heat pumps	UL 484 or UL/CSA 60335-2-40
Split-system air conditioners and heat pumps	UL 1995 or UL/CSA 60335-2-40
Dehumidifiers	UL 474 or UL/CSA 60335-2-40
Unit coolers	UL 412 or UL/CSA 60335-2-89
Commercial refrigerators, freezers, beverage coolers and walk-in coolers	UL 471 or UL/CSA 60335-2-89
Refrigerating units and walk-in coolers	UL 427 or UL 60335-2-89
Refrigerant-containing components and accessories	UL 207

1101.2.1 Group A2L, A2, A3 and B1 high-probability equipment. High-probability equipment using Group A2L, A2, A3 or B1 refrigerant shall comply with UL 484, UL/CSA 60335-2-40 or UL/CSA 60335-2-89.

IMC (2024)

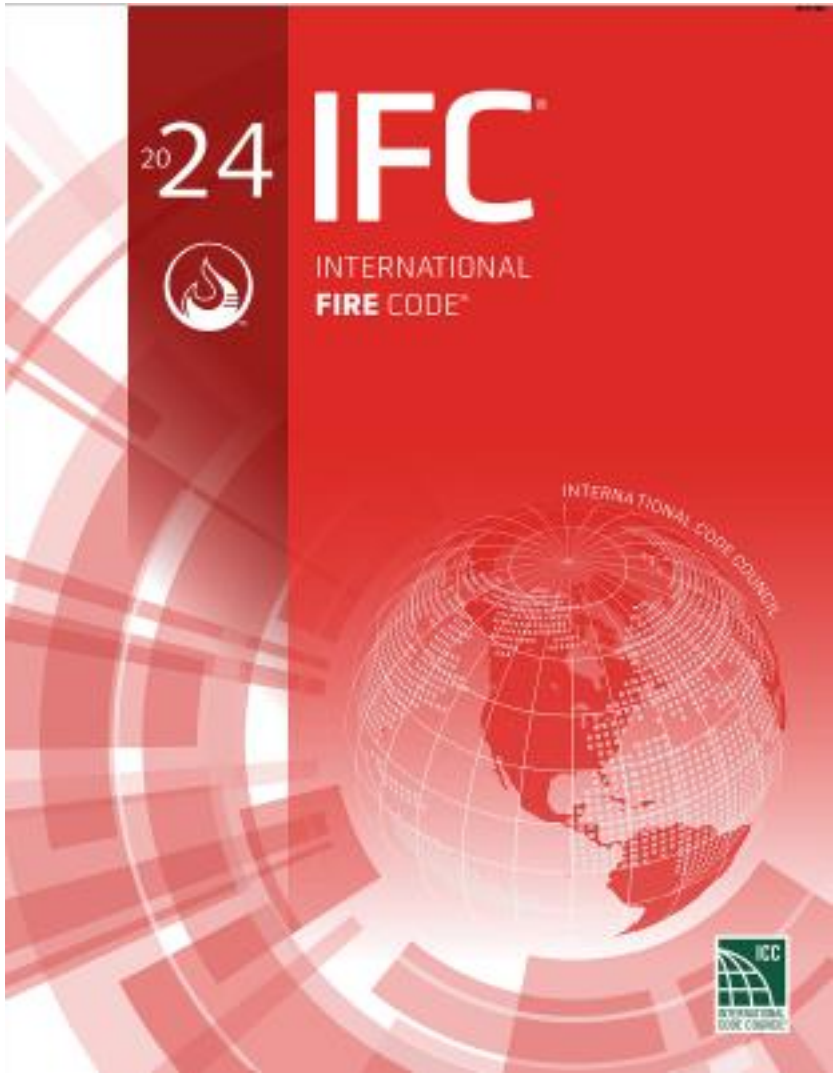
SECTION 304 - INSTALLATION

304.1 General. *Equipment* and *appliances* shall be installed as required by the terms of their approval, in accordance with the conditions of the listing, the manufacturer's installation instructions and this code. Manufacturer's installation instructions shall be available on the job site at the time of inspection.

304.2 Conflicts. Where conflicts between this code and the conditions of listing or the manufacturer's installation instructions occur, the provisions of this code shall apply.

Exception: Where a code provision is less restrictive than the conditions of the listing of the *equipment* or *appliance* or the manufacturer's installation instructions, the conditions of the listing and the manufacturer's installation instructions shall apply.

International Fire Code (IFC - 2024)



IFC (2024)

SECTION 608—MECHANICAL REFRIGERATION

608.1.1 Refrigerants other than ammonia. Where a refrigerant other than ammonia is used, refrigeration systems and the buildings in which such systems are installed shall be in accordance with ASHRAE 15.

608.2 Permits. An operational permit shall be obtained for refrigeration systems as set forth in Section 105.5.46.

[**105.5.46 Refrigeration equipment.** An operational permit is required to operate a mechanical refrigeration unit or system regulated by Chapter 6.]

IFC (2024)

SECTION 608—MECHANICAL REFRIGERATION (CONTINUED)

608.6 Access. Access to refrigeration systems having a refrigerant circuit containing more than 220 pounds (100 kg) of Group A1 or 30 pounds (14 kg) of any other group refrigerant shall be provided for the fire department at all times as required by the *fire code official*.

608.7 Testing of equipment. Refrigeration equipment and systems having a refrigerant circuit containing more than 220 pounds (100 kg) of Group A1 or 30 pounds (14 kg) of any other group refrigerant shall be subject to periodic testing in accordance with Section 608.7.1. Records of tests shall be maintained. Tests of emergency devices or systems required by this chapter shall be conducted by persons trained and qualified in refrigeration systems.

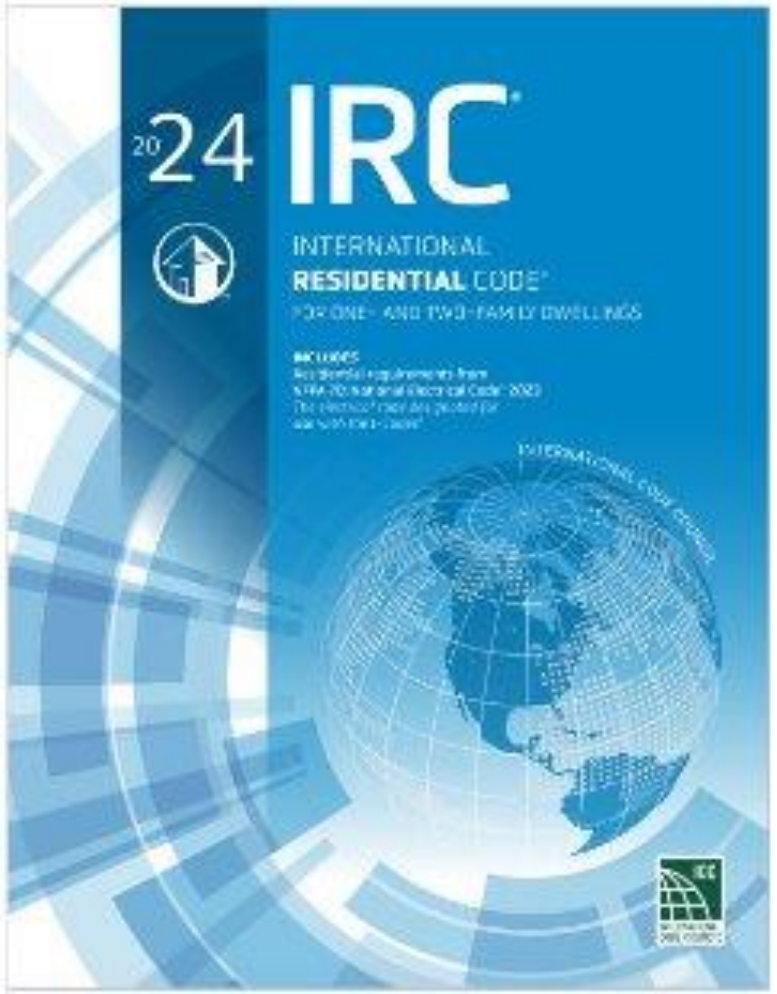
IFC (2024)

SECTION 608—MECHANICAL REFRIGERATION (CONTINUED)

608.7.1 Periodic testing. The following emergency devices or systems shall be periodically tested in accordance with the manufacturer's instructions and as required by the *fire code official*.

