Final Draft Proposed Changes to the 2020 Mechanical Code of New York State
Issued July 2024

This document is being developed for the purpose of posting a notice of rule in development for the New York State Fire Prevention and Building Code Council (Code Council) and the New York State Department of State. The purpose is to show the final draft proposed changes to the current version of the 2020 Mechanical Code of New York State (2020 MCNYS). Separate documents will exist for each of the current NYS specific code books. This document **is not intended to include** all of the proposed code language; it only contains those sections of code that are proposed to be new or modified. Please note that unaltered portions of the 2020 code books are not included within this document and should be considered to remain the same for this code update.

This document is the final draft of the notice of rule in development being released for comment from the public and the Code Council. Accordingly, the Yellow highlighted text included in earlier versions to denote the changes from earlier versions of the documents has been removed.

Please note:

- Chapter 1's are included as a separate document for all of the code books
- This document does not include grammatical, punctuation, and simple word clarifications that do not change the intent or meaning of a provision.
- Where a change is made by NYS, rather than an ICC level change, "[NY]" is added to the section numbers; however, grammatical and punctuation changes made by NYS that do not change the intent or meaning of a provision are not denoted by [NY]. Similarly, updates made by NYS to cross-referenced sections or sections where the only change is to the referenced code book (i.e. ~~International Plumbing Code~~ Plumbing Code of New York State are not denoted by [NY]).
- Changes to the existing text are denoted in the following manner:
  - Text insertions: TEXT
  - Text deletions: ~~TEXT~~
- Cross-referenced code sections may not be accurate and/or may change based on existing and future modifications. Code sections are based on the anticipated 2024 ICC code section.
- Where multiple code change proposals are listed together, it represents multiple ICC code changes that dealt with the same code sections and were therefore consolidated.
- Some code changes involve complex tables, lists, or lengthy sections in which a small change was made to only a portion of the section. In those instances, the entire section, table, list, etc. that was unchanged may not be included below. A note has been added to indicate when that happens (i.e. "Items 1 through 13 remain unchanged").
- Reference to Chapter 11 of the Residential Code of New York State for energy provisions will be corrected in the notice of proposed rule making documents to reference the corresponding provision from the Energy Conservation Construction Code of New York State.

Chapter 2 - Definitions

[BG] AMBULATORY CARE FACILITY. Buildings or portions thereof used to provide medical, surgical, psychiatric, nursing or similar care on a less than 24-hour basis to persons who are rendered incapable of self-preservation by the services provided or staff has accepted responsibility for care recipients already incapable.

[A]APPROVED AGENCY. An established and recognized ~~agency~~ organization that is regularly engaged in conducting tests, furnishing inspection services or furnishing product evaluation or certification where such ~~agency~~ organization has been *approved* by the code official.

BALANCED VENTILATION SYSTEM. A ventilation system that simultaneously supplies outdoor air to and exhausts air from a space, where the mechanical supply airflow rate and the mechanical exhaust airflow rate are each within 10% of the average of the two airflow rates.

[BF] 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.

CONDENSING UNIT. ~~A specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers and, where required, liquid receivers, and the regularly furnished accessories.~~ A factory-made assembly of refrigeration components designed to compress and liquefy a specific refrigerant. The unit consists of one or more power-driven compressors, condensers, liquid receivers (where required) and factory-supplied accessories.

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.

DRAFTSTOP. A material, device or construction installed to restrict the movement of air within open spaces of concealed areas of *building* components such as crawl spaces, floor/ceiling assemblies, roof/ceiling assemblies and attics.

~~**FLAMMABILITY CLASSIFICATION (REFRIGERANT).** Refrigerants shall be assigned to one of the three classes 1, 2 or 3 in accordance with ASHRAE 34. For Classes 2 and 3, the heat of combustion shall be calculated assuming that combustion products are in the gas phase and in their most stable state.~~

GREASE DUCT. A duct serving a Type I hood, or cooking appliances equipped with integral down-draft exhaust systems that produce grease, to convey grease-laden air from the hood or cooking appliance directly to the outdoors.

GYPSUM BOARD. A type of gypsum panel product consisting of a noncombustible core primarily of gypsum with paper surfacing.

GYPSUM WALLBOARD. A gypsum board used primarily as an interior surfacing for building structures.

HEAT PUMP. A refrigeration system ~~that extracts heat from one substance and transfers it to another portion of the same substance or to a second substance at a higher temperature for a beneficial~~ purpos or factory-made appliance that utilizes refrigerant to transfer heat into a space or substance.

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.

~~**HIGH VOLUME,**~~ **LARGE-DIAMETER CEILING FAN**. A ~~lowspeed~~ ceiling fan that ~~circulates large volumes of air and that~~ is greater than 7 feet (2134 mm) in diameter. These fans are ~~sometimes~~ also referred to as High-Volume, Low-Speed (HVLS) fans.

[A]LISTED.*Equipment*, materials, products or services included in a list published by an organization acceptable to the code official and concerned with evaluation of products or services that maintains periodic inspection of production of *listed equipment* or materials or periodic evaluation of services and whose listing states either that the *equipment*, material, product or service meets identified standards or has been tested and found suitable for a specified purpose. Terms that are used to identify *listed equipment*, products or materials include "listed," "certified," "classified" or other terms as determined appropriate by the listing organization

LOWER FLAMMABLE LIMIT (REFRIGERANT) (LFL). The minimum concentration of refrigerant ~~that is~~ at which a flame is capable of propagating ~~a flame~~ through a homogeneous mixture of refrigerant and air under specific test conditions in accordance with ASHRAE 34.

NONCOMBUSTIBLE MATERIAL~~S~~. A material that passes ASTM E136. ~~Materials that, when tested in accordance with ASTM E136, have not fewer than three of four specimens tested meeting all of the following criteria:~~

1. The recorded temperature of the surface and interior thermocouples shall not at any time during the test rise more than 54°F (30°C) above the furnace temperature at the beginning of the test.
2. There shall not be flaming from the specimen after the first 30 seconds.
3. If the weight loss of the specimen during testing exceeds 50 percent, the recorded temperature of the surface and interior thermocouples shall not at any time during the test rise above the furnace air temperature at the beginning of the test, and there shall not be flaming of the specimen.

[A] PEER REVIEW. An independent and objective technical review conducted by an *approved* third party.

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.

REFRIGERANT. A substance utilized to produce refrigeration by its expansion or vaporization.

REFRIGERANT. The fluid used for heat transfer in a refrigeration system that undergoes a change of state to absorb heat.

REFRIGERANT DESIGNATION. The unique identifying alphanumeric value or refrigerant number assigned to an individual refrigerant and published in ASHRAE 34.

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

REFRIGERANT SAFETY GROUP CLASSIFICATION. The alphanumeric designation that indicate indicates both the toxicity and flammability classifications classes in accordance with Section 1103.1. The classification group is made up of a letter (A or B) that indicates the toxicity class, followed by a number (1, 2 or 3) that indicates the flammability class. Refrigerant blends are similarly classified, based on the compositions at their worst cases of fractionation, as separately determined for toxicity and flammability. In some cases, the worst case of fractionation is the original formulation of refrigerants in accordance with ASHRAE 34.

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.

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.

REFRIGERATION REFRIGERATING SYSTEM. A combination of interconnected parts in which a refrigerant is enclosed and refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting then rejecting heat.

STEAM BATH EQUIPMENT. Includes steam bath generators, combination room and steam generator systems, and steam bath cabinets intended for high-humidity concentrated heating at elevated temperatures for personal bathing.

TOXICITY CLASSIFICATION (REFRIGERANT). Refrigerants shall be classified for toxicity in one of two classes in accordance with ASHRAE 34.

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

301.18 Seismic resistance. Where earthquake loads are applicable in accordance with the International Building Code, mechanical system supports, anchorage, and bracing, shall be designed and installed for ~~the~~ seismic forces in accordance with Chapter 16 of the International Building Code.

[BS] 302.3 Cutting, notching and boring in wood framing. The cutting, notching and boring of wood framing members shall comply with Section~~s~~ 2308.3 of the International Building Code. ~~302.3.1 through 302.3.4.~~

~~**[BS] 302.3.1 Joist notching**. Notches on the ends of joists shall not exceed one-fourth the joist depth. Holes bored in joists shall not be within 2 inches (51 mm) of the top or bottom of the joist, and the diameter of any such hole shall not exceed one-third the depth of the joist. Notches in the top or bottom of joists shall not exceed one-sixth the depth and shall not be located in the middle third of the span.~~

~~**[BS] 302.3.2 Stud cutting and notching**. In exterior walls and bearing partitions, a wood stud shall not be cut or notched in excess of 25 percent of its depth. In nonbearing partitions that do not support loads other than the weight of the partition, a stud shall not be cut or notched in excess of 40 percent of its depth.~~

~~**[BS] 302.3.3 Bored holes**. The diameter of bored holes in wood studs shall not exceed 40 percent of the stud depth. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in nonbearing partitions. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in any wall where each stud is doubled, provided that not more than two such successive doubled studs are so bored. The edge of the bored hole shall be not closer than $^{5}/_{8}$ inch (15.9 mm) to the edge of the stud. Bored holes shall be not located at the same section of stud as a cut or notch.~~