1. Treatment and flaring systems.
2. Valves and appurtenances necessary to the operation of emergency refrigeration control boxes.
3. Fans and associated equipment intended to operate emergency ventilation systems.
4. Detection and alarm systems.

International Residential Code (IRC - 2024)



Principles of Mitigation

High level summary on the safe use of flammable refrigerants

Lower Flammability Limit (LFL)

The minimum concentration of refrigerant at which a flame is capable of propagating through a homogeneous mixture of refrigerant and air under specific test conditions in accordance with ASHRAE 34.

[ppm]

[kg/m^3]

[lbs/1000 ft^3] [lbs/ft^3]

Metric values are used formulas which relate charge tiers (m_1, m_2, m_3) to refrigerant LFL values.

Refrigerant Concentration Limit (RCL)

The refrigerant concentration limit, in air, determined in accordance with this standard and intended to reduce the risks of acute toxicity, asphyxiation, and flammability hazards in normally occupied, enclosed spaces.

IMC (2024)

SECTION 1103—REFRIGERATION SYSTEM CLASSIFICATION (CONTINUED)

[ASHRAE 34-2022: Table 4-2]

TABLE 1103.1—REFRIGERANT CLASSIFICATION, AMOUNT AND OEL

CHEMICAL REFRIGERANT	FORMULAS	CHEMICAL NAME OF BLENDS	REFRIGERANT SAFETY GROUP CLASSIFICATION	AMOUNT OF REFRIGERANT PER OCCUPIED SPACE							(F) DEGREES OF HAZARD[a]
				RCL			LFL			OEL	
				lb/MCf	ppm	g/m³	lb/MCf	ppm	g/m³	ppm	
R-11[c]	CCl_3F	trichlorofluoromethane	A1	0.39	1,100	6.1	—	—	—	1,000	2-0-0[b]
R-12[c]	CCl_2F_2	dichlorodifluoromethane	A1	5.6	18,000	90	—	—	—	1,000	2-0-0[b]
R-13[c]	$CClF_3$	chlorotrifluoromethane	A1	—	—	—	—	—	—	1,000	2-0-0[b]
R-13B1[c]	$CBrF_3$	bromotrifluoromethane	A1	—	—	—	—	—	—	1,000	2-0-0[b]
R-13I1	CF_3I	trifluoroiodomethane	A1	1.0	2,000	16	—	—	—	500	—
R-14	CF_4	tetrafluoromethane (carbon tetrafluoride)	A1	25	110,000	400	—	—	—	1,000	2-0-0[b]
R-22	$CHClF_2$	chlorodifluoromethane	A1	13	59,000	210	—	—	—	1,000	2-0-0[b]
R-23	CHF_3	trifluoromethane (fluoroform)	A1	7.3	41,000	120	—	—	—	1,000	2-0-0[b]
R-30	CH_2Cl_2	dichloromethane (methylene chloride)	B1	—	—	—	—	—	—	—	—
R-31	CH_2ClF	chlorofluoromethane	—	—	—	—	—	—	—	—	—
R-32	CH_2F_2	difluoromethane (methylene fluoride)	A2L	4.8	36,000	77	19.1	144,000	306	1,000	1-4-0

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

a. Degrees of hazard are for health, fire, and reactivity, respectively, in accordance with NFPA 704.

b. Reduction to 1-0-0 is allowed if analysis satisfactory to the code official shows that the maximum concentration for a rupture or full loss of refrigerant charge would not exceed the IDLH, considering both the refrigerant quantity and room volume.

c. Class I ozone depleting substance; prohibited for new installations.

d. Occupational Exposure Limit based on the OSHA PEL, ACGIH TLV-TWA, the TERA WEEL or consistent value on a time-weighed average (TWA) basis (unless noted C for ceiling) for an 8 hr/d and 40 hr/wk.

ASHRAE 34-2022 Addendum a (Corrects RCL and LFL of R-454B)

Table 4-2 Data and Safety Classifications for Refrigerant Blends *(Continued)*

Refrigerant Number	Composition (Mass%) (Composition Tolerances)	OEL[h], ppm v/v	Safety Group	RCL[a] ppm v/v	RCL[a] lb/1000 ft³	RCL[a] g/m³	LFL[j] ppm v/v	LFL[j] lb/1000 ft³	LFL[j] g/m³	BV[g] (cm/s)	Highly Toxic or Toxic[f] Under Code Classification
451A	R-1234yf/134a (89.8/10.2) (±0.2/±0.2)	530	A2L	18,000	~~5.0~~5.3	81	~~70,000[m]~~ 74,000	~~20.3[m]~~ 21.3	~~326.6[m]~~ 341	≤4.0	Neither
451B	R-1234yf/134a (88.8/11.2) (±0.2/±0.2)	530	A2L	18,000	5.0	81	~~70,000[m]~~ 74,000	~~20.3[m]~~ 21.3	~~326.6[m]~~ 341.6	≤4.0	Neither
[. . .]											
452B	R-32/125/1234yf (67.0/7.0/26.0) (±2.0/±1.5/±2.0)	870	A2L	30,000	4.8	77	119,000	19.3	310.5	≤4.0	Neither
[. . .]											
454A	R-32/1234yf (35.0/65.0) (+2.0/–2.0, +2.0/–2.0)	690	A2L	~~16,000~~ 21,000	~~3.2~~4.4	~~52~~70	~~63,000[m]~~ 84,000	~~18.3[m]~~ 17.5	~~293.9[m]~~ 281.4	1.4	Neither
454B	R-32/1234yf (68.9/31.1) (+1.0/–1.0, +1.0/–1.0)	850	A2L	~~19,000~~ 29,000	~~3.1~~4.6	~~49~~74	~~77,000[m]~~ 115,000	~~22.0[m]~~ 18.5	~~352.6[m]~~ 296.8	5.2	Neither
454C	R-32/1234yf (21.5/78.5) (±2.0/±2.0)	620	A2L	19,000	~~4.4~~4.6	~~71~~73	~~62,000[m]~~ 77,000	~~18.0[m]~~ 18.2	~~289.5[m]~~ 291.7	~~≤4.0[4]~~	Neither
455A	R-744/32/1234yf (3.0/21.5/75.5) (+2.0, –1.0/+1.0, –2.0/±2.0)	650	A2L	~~22,000~~ 30,000	~~4.9~~6.8	~~79~~108	118,000	26.9	432.1	≤1.5	Neither

Informative Note: ~~LFL of~~Data values highlighted in gray in this table are based on conditions other than WCF @ 23°C (73.4°F). Refer to applicable table footnotes for details.