[BS] 302.5 Cutting~~,~~ and notching ~~and boring~~ in cold-formed steel framing. The cutting and notching of holes in cold-formed steel framing members shall be in accordance with AISI S240 for structural members and AISI S220 for non-structural members. ~~The cutting, notching and boring of steel framing members shall comply with Sections 302.5.1 through 302.5.3.~~

~~**[BS] 302.5.2 Cutting, notching and boring holes in cold-formed steel framing**. Flanges and lips of load-bearing cold-formed steel framing members shall not be cut or notched. Holes in webs of load-bearing cold-formed steel framing members shall be permitted along the centerline of the web of the framing member and shall not exceed the dimensional limitations, penetration spacing or minimum hole edge distance as prescribed by the *registered design professional*. Cutting, notching and boring holes of steel floor/roof decking shall be as prescribed by the *registered design professional*.~~

~~**[BS] 302.5.3 Cutting, notching and boring holes in non-structural cold-formed steel wall framing**. Flanges and lips of nonstructural cold-formed steel wall studs shall not be cut or notched. Holes in webs of nonstructural cold-formed steel wall studs shall be permitted along the centerline of the web of the framing member, shall not exceed $1^{1}/_{2}$ inches (38 mm) in width or 4 inches (102 mm) in length, and shall not be spaced less than 24 inches (610 mm) center to center from another hole or less than 10 inches (254 mm) from the bearing end.~~

[BE] 304.11 Guards. Guards shall be provided where various 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 that require service and each end of the 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:** Guards are not required where fall arrest/restraint anchorage connector devices that comply with ANSI/ASS~~E~~P Z359.1 are installed.

TABLE 305.4 PIPING SUPPORT SPACING[a]

The remaining portion of the table is unchanged and omitted for clarity.

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
~~PB pipe or tubing~~	~~22/3 (32 inches)~~	~~4~~

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. See Section 301.18.

b. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.

c. Mid-story guide.

305.5 Protection against physical damage. In concealed locations where piping, other than cast-iron or steel, is installed through holes or notches in studs, joists, rafters or similar members less than ~~1 1/2 inches (38 mm)~~ 1 1/4 inches (32 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Protective steel shield plates ~~having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage)~~ shall cover the area of the pipe where the member is notched or bored, and shall extend not less than 2 inches (51 mm) above sole plates and below top plates.

Protection required against physical damage. Protective shield plates shall be placed where nails or screws from finish or other work are likely to penetrate the clothes dryer exhaust duct. Shield plates shall be placed on the finished face of all framing members where there is less than 11/4 inches (32 mm) between the duct and the finished face of the framing member. Protective shield plates ~~shall be constructed of steel, have a thickness of 0.062 inch (1.6 mm) and~~ extend not less than 2 inches (51 mm) above sole plates and below top plates.

305.5.1 Shield plates. Shield plates shall be of steel material having a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 gage).

306.1 Access. *Appliances*, controls devices, heat exchangers and HVAC system components that utilize energy shall ~~be accessible~~ provide access for inspection, service, repair and replacement without disabling the function of a fire-resistance-rated assembly or removing permanent construction, other appliances, venting systems or any other piping or ducts not connected to the *appliance* being inspected, serviced, repaired or replaced. A level working space not less than 30 inches deep and 30 inches wide (762 mm by 762 mm) shall be provided in front of the control side to service an *appliance*.

306.5 Equipment and appliances on roofs or elevated structures. Where *equipment* requiring access or *appliances* are located on an elevated structure or the roof of a building such that personnel will have to climb higher than 16 feet (4877 mm) above grade 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 four 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.

Permanent ladders installed to provide the required access shall comply with the following minimum design criteria:

1. The side railing shall extend above the parapet or roof edge or landing platform not less than ~~30 inches (762 mm)~~ 42 inches (1067 mm).
2. Ladders shall have rung spacing not less than 10 inches (254 mm) and not to exceed 14 inches (356 mm) on center. The uppermost rung shall be not greater than 24 inches (610 mm) below the upper edge of the roof hatch, roof or parapet, as applicable.
3. Ladders shall have a toe spacing not less than ~~6 inches (152 mm)~~ 7 inches (178 mm) and not more than 12 inches (305 mm) deep.
4. There shall be not less ~~than 18 inches (457 mm)~~ 16 inches (406 mm) between rails.
5. Rungs shall have a diameter not less than 0.75-inch (19.1 mm) and be capable of withstanding a 300-pound (136 kg) load.
6. Ladders over 30 feet (9144 mm) in height shall be provided with offset sections and landings capable of withstanding 100 pounds per square foot (488 kg/m2). Landing dimensions shall be not less than 18 inches (457 mm) and not less than the width of the ladder served. A guard rail shall be provided on all open sides of the landing.
7. Climbing clearance. The distance from the centerline of the rungs to the nearest permanent object on the climbing side of the ladder shall be not less than 30 inches (762 mm) measured perpendicular to the rungs. This distance shall be maintained from the point of ladder access to the bottom of the roof hatch. A minimum clear width of 15

inches (381 mm) shall be provided on both sides of the ladder measured from the midpoint of and parallel with the rungs except where cages or wells are installed.

8. Landing required. The ladder shall be provided with a clear and unobstructed bottom landing area having a minimum dimension of 30 inches (762 mm) by 30 inches (762 mm) centered in front of the ladder.
9. Ladders shall be protected against corrosion by *approved* means.
10. Access to ladders shall be provided at all times.
11. Top landing required. The ladder shall be provided with a clear and unobstructed landing on the exit side of the roof hatch having a minimum space of 30 inches deep and be of the same width as the hatch.

Catwalks installed to provide the required access shall be not less than 24 inches (610 mm) wide and shall have railings as required for service platforms.

Exception: This section shall not apply to Group R-3 *occupancies*.

307.1.2 Identification. The termination of concealed condensate piping shall be marked to indicate whether the piping is connected to the primary or to the secondary drain.

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, shall not be considered as discharging to a plumbing fixture. 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.

307.2.2 Drain pipe materials and sizes. Components of the condensate disposal system shall be ABS, cast iron~~, galvanized steel~~, copper ~~,~~ and copper alloy, CPVC, cross-linked polyethylene, galvanized steel, PE-RT, polyethylene, ~~ABS~~ polypropylene, ~~CPVC,~~ PVC ~~,~~ or ~~polypropylene~~ 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 ~~internal diameter~~ 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 Table 307.2.2.

307.2.3.3 Identification. ~~Where condensate piping is concealed, primary and secondary drain pipes that serve the same appliance and terminate together at a remote location shall be identified.~~ The termination of concealed condensate piping shall be marked to indicate whether the piping is connected to the primary or to the secondary drain.

Chapter 4 - Ventilation

[NY] 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. All dwelling units, where natural ventilation is proposed, shall be tested in accordance with Section R402.4.1.2 of the *Energy Conservation Construction Code of New York State*. ~~Where the air infiltration rate in a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2 inch water column (50 Pa) in accordance with Section R402.4.1.2 of the International Energy Conservation Code, the dwelling unit shall be ventilated by~~ Dwelling units complying with the air leakage requirements of the *International Energy Conservation Code* or ASHRAE 90.1 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.

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

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air intake openings shall be permitted to be located less than

10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such locations. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.

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 a factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the fan manufacturer's instructions.
4. Intake openings on structures in flood hazard areas shall be at or above the elevation required by Section 1612 of the *International Building Code* for utilities and attendant *equipment*.

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return 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. The outdoor air required by Section 403.3 shall not be recirculated. Air in excess of that required by Section 403.3 shall not be prohibited from being recirculated as a component of supply air to building spaces, except that:

1. Ventilation air shall not be recirculated from one dwelling to another or to dissimilar occupancies.
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 ACCA Manual SPS.
3. Where mechanical exhaust is required by Note b in Table 403.3.1.1, recirculation of air from such spaces shall be prohibited. Recirculation of air that is contained completely within such spaces shall not be prohibited. Where recirculation of air is prohibited, all air supplied to such spaces shall be exhausted, including any air in excess of that required by Table 403.3.1.1.
4. Where mechanical exhaust is required by Note g in Table 403.3.1.1, mechanical exhaust is required and recirculation from such spaces is prohibited where more than 10 percent of the resulting supply air-stream consists of air recirculated from these spaces. Recirculation of air that is contained completely within such spaces shall not be prohibited.

403.3.1 Other buildings intended to be occupied. The design of local exhaust systems and ventilation systems for outdoor air for *occupancies* other than Groups R-2, R-3 and R-4 three stories and less in height above grade plane shall comply with the *Energy Conservation Construction Code of New York State* and with Sections 403.3.1.1 through 403.3.1.4.

403.3.2 Group R-2, R-3 and R-4 occupancies. The design of local exhaust systems and ventilation systems for outdoor air in Group R-2, R-3 and R-4 *occupancies* three stories and less in height above grade plane shall comply with Sections 403.3.2.1 through 403.3.2.5.