Safety factors

Typically, refrigerant concentration limits are based on 25% of the LFL. This factor may be adjusted in the codes based on the occupancy (e.g. institutional).

Refrigerant leak detection systems

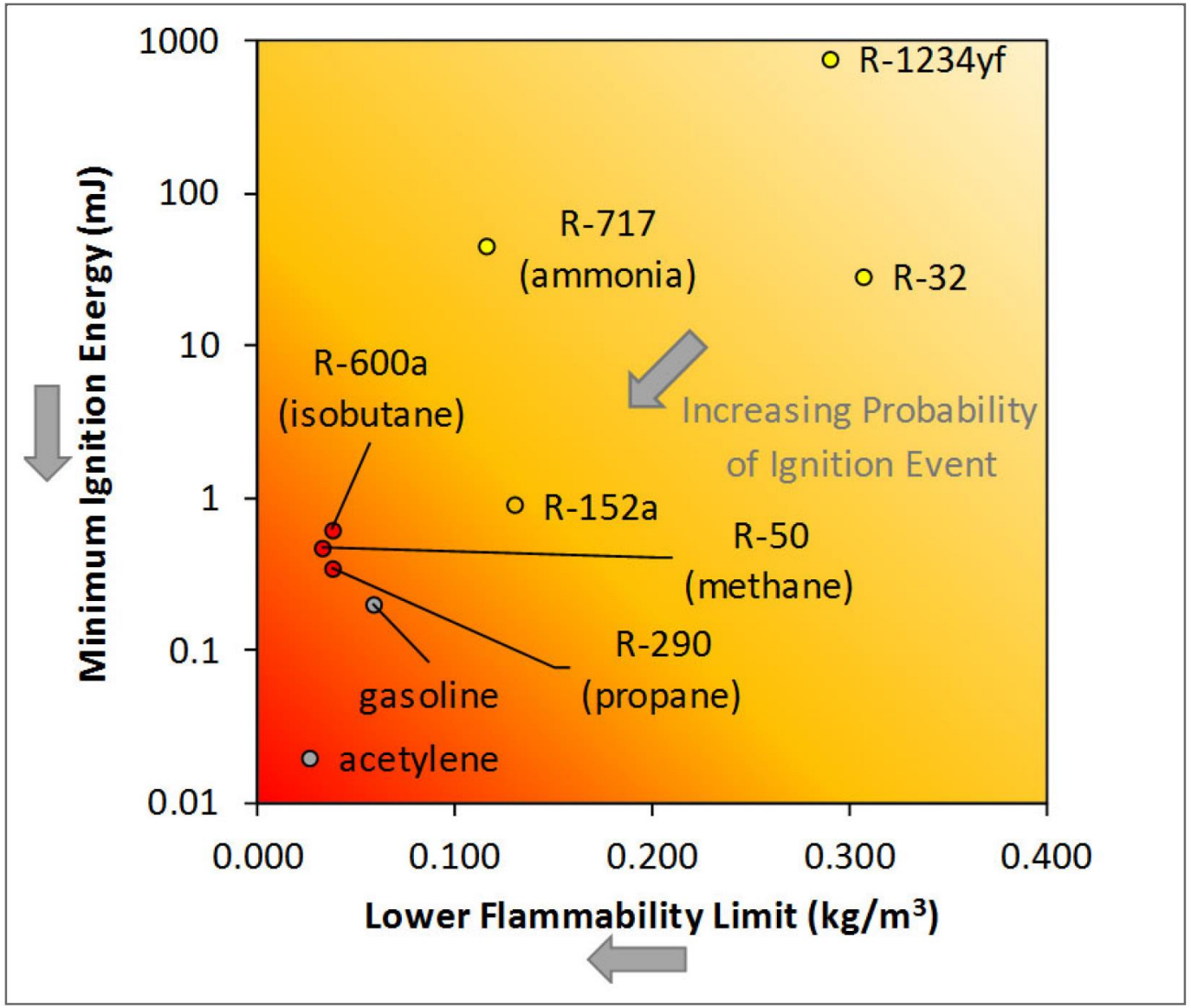
As specified, detectors may be required to be integral to appliance. They may also be required within a machinery room, mechanical spaces, and/or within the conditioned space.

Potential Ignition Sources require energy or temperatures above defined thresholds

Ignition of refrigerant can be caused by arcing and sparking above defined energy levels, hot surfaces above defined temperature limits, or open flames.

Potential ignition sources are controlled within appliances, equipment, ductwork, and machinery room.

LFL and Minimum Ignition Energy Values Comparison



Refrigeration systems contain finite charges of refrigerant

Risk tiers are established based on the amount of the potential leak.

UL 60335-2-40 Charge Limits			
Charge	**R-32 (pounds)**	**R-454B (pounds)**	**R-290 (pounds)**
m1 (non-fixed, factory sealed)	2.03	1.99	0.25
m1	4.06	3.98	0.25
m2	35.18	34.49	N/A
m3	175.93	172.46	N/A

Connected Spaces

Two or more spaces connected by natural ventilation, a ducted air distribution system, or mechanical ventilation.

Circulation airflow

Where specified, the circulating fan of a ducted HVAC will operate to disperse leaked refrigerant in the conditioned space.

Ventilation

As specified:

- Natural or mechanical ventilation
- Continuous, or initiated by refrigerant leak detection system
- Machinery rooms
- Conditioned spaces
- Shafts containing refrigerant piping
- Overpressure devices

A2L and A3 refrigerants are heavier than air

Requirements assume that refrigerant will sink and pool in undisturbed air.

Controls

Includes as specified,

Safety controls:

Shut-off valves

Stop valves

Pump down controls

Ventilation

Group controllers

Coordination of system controls:

Dampers

Zoning systems

Compressor operation

Circulating blower operation

Electrical equipment in ducts and plenums interlocked with airflow

Interface:

Building Management System

Signals and Alarms

Active mitigation requires equipment to be energized at all times.

Warnings and Markings for First Responders

Appliances, equipment and piping are marked to identify hazards for first responders.

Piping installation and protection

- Requirements for piping installation, securement, testing, and protection from damage
- Fire resistance-rated shafts and ventilation

Professional design, installation, and maintenance according to established safety standards and codes

The roles of design professionals, installers, and code enforcement is more important than ever.

Installation Best Practices / Installer Training

UL 60335-2-40 Informative Annex HH establishes information of procedures additional to usual information for refrigerating appliance installation, repair, maintenance and decommission procedures is required when an appliance with flammable refrigerants is affected.

The training of these procedures is to be carried out by national training organizations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation.

The achieved competence should be documented by a certificate.

UL Solutions partnered with NATE (North American Technician Excellence) to develop an installer training curriculum for A2L refrigerants.

https://natex.org/technician/take-an-exam/low-gwp-refrigerant-certification-exam

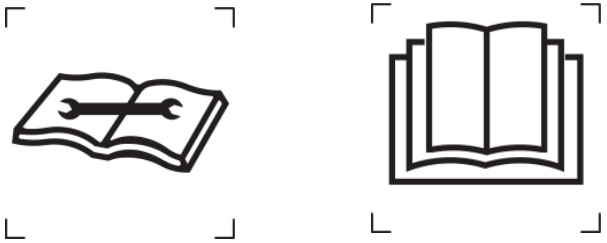
Applying Mitigations

Applying the requirements of the listing and ASHRAE 15/15.2

The manufacturer’s installation instructions are the primary source of information regarding the mitigation.

Compliance with the manufacturer’s instructions are required by model codes. Along with markings, they are the method by which the terms of the listing certification are communicated.