403.3.2.1Outdoor air for dwelling units. An outdoor air ventilation system consisting of a *balanced ventilation system* mechanical exhaust system, supply system or combination thereof shall be installed for each *dwelling unit*. Local exhaust or supply systems, including outdoor air ducts connected to the return side of an air handler, are permitted to serve as such a system. The *balanced ventilation system* outdoor air ventilation system shall be an energy recovery ventilation system or a heat recovery ventilation system in accordance **with Section R403.6 of the *Energy Conservation Construction Code of New York State* and** be designed to provide the required rate of outdoor air continuously during the period that the *building* is occupied. The minimum continuous outdoor airflow rate shall be determined in accordance with Equation 4-9.

$$Q_{OA} = 0.03A_{floor} + 7.5(N_{br} + 1)$$

(Equation 4-9)

where:

Q_{OA} = outdoor airflow rate, cfm

A_{floor} = conditioned floor area, ft^2

N_{br} = number of bedrooms; not to be less than one

Exceptions:

1.The *balanced ventilation system* outdoor air ventilation system is not required to operate continuously where the system has controls that enable operation for not less than 1 hour of each 4-hour period. The average outdoor airflow rate over the 4-hour period shall be not less than that prescribed by Equation 4-9.
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 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.*

TABLE 403.3.1.1 MINIMUM VENTILATION RATES

The remaining portion of the table is unchanged and omitted for clarity.

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT^{2a}	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_a CFM/FT^{2a}	EXHAUST AIRFLOW RATE CFM/FT^{2a}
Animal Facilities				
Animal exam room (veterinary office)	20	10	0.12	-
Animal imaging (MRI/CT/PET)	20	10	0.18	0.9

Animal operating rooms	20	10	0.18	3.00
Animal postoperative recovery room	20	10	0.18	1.50
Animal preparation rooms	20	10	0.18	1.50
Animal procedure room	20	10	0.18	2.25
Animal surgery scrub	20	10	0.18	1.50
Large-animal holding room	20	10	0.18	2.25
Necropsy	20	10	0.18	2.25
Small-animal cage room (static cages)	20	10	0.18	2.25
Small-animal-cage room (ventilated cages)	20	10	0.18	1.50
Correctional facilities				
Booking/waiting	50	7.5	0.06	—
Cells				
without plumbing fixtures	25	5	0.12	—
with plumbing fixtures[g]	25	5	0.12	1
Dry cleaners, laundries				
Coin-operated dry cleaner	20	15	—	—
Coin-operated laundries	20	7.5	0.12	—
Commercial dry cleaner	30	30	—	—
Commercial laundry	10	5	0.12	—
Storage, pick up	30	7.5	0.12	—
Education				
Art Classroom [g]	20	10	0.18	0.7
Auditoriums	150	5	0.06	—
Classrooms (ages 5–8)	25	10	0.12	—
Classrooms (age 9 plus)	35	10	0.12	—
Computer lab	25	10	0.12	—
Corridors (see “Public spaces”)	—	—	—	—
Day care (through age 4)	25	10	0.18	—
Lecture classroom	65	7.5	0.06	—

Lecture hall (fixed seats)	150	7.5	0.06	—	
Locker/dressing roomsg	—	—	—	0.25	
Media center	25	10	0.12	—	
Multiuse assembly	100	7.5	0.06	—	
Music/theater/dance	35	10	0.06	—	
Science laboratories[g]	25	10	0.18	1	
Smoking lounges[b]	70	60	—	—	
Sports locker rooms[g]	—	—	—	0.5	
Wood/metal shops[g]	20	10	0.18	0.5	
Food and beverage service					
Bars, cocktail lounges	100	7.5	0.18	—	
Break rooms	25	5	0.06	-	
Cafeteria, fast food	100	7.5	0.18	—	
Coffee stations	20	5	0.06	-	
Corridors	-	-	0.06	-	
Dining rooms	70	7.5	0.18	—	
Kitchens (cooking)[b]	20	7.5	0.12	0.7	
Occupiable storage rooms for liquids or gels	2	5	0.12	-	
Hotels, motels, resorts and dormitories					
Bathrooms/toilet —private[g]		—	—	—	25/50[f]
Bedroom/living room	10	5	0.06	—	
Conference/meeting	50	5	0.06	—	
Dormitory sleeping areas	20	5	0.06	—	
Gambling casinos	120	7.5	0.18	—	
Laundry rooms, central	10	5	0.12	-	
Laundry rooms within dwelling units	10	5	0.12	-	
Lobbies/prefunction	30	7.5	0.06	—	
Multipurpose assembly	120	5	0.06	—	
Offices					
Break rooms		50	5	0.12	-

Conference rooms	50	5	0.06	—
Main entry lobbies	10	5	0.06	—
Occupiable storage rooms for dry materials	2	5	0.06	-
Office spaces	5	5	0.06	—
Reception areas	30	5	0.06	—
Telephone/data entry	60	5	0.06	—
Outpatient healthcare facilities[i, j]				
Birthing room		15	10	0.18 -
Class 1 imaging room	5	5	0.12	-
Dental operatory[k]	20	10	0.18	-
General examination room	20	7.5	0.12	-
Other dental treatment areas	5	5	0.06	-
Physical therapy exercise area	7	20	0.18	-
Physical therapy individual room	20	10	0.06	-
Physical therapeutic pool area	-	-	0.48	-
Prosthetics and orthotics room	20	10	0.18	-
Psychiatric consultation room	20	5	0.06	-
Psychiatric examination room	20	5	0.06	-
Psychiatric group room	50	5	0.06	-
Psychiatric seclusion room	5	10	0.06	-
Speech therapy room	20	5	0.06	-
Urgent care examination room	20	7.5	0.12	-
Urgent care observation room	20	5	0.06	-
Urgent care treatment room	20	7.5	0.18	-
Urgent care triage room	20	10	0.18	-
Private dwellings, single and multiple				

Garages, common for multiple units[b]			—	—	—
Kitchens[b]	—	—	—	~~25~~ 50/100[f]	
Living areas[c]	Based on number of bedrooms. First bedroom, 2; each additional bedroom, 1	0.35 ACH but not less than 15 cfm/person	—	—	
Toilet rooms and bathrooms[g]	—	—	—	~~20~~ 25/50[f]	
Public spaces					
Corridors		—	—	0.06	—
Courtrooms	70	5	0.06	—	
Elevator car	—	—	—	1.0	
Legislative chambers	50	5	0.06	—	
Libraries	10	5	0.12	—	
Museums (children's)	40	7.5	0.12	—	
Museums/galleries	40	7.5	0.06	—	
Places of religious worship	120	5	0.06	—	
Shower room (per shower head)[g]	—	—	—	50/20[f]	
Smoking lounges[b]	70	60	—	—	
Toilet rooms — public[g]	—	—	—	50/70[e]	
Room with adult changing station			,	50/70[e]	
Specialty shops					
Automotive motor fuel-dispensing stations[b]		—	—	—	1.5
Banks or lobbies	15	7.5	0.06	-	
Barber	25	7.5	0.06	0.5	
Beauty salons[b]	25	20	0.12	0.6	
Embalming room[b]	—	—	—	2.0	
Nail salons[b, h]	25	20	0.12	0.6	
Pet shops (animal areas)[b]	10	7.5	0.18	0.9	
Supermarkets	8	7.5	0.06	—	
Storage					

Refrigerated warehouses/freezers (<50°F)		—	10	—	0.75
Repair garages, enclosed parking garages[b, d]	—	—	—	0.75	
Warehouses[l]	—	10	0.06	—	
Workrooms					
Bank vaults/safe deposit		5	5	0.06	—
Computer (without printing)	4	5	0.06	—	
Copy, printing rooms	4	5	0.06	0.5	
Darkrooms	—	—	—	1.0	
Manufacturing where hazardous materials are not used	7	10	0.18	-	
Manufacturing where hazardous materials are used (excludes heavy industrial and chemical processes)	7	10	0.18	-	
Meat processing[c]	10	15	—	—	
Pharmacy (prep. area)	10	5	0.18	—	
Photo studios	10	5	0.12	—	
Sorting, packing, light assembly	7	7.5	0.12	-	
Telephone closets	-	-	0.00	-	

For SI: 1 cubic foot per minute = 0.0004719 m^3/s, 1 ton = 908 kg, 1 cubic foot per minute per square foot = 0.00508 $m^3/(s \cdot m^2)$, °C = [(°F) – 32]/1.8, 1 square foot = 0.0929 m^2.

a. Based on *net occupiable floor area.*

b. Mechanical exhaust required and the recirculation of air from such spaces is prohibited. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Item 3).

c. Spaces unheated or maintained below 50°F are not covered by these requirements unless the occupancy is continuous.

d. Ventilation systems in enclosed parking garages shall comply with Section 404.

e. Rates are per water closet, ~~or~~ urinal or adult changing station. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.

f. Rates are per room unless otherwise indicated. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.