Manufacturer’s Installation Instructions



- Installation details for refrigerant leak detection system
  - Location and mounting
  - Wiring diagram
- Instructions on installation of safety shutoff valves and other mitigation controls.
- System charge and releasable charge
- Minimum room size of indoor space or minimum effective dispersal volume
- Minimum installed height (ceiling-mount/wall-mount/floor-mount)
- Installation accessories identified for use with the equipment (e.g. electric heater kits, germicidal UV-C systems)
- Certification for special applications (e.g. ITE or coil only)
- May specify use of installation standards (e.g. ASHRAE 15/5.2)

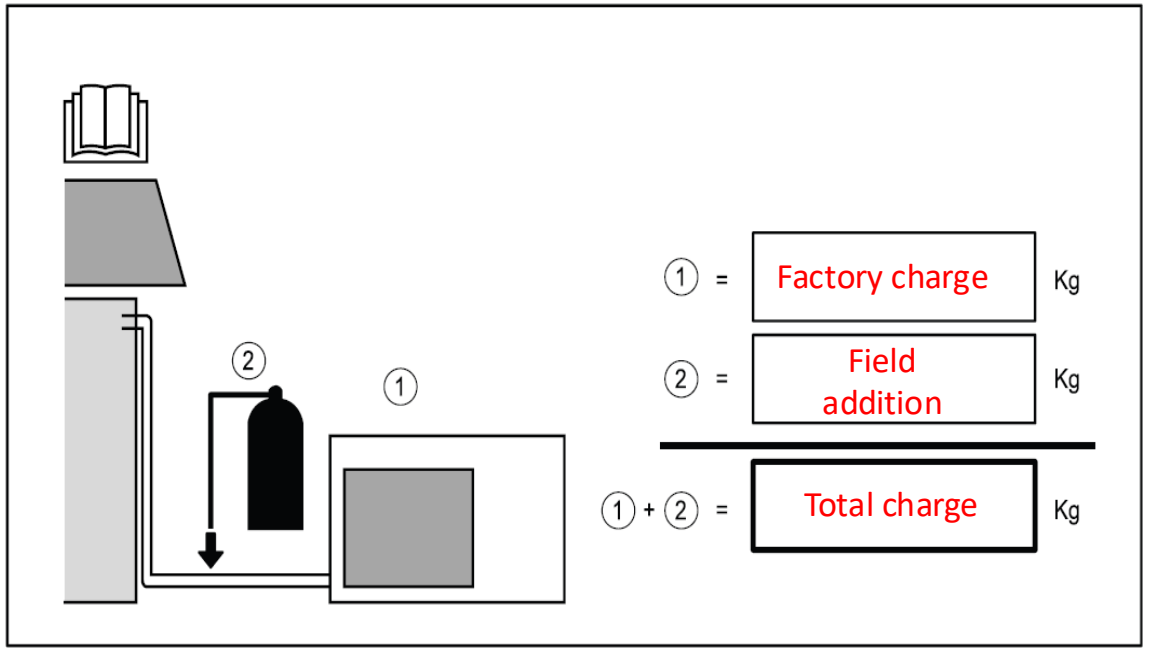
Determining the System/Releasable Charge

- The equipment nameplate shall specify the ASHRAE designation of the refrigerant contained in the equipment (R-32, R-454B,*etc*.)

- For factory-charged equipment, the nameplate shall specify the refrigerant charge quantity

- For field-adjusted charge for split systems:

  (Note, adjustment may move system to a different charge limit category)



Example label from UL 60335–2–40.

Charge limits are per independent refrigerant circuit.

An individual unit or system may have more than one independent circuit.

The releasable charge may be less than the system charge.

The releasable charge may be reduce based on installed mitigation, such as shutoff valves and pump down / pump out controls, which is initiated by a refrigerant detection system.

Safety Shutoff Valves

An automatically controlled *refrigerant* valve for the purpose of limiting the amount of *refrigerant* released into a space when a *refrigerant* leak is detected.)

Pump down / Pump out controls

Pump down and pump out controls activate the compressor or another refrigerant pump as part of the mitigation to move refrigerant to the outdoor coil or to a designated holding vessel, reducing the releasable charge.

May be specified as part of the equipment certification, or as part of the system's engineering design.

Room Size vs Effective Dispersal Volume Charge (EDVC)

Room Size

ASHRAE 15.2, most UL 60335-2-40 markings and instructions (residential and light commercial)

Simplified approach with conservative assumptions

Minimal math (no formulas other than correction factors and extrapolations)

For basic comfort cooling applications

EDVC

ASHRAE 15, some UL 60335-2-40 markings and instructions (ITE, charges >m3)

Comprehensive engineering analysis and design, can use more sophisticated approaches

Multiple calculations and formulas (large equations, multiple variables)

Wide variety of applications including large commercial, industrial, and commercial refrigeration

Room Size / EDVC
(based on refrigerant charge)

UL 60335-2-40 Charge Limits			
Charge	**R-32 (pounds)**	**R-454B (pounds)**	**R-290 (pounds)**
m1 (non-fixed, factory sealed)	2.03	1.99	0.25
m1	4.06	3.98	0.25
m2	35.18	34.49	N/A
m3	175.93	172.46	N/A

Refrigerant Charge Limits / Room Size Restrictions / EDVC		
Greater than	**Up to**	**Notes**
0	m1	No room size restrictions (no product marking)
m1	m2	Room size markings / ASHRAE 15.2 room size / ASHRAE 15 EDVC
m2	m3	Room size markings / ASHRAE 15 EDVC
m3	Upper limit	Indoor equipment in machinery room, ASHRAE 15 mandatory

*ASHRAE 15 has no minimum room size for systems with releasable charge less than 6.6 lbs., but still requires installation per the listing, which may specify a minimum room size.

Minimum Room Size and Installation Height

UL 60335-2-40 requires this information to be provided in installation instructions—as values or in table form (without equations).

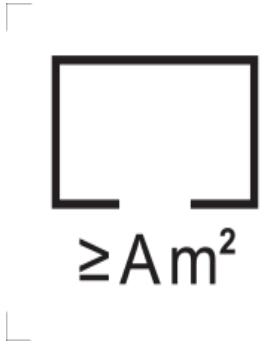
Maximum allowable refrigerant charge tables from ASHRAE 15.2 (+ addendum ***a***)

Table 9-3 M for A2L Systems Based on 7.2 ft (2.2 m) Dispersal Height[a]

Area[b]		M[c]			
		With *Circulation*		Without *Circulation*	
ft^2	m^2	lb_m	kg	lb_m	kg
100	9.3	6.0	3.1	6.0	3.1

Table 9-4 Additional Charge Permitted for A2L Systems Using Ventilation

Ventilation Rate		MV[a]			
		With *Circulation*		Without *Circulation*	
cfm	m^3/h	lb_m	kg	lb_m	kg
20	34	0.8	0.4	0.4	0.2
40	68	1.4	0.6	0.7	0.3
60	102	2.2	1.0	1.1	0.5



WARNING

Appliance shall be installed, operated, and stored in a room with floor area not less than A m^2 (B ft^2).

WARNING

Minimum installation height, X m (W ft).
Minimum room area (operating or storage), Y m^2 (Z ft^2).

UL Solutions

Effective Dispersal Volume Charge (EDVC)

effective dispersal volume charge (EDVC): the maximum *refrigerant* charge permitted for an *effective dispersal volume*.

effective dispersal volume: the volume of a space or *connected spaces* in which leaked *refrigerant* will disperse.

connected spaces: two or more spaces connected by natural ventilation, a ducted air distribution system, or mechanical ventilation.