g. Mechanical exhaust is required and recirculation from such spaces is ~~prohibited except that recirculation shall be permitted where the resulting supply airstream consists of not more than 10 percent air recirculated from these spaces~~

prohibited. For occupancies other than science laboratories, where there is a wheel-type energy recovery ventilation (ERV) unit in the exhaust system design, the volume of air leaked from the exhaust airstream into the outdoor airstream within the ERV shall be less than 10 percent of the outdoor air volume. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Items 2 and 4).

h. For nail salons, each manicure and pedicure station shall be provided with a *source capture system* capable of exhausting not less than 50 cfm per station. Exhaust inlets shall be located in accordance with Section 502.20. Where one or more required source capture systems operate continuously during occupancy, the exhaust rate from such systems shall be permitted to be applied to the exhaust flow rate required by Table 403.3.1.1 for the nail salon.

i. Outpatient facilities to which the rates apply are freestanding birth centers, urgent care centers, neighborhood clinics and physicians' offices, Class 1 imaging facilities, outpatient psychiatric facilities, outpatient rehabilitation facilities, and outpatient dental facilities.

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

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

l. The occupiable floor area in warehouses shall not include the floor area of self-storage units, floor areas under rack storage, or designated palletized storage floor areas.

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 air flow rate based on the actual number of occupants present, the minimum quantity of outdoor air shall not fall below that determined from the area outdoor airflow rate column of Table 403.3.1.1 during periods when the building is expected to be occupied.

~~**403.3.1.5 Balancing**. The ventilation air distribution system shall be provided with means to adjust the system to achieve not less than the minimum ventilation airflow rate as required by Sections 403.3 and 403.3.1.2. Ventilation systems shall be balanced by an approved method. Such balancing shall verify that the ventilation system is capable of supplying and exhausting the airflow rates required by Sections 403.3 and 403.3.1.2.~~

403.3.2 Group R-2, R-3 and R-4 occupancies~~, three stories and less~~. The design of local exhaust systems and ventilation systems for outdoor air in Group R-2, R-3 and R-4 *occupancies* ~~three stories and less in height above grade plane~~ shall comply with Sections 403.3.2.1 through 403.3.2.5.

403.3.2.1 Outdoor air for dwelling units. An outdoor air ventilation system consisting of a mechanical exhaust system, supply system or combination thereof shall be installed for each *dwelling unit*. Local exhaust or supply systems, including outdoor air ducts connected to the return side of an air handler, are permitted to serve as such a system. The outdoor air ventilation system shall be designed to provide the required rate of outdoor air continuously during the period that the building is occupied. The minimum continuous outdoor airflow rate shall be determined in accordance with Equation 4-9.

$$Q_{OA} = 0.03A_{floor} + 7.5(N_{br} + 1) \qquad \textbf{(Equation 4-9)}$$

where:

Q_{OA} = outdoor airflow rate, cfm

A_{floor} = conditioned floor area, ft^2

N_{br} = number of bedrooms; not to be less than one

~~Exception~~ Exceptions:

1. The outdoor air ventilation system is not required to operate continuously where the system has controls that enable operation for not less than 1 hour of each 4-hour period. The average outdoor airflow rate over the 4-hour period shall be not less than that prescribed by Equation 4-9.

2. The minimum mechanical ventilation rate determined in accordance with Equation 4-9 shall be reduced by 30%, 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*.

TABLE 403.3.2.3 MINIMUM REQUIRED LOCAL EXHAUST RATES FOR GROUP R-2, R-3 AND R-4 OCCUPANCIES

AREA TO BE EXHAUSTED	EXHAUST RATE CAPACITY
Kitchens	100 cfm intermittent or ~~25~~ 50 cfm continuous
Bathrooms and toilet rooms	50 cfm intermittent or ~~20~~ 25 cfm continuous

For SI: 1 cubic foot per minute = 0.0004719 m^3/s.

403.3.2.5 Ventilating equipment. ~~Exhaust equipment serving single dwelling units~~ 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.

407.1 General. Mechanical ventilation for ambulatory care facilities and Group I-2 occupancies shall be designed and installed in accordance with this code, ASHRAE /ASHE 170 and NFPA 99.