Effective Dispersal Volume Charge analysis

Occupied Space	Volume of Space, ft³	V_{ot}, ft³
Office 1	2700	
Office 2	4000	
Office 3	2700	
Office 4	2700	
Office 5	2990	
Office 6	5390	
Office 7	2700	
Office 8	2990	
Conf Room 1	3330	
Conf Room 2	3830	
Conf Room 3	3140	
Conf Room 4	3330	183,288
Conf Room 5	3140	
Work Space 1	10350	
Work Space 2	14860	
Data Center	3140	
Executive	7320	
Lounge	8320	
Reception	8980	
Corridor 1	43750	
Corridor 2	43460	
Ductwork	168	

Refrigerant Leak Detection

Integral (Refrigerant Detection System)

- Part of certified equipment
- Typically located at indoor coils
- Factory set at 25% LFL (non-adjustable)
- Response time within 15 seconds (non-adjustable)
- Installed and maintained per equipment manufacturer's instructions

Non-Integral (Refrigerant Detector)

Can be part of certification requirements of equipment, but typically based on engineering design or code requirements.

- Machinery rooms
- Shafts
- Within conditioned space
- Setpoint typically at 25% LFL, but requirements vary based on occupancy type and code requirements
- Response time based on engineering design and code requirements

Refrigerant Detection System (RDS)

A system or portion of a combination system that uses one or more stationary devices to detect the presence of a specified *refrigerant* at a specified concentration and initiates one or more *mitigation actions* required by this standard. A self-contained *refrigerant detector* and alarm device that is not *integral* to a *refrigeration system* is not classified as a *refrigerant detection system*.

Integral Refrigerant Detection System – Direct Systems (based on refrigerant charge)

UL 60335-2-40 Charge Limits			
Charge	**R-32 (pounds)**	**R-454B (pounds)**	**R-290 (pounds)**
m1 (non-fixed, factory sealed)	2.03	1.99	0.25
m1	4.06	3.98	0.25
m2	35.18	34.49	N/A
m3	175.93	172.46	N/A

Refrigerant Charge		Integral Refrigerant Detection System
Greater than	**Up to**	
0	m1	Not usually required (unless system charge >m1, with releasable charge limited by shut-off valves)
m1	m2	Required in most cases (see installation instructions)
m2 to m3	m3	Required
m3	Upper limit	Required

Integral Refrigerant Detection Systems may be shipped and installed separately.

Sensor placement and correct wiring, per the equipment manufacturer’s installation instructions, is critical to correct operation.

Refrigerant Detection Systems - Performance

- Certification requirements when part of listed equipment: UL 60335-2-40 Annex LL; UL 60335-2-89 Annex 101.DVP; CRD (Certification Requirement Decision) documents.
- Evaluates such factors as
  - Response time
  - Response threshold
  - Calibration
  - Stability
  - Drift
  - Self-monitoring
  - Poisoning
  - Environmental factors.
- Per manufacturer's instructions may require periodic testing, maintenance, or replacement over life-cycle of system.

Mitigation Actions based on Integral RDS (ASHRAE 15)

7.6.2.5* Mitigation Action Requirements. The following *mitigation actions shall* be completed in not more than 15 seconds after the initiation of the output signal of Section 7.6.2.4(g), and *shall* be maintained for at least 5 minutes after the output signal has reset:

a. Energize the *air circulation* fan(s) of the equipment per the *manufacturer*'s instructions.
b. Open zoning dampers, or set zone dampers to full airflow set point, that are installed in the *air ducts* connected to the *refrigeration system*.
c.* Activate mechanical ventilation if required by Section 7.6.4.
d. De-energize electric resistance heat installed in the *air duct* that is connected to the *refrigeration system*.
e.* Activate *safety shutoff valves* utilized to reduce *releasable refrigerant charge*.
f.* De-energize potential ignition sources, including open flames and unclassified electrical sources of ignition with apparent power rating greater than 1 kVA, where the apparent power is the product of the circuit voltage and current rating.

Zoning Systems shall be configured to open all zones if a refrigerant leak is detected by the Integral RDS.

Reference ASHRAE 15 (7.6.2.5), ASHRAE 15.2 (5.3.2)

Mitigation controls require unit to remain energized other than for brief service periods.

WARNING – Risk of Fire

LEAK DETECTION SYSTEM installed. Unit must be powered except for service.

WARNING – Risk of Fire

Continuous air circulation required for proper functioning. Unit must be powered except for service.

WARNING – Risk of Fire

This unit is equipped with electrically powered safety measures. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.

Internal components of certified HVAC equipment are evaluated and tested to not be ignition sources.

Components may include special features such as flame arrestors. Modifications to the equipment, or the additions of unevaluated circuit components with the equipment, may create ignition sources. Repairs must be performed per OEM.

Ignition Sources – Internal Components

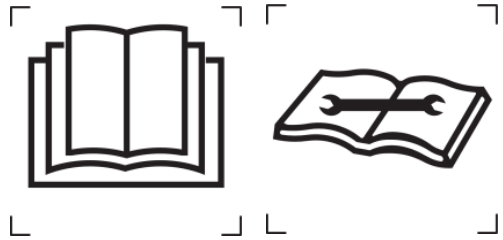
- Manual, magnetic, and solid-state starter and controllers
- Thermal, magnetic, and solid-state overload relays
- Control circuit switches and relays
- Float, flow, pressure, and vacuum-operated switches
- Resistors and rheostats
- Proximity switches
- Time-delay relays and switches
- Solid-state time-delay relays
- Programmable controllers
- Definite purpose controllers
- Solid-state logic controllers
- Industrial microprocessors
- Variable voltage autotransformers
- Motor starting autotransformers

Ignition Sources – Duct Mounted Components Markings/Installation Instructions

1. For ducted equipment, a warning label instructs the installer:

WARNING – Risk of Fire

Auxiliary devices which may be ignition sources shall not be installed in the ductwork, other than auxiliary devices listed for use with the specific appliance. See instructions.



2. The installation instructions will identify auxiliary devices by the equipment manufacturer, if those devices are potential ignition sources.
   - Electrostatic air cleaners, electric heater kits, UV-C germicidal lamps, etc.
   - Based on surface temperature or capability to generate electrical arcing
3. Specified minimum airflow must be provided and interlocked with potential ignition sources.

Ignition Sources – Duct Mounted Components (AHSRAE 15)

7.6.3 Ignition Sources Located in Ductwork

7.6.3.1 Open-flame-producing devices *shall not* be permanently installed in the ductwork that serves the space.

7.6.3.2 Unclassified electrical devices *shall not* be located within the ductwork that serves the space.

7.6.3.3* Refrigeration Systems with Ductwork. Devices containing hot surfaces exceeding 1290°F (700°C) *shall not* be located in the ductwork that serves the space unless there is an average airflow velocity not less than 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. Average airflow velocity *shall* be determined by volumetric airflow rate divided by *duct* flow area.

M59-24 Part I

IMC®: 1101.2.1 (New)

Proponents: Jonathan Roberts, UL Solutions, UL Solutions (jonathan.roberts@ul.com)

THIS IS A 2 PART CODE CHANGE. PART I WILL BE HEARD BY THE MECHANICAL CODE COMMITTEE. PART II WILL BE HEARD BY THE IRC-MP CODE COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THESE COMMITTEES.

2024 International Mechanical Code

Add new text as follows:

1101.2.1 Field installed auxiliary electric heaters. Where auxiliary electric resistance heaters are field installed within the enclosure of listed heating and cooling equipment, the equipment shall be labeled to indicate that the heater is a field installable accessory as part of the equipment listing. The auxiliary electric resistance heater shall be listed and labeled in accordance with UL 60335-2-40 and be installed in accordance with the listing and the manufacturer's instructions.

Indoor Coil-Only Units (Add-on Heat Pumps) ASHRAE 15.2 / Manufacturer's Installation Instructions

12. ADD-ON HEAT PUMPS

12.1 Installation of *add-on heat pumps* containing A2L *refrigerants shall* comply additionally with Sections 12.1.1 through 12.1.6.

12.1.1 The sensor of the *refrigerant detection system shall* be an *integral* part of the indoor coil assembly.

12.1.2 Wiring connecting the *refrigerant detection system* to a furnace assembly *shall* use, at a minimum, 18 AWG wire with a minimum insulation thickness of 0.0625 in. (1.58 mm), or the wire *shall* be protected from damage.

12.1.3* Upon detection of a leak, the *refrigerant detection system shall* activate the indoor fan to supply full stage cooling airflow.

12.1.4 The airflow speed setting selected on the furnace *shall* provide the airflow specified in the *add-on heat pump manufacturer's installation instructions*.

12.1.5 The *refrigerant detection system shall* be tested for proper operation after installation in accordance with the *manufacturer's installation instructions*.

ITE Special Requirements

- For cooling ITE (information technology equipment) or computer room air conditioners (CRACs): UL 60335-2-40 Annex 101.DVN
- Not accessible to the general public
- Special markings and instructions
- Reference ASHRAE 15–2022 addendum *t*

Group Controller

An electrical or electronic control system that monitors and responds to distinct signals from two or more refrigeration systems.

Refrigerant Piping Testing Comparison

IMC – 2024
Section 1110

- Over 3/4 inch: ASHRAE 15.
- 3/4 inch or less: ASME B31.5 or 10 minutes at designated test pressure.
- Over 55 pounds, requires contractor or engineer’s declaration.

IRC – 2024
M1411.7

Tested in accordance with the manufacturer's installation instructions and the requirements of the certification.

ASHRAE 15-2022
Section 9.13

- ASME B31.5 or the following:
- Pressure test at designated pressure (duration per chart).
- Vacuum test at 500 microns. Cannot rise to more than 1500 microns (duration per chart).

ASHRAE 15.2-2022
Section 10.5

- Manufacturer’s installation instructions or the following:
- 60 minutes at designated test pressure.
- Followed by vacuum test at 500 microns. Cannot rise to more than 1500 microns within 10 minutes.

Refrigerant Piping Testing – ASHRAE 15-2022
(Continued)

Table 9-13 Duration of Leak Test

Leak Test	Pipe Length, L		Maximum Nominal Pipe Size		Minimum Period of Test
	ft	m	NPS, in.	DN, mm	hours
Pressure test	$L \leq 100$	$L \leq 30$	NPS $\leq$ 3/4	DN $\leq$ 20	0.25
			3/4 < NPS $\leq$ 3	20 < DN $\leq$ 75	1.0
			3 < NPS	75 < DN	24
	$100 < L \leq 200$	$30 < L \leq 61$	NPS $\leq$ 3	DN $\leq$ 75	1.0
			3 < NPS	75 < DN	24
	$200 < L$	$61 < L$	Any	Any	24
Vacuum test	$L \leq 100$	$L \leq 30$	NPS $\leq$ 3/4	DN $\leq$ 20	1.0
			3/4 < NPS $\leq$ 3	20 < DN $\leq$ 75	8.0
			3 < NPS	75 < DN	24
	$100 < L \leq 200$	$30 < L \leq 61$	NPS $\leq$ 3	DN $\leq$ 75	8.0
			3 < NPS	75 < DN	24
	$200 < L$	$61 < L$	Any	Any	24

Informative Note: The maximum nominal pipe size is the largest interconnecting field *piping* installed.

UL Solutions

Machinery Room

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

ASHRAE 15: A space meeting the requirements of Sections 8.11 and 8.12 that is designed to house compressors and pressure vessels.

IMC (2024)

SECTION 1109—REFRIGERANT PIPE INSTALLATION (CONTINUED)

1109.2.5 Refrigerant pipe shafts. Refrigerant piping that penetrates two or more floor/ceiling assemblies shall be enclosed in a fire-resistance-rated shaft enclosure. The fire-resistance-rated shaft enclosure shall comply with Section 713 of the *International Building Code*

[ASHRAE 15-2022: 9.12.1.5**]

Exceptions:

1. *Refrigeration* systems using R-718 refrigerant (water).
2. Piping in a direct refrigeration system using Group A1 refrigerant where the refrigerant quantity does not exceed the limits of Table 1103.1 for the smallest occupied space through which the piping passes.
3. Piping located on the exterior of the *building* where vented to the outdoors.

M75-24

IMC®: 1109.2.5

Proponents: Greg Johnson, Johnson & Associates Consulting Services, National Multifamily Housing Council

Vladimir G. Kochkin, National Association of Home Builders - NAHB, NAHB

Andrew Klein, A S Klein Engineering, PLLC, BOMA International

Emily Toto, ASHRAE, ASHRAE

2024 International Mechanical Code

Revise as follows:

1109.2.5 Refrigerant pipe shafts. Refrigerant piping that penetrates two or more floor/ceiling assemblies shall be enclosed in a fire-resistance-rated shaft enclosure. The fire-resistance-rated shaft enclosure shall comply with Section 713 of the International Building Code.

Exceptions:

1. *Refrigeration* systems using R-718 refrigerant (water).
2. Piping in a direct refrigeration system ~~using Group A1 refrigerant~~ where the refrigerant quantity does not exceed the limits of Table 1103.1 for the smallest occupied space through which the piping passes.
3. Piping located on the exterior of the *building* where vented to the outdoors.

IMC (2024)

SECTION 1109—REFRIGERANT PIPE INSTALLATION (CONTINUED)

1109.3.2 Shaft ventilation. Refrigerant pipe shafts with systems using Group A2L or B2L refrigerant shall be naturally or mechanically ventilated. Refrigerant pipe shafts with one or more systems using any Group A2, A3, B2 or B3 refrigerant shall be continuously mechanically ventilated and shall include a refrigerant detector. The shaft ventilation exhaust outlet shall comply with Section 501.3.1. Naturally ventilated shafts shall have a pipe, duct or conduit not less than 4 inches (102 mm) in diameter that connects to the lowest point of the shaft and extends to the outdoors. The pipe, duct or conduit shall be level or pitched downward to the outdoors. Mechanically ventilated shafts shall have a minimum airflow velocity in accordance with Table 1109.3.2. The mechanical ventilation shall be continuously operated or activated by a refrigerant detector….

[ASHRAE 15-2022: 9.12.3.2]

IMC (2024)

SECTION 1109—REFRIGERANT PIPE INSTALLATION (CONTINUED)

1109.3.2 Shaft ventilation (continued) … Systems utilizing a refrigerant detector shall activate the mechanical ventilation at a maximum refrigerant concentration of 25 percent of the lower flammable limit of the refrigerant. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The shaft shall not be required to be ventilated for double-wall refrigerant pipe where the interstitial space of the double-wall pipe is vented to the outdoors.

[ASHRAE 15-2022: 9.12.2.2]

TABLE 1109.3.2—SHAFT VENTILATION VELOCITY

CROSS-SECTIONAL AREA OF SHAFT (square inches)	MINIMUM VENTILATION VELOCITY (feet per minute)
≤ 20	100
> 20 ≤ 250	200
> 250 ≤ 1,250	300
> 1,250	400

For SI: 1 square inch = 645 mm^2, 1 foot per minute = 0.0058 m/s.

M62-24

IMC®: CHAPTER 11, SECTION 1101, 1101.1, 1101.1.1, 1107.4, 1107.5, 1109.2.7, 1109.3.2, ASHRAE Chapter 15 (New)

Proponents: Emily Toto, ASHRAE, ASHRAE

2024 International Mechanical Code

CHAPTER 11 REFRIGERATION

Revise as follows:

1101.1.1 Refrigerants other than ammonia. *Refrigeration systems* using a refrigerant other than ammonia shall comply with this chapter, the International Fire Code, and either ASHRAE 15 or ASHRAE 15.2, as applicable ~~and the *International Fire Code*~~. *Refrigeration systems* containing carbon dioxide as the refrigerant shall also comply with IIAR CO2 .

. . .

1109.3.2 Shaft ventilation. Refrigerant pipe shafts with systems using Group A2L or B2L refrigerant shall be naturally or mechanically ventilated. Refrigerant pipe shafts with one or more systems using any Group A2, A3, B2 or B3 refrigerant shall be continuously mechanically ventilated and shall include a refrigerant detector. The shaft ventilation exhaust outlet shall comply with Section 501.3.1. Naturally ventilated shafts shall have a pipe, duct or conduit not less than 4 inches (102 mm) in diameter that connects to the lowest point of the shaft and extends to the outdoors. The pipe, duct or conduit shall be level or pitched downward to the outdoors. Mechanically ventilated shafts shall have a minimum airflow velocity in accordance with Table 1109.3.2. The mechanical ventilation shall be continuously operated or activated by a refrigerant detector. Systems utilizing a refrigerant detector shall activate the mechanical ventilation at a maximum refrigerant concentration of 25 percent of the lower flammable limit of the refrigerant. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The shaft shall not be required to be ventilated for double-wall refrigerant pipe where the interstitial space of the double-wall pipe is vented to the outdoors. For refrigeration systems used in residential occupancies serving only a single dwelling unit or sleeping unit, shaft ventilation shall not be required where the pipe or tube is continuous without fittings in the shaft.

Additional Topics

Related Topics & Discussion

A3 Refrigerants in HVAC

UL 60335-2-40, 4th Edition

Charge limit for A3 refrigerants:
3 x LFL (0.25 lbs. for R-290)

A3 Refrigerants in Commercial Refrigeration

UL 60335-2-89, 2nd Edition

Charge limits for A3 refrigerants:

13 x LFL (1.08 lbs. for R-290)

8 x LFL (0.67 lbs. for R-290) for refrigerators with doors and drawers

4 x LFL (0.33 lbs. for R-290) for split systems

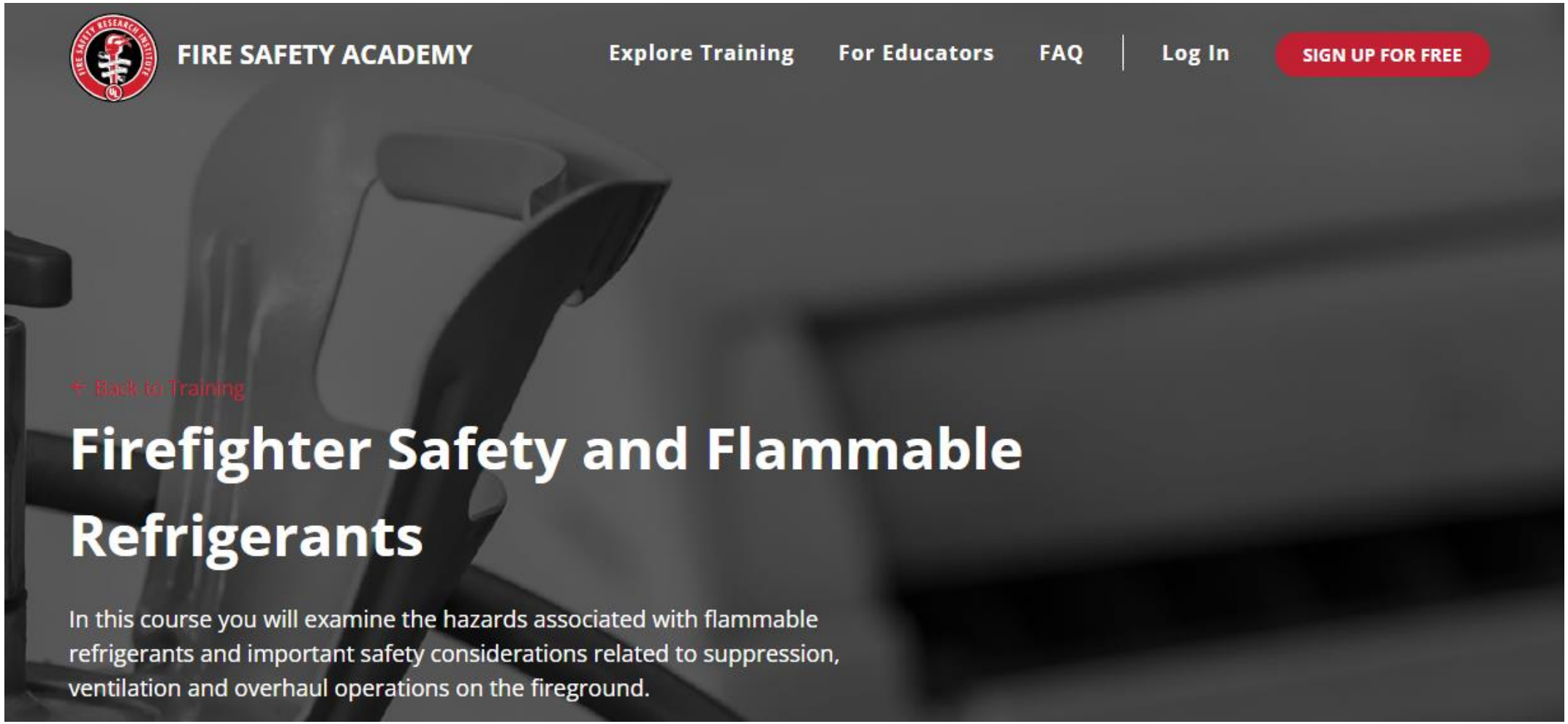
3 x LFL (0.25 lbs. for R-290) when in public corridor or lobby

AHL24EV1644201

A3 refrigerants such as R-290 (propane) do not contain odorants.

Odorants such as mercaptans are incompatible with refrigeration systems.

Fire Safety Research Institute (FSRI) training



https://training.fsri.org/course/100/firefighter-safety-and-flammable-refrigerants

The Code Authority Newsletter

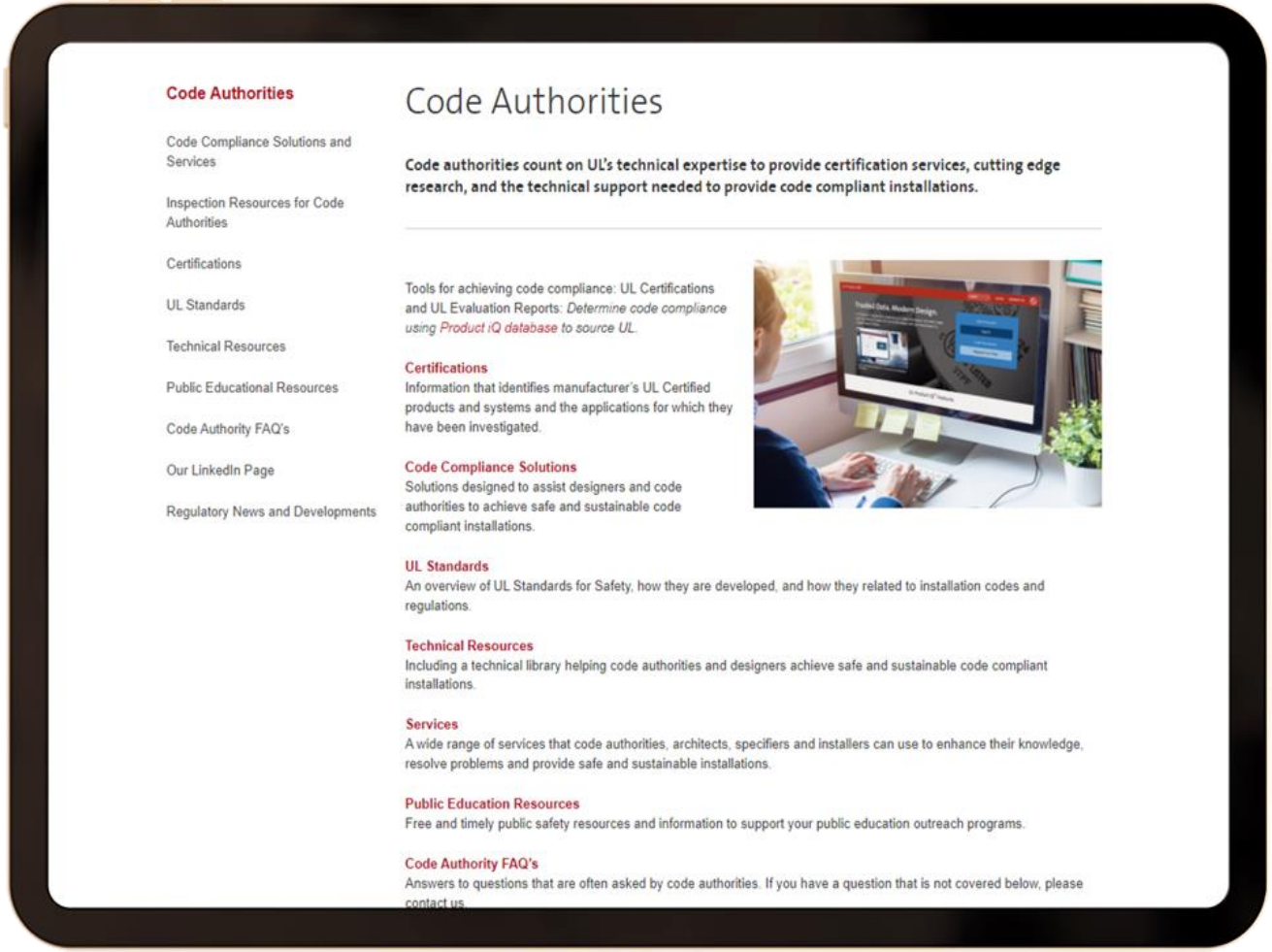
https://www.ul.com/news/code-authority-newsletter

Technical updates and code-related considerations for UL Certified products.

Code Authorities Website

https://code-authorities.ul.com/

Providing technical support for Code Authorities to verify UL Certifications and parameters to determine code compliant installations.



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- Basic service – no charge for use
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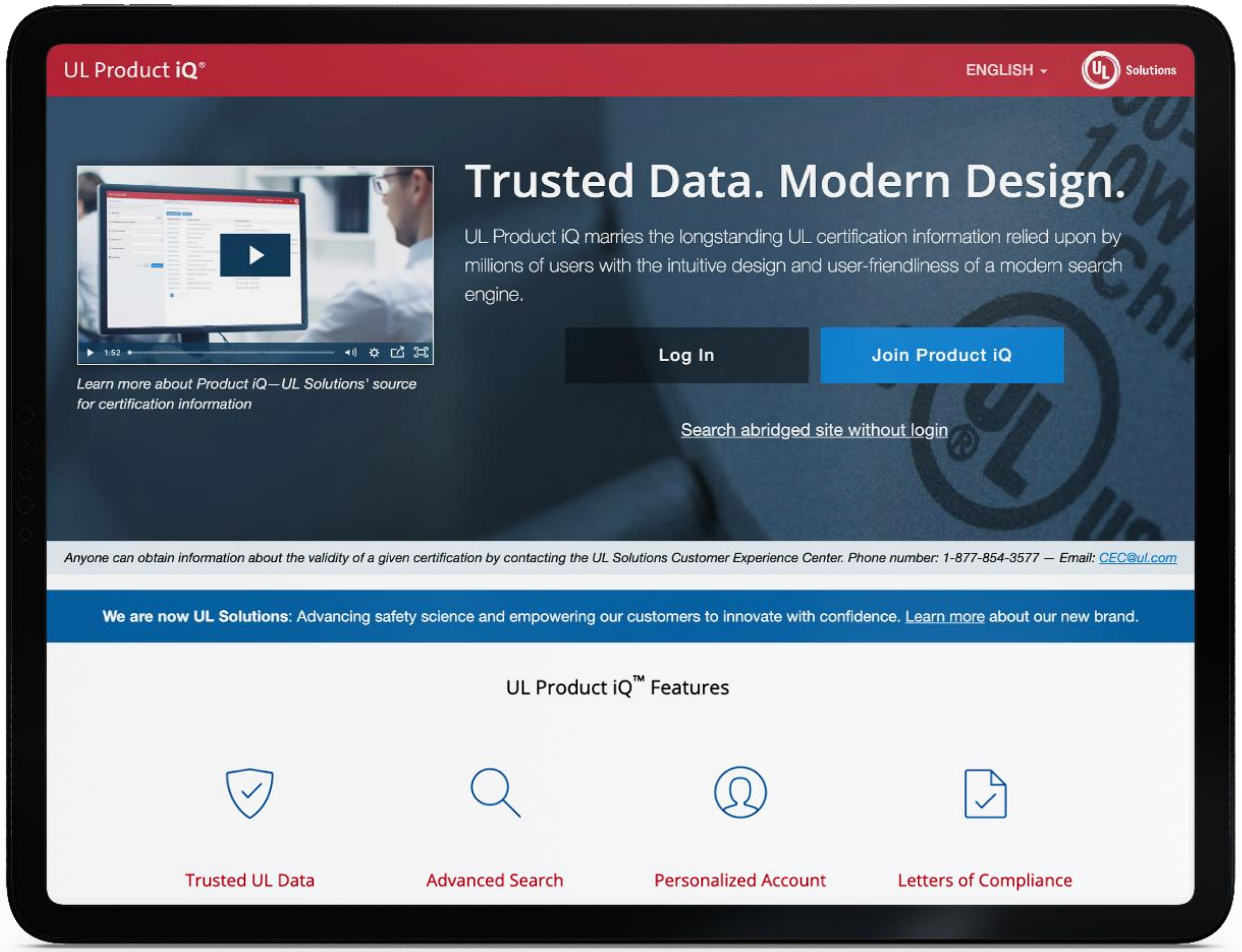

QUESTIONS?

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Thank you

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