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

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. For ducts conveying explosive or flammable vapors, fumes or dusts: 30 feet (9144 mm) from property lines; 10 feet (3048 mm) from operable openings into buildings; 6 feet (1829 mm) from exterior walls and roofs; 30 feet (9144 mm) from combustible walls and operable openings into buildings that are in the direction of the exhaust discharge; 10 feet (3048 mm) above adjoining grade.
2. For other product-conveying outlets: 10 feet (3048 mm) from the property lines; 3 feet (914 mm) from exterior walls and roofs; 10 feet (3048 mm) from operable openings into buildings; 10 feet (3048 mm) above adjoining grade.
3. For all *environmental air* exhaust: 3 feet (914 mm) from property lines; 3 feet (914 mm) from operable openings, except where the exhaust opening is located not less than 1 foot (305 mm) above the gravity air intake opening 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 a factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the fan manufacturer's instructions.

4. Exhaust outlets serving structures in flood hazard areas shall be installed at or above the elevation required by Section 1612 of the International Building Code for utilities and attendant equipment.
5. For specific systems, see the following sections:
    5.1. Clothes dryer exhaust, Section 504.4.
    5.2. Kitchen hoods and other kitchen exhaust equipment, Sections 506.3.13, 506.4 and 506.5.
    5.3. Dust, stock and refuse conveying systems, Section 511.2.
    5.4. Subslab soil exhaust systems, Section 512.4.
    5.5. Smoke control systems, Section 513.10.3.
    5.6. Refrigerant discharge, Section 1105.7.
    5.7. *Machinery room* discharge, Section 1105.6.1.

501.6 Common ducts. The discharge from exhaust fans serving separate dwelling or sleeping units shall not be connected to a common duct or shaft, except where the common duct or shaft is maintained at a negative pressure.

[F]502.9.5 Flammable and combustible liquids. Exhaust ventilation systems shall be provided as required by Sections 502.9.5.1 through 502.9.5.5 for the storage, use, dispensing, mixing and handling of flammable and combustible liquids. Unless otherwise specified, this section shall apply to any quantity of flammable and combustible liquids.

~~**Exception**~~ **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 wines in barrels and casks conforming to the requirements of the Fire Code of New York State.

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.

504.1 Installation. Clothes dryers shall be exhausted in accordance with the manufacturer's instructions. Dryer exhaust systems shall ~~be independent of all other systems and shall~~ convey the moisture and any products of combustion to the outside of the building.

Exception: This section shall not apply to listed and labeled condensing (ductless) clothes dryers.

504.2 Exhaust penetrations. Where a clothes dryer exhaust duct penetrates a wall or ceiling membrane, the annular space shall be sealed with noncombustible material, *approved* fire caulking or a noncombustible dryer exhaust duct wall receptacle. Ducts that exhaust clothes dryers shall not penetrate or be located within any fireblocking, draftstops or any wall, floor/ceiling or other assembly required by the International Building Code to be fire-resistance rated, unless such duct is constructed of galvanized steel or aluminum of the thickness specified in Section 603.4 and the fire-resistance rating is maintained in accordance with the International Building Code. *Fire dampers*, *combination fire/smoke dampers* and any similar devices that will obstruct the exhaust flow shall be prohibited in clothes dryer exhaust ducts.

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.

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

~~**504.7**~~**504.8 Protection** ~~**required**~~ **against physical damage.** Protective shield plates shall be placed where nails or screws from finish or other work are likely to penetrate the clothes dryer exhaust duct. Shield plates shall be placed on the finished face of all framing members where there is less than 11/4 inches (32 mm) between the duct and the finished face of the framing member. Protective shield plates shall ~~be constructed of steel, have a thickness of 0.062 inch (1.6 mm) and~~ extend not less than 2 inches (51 mm) above sole plates and below top plates.

504.8.1 Shield plates. Shield plates shall be of steel material having a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 gage).

~~504.9~~ 504.10 **Commercial clothes dryers**. The installation of dryer exhaust ducts serving commercial clothes dryers shall comply with the *appliance* manufacturer's installation instructions. Exhaust fan motors installed in exhaust systems shall be located outside of the airstream. In multiple installations, the fan shall operate continuously or be interlocked to operate when any individual unit is operating. Ducts shall have a minimum *clearance* of 6 inches (152 mm) to combustible materials. Clothes dryer transition ducts used to connect the *appliance* to the exhaust duct system shall be limited to single lengths not to exceed 8 feet (2438 mm) in length and shall be *listed* and *labeled* in accordance with UL 2158A ~~for the application~~. Transition ducts shall not be concealed within construction.

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~~, and shall be independent of all other exhaust systems~~. 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 and Section 505.7 or 505.8.

Exceptions:

1. ~~In other than Groups I-1 and I-2, where~~ Where installed in accordance with the manufacturer's instructions and where mechanical or natural ventilation is otherwise provided in accordance with Chapter 4, *listed* and *labeled* ductless range hoods shall not be required to discharge to the outdoors.
2. Ducts for domestic kitchen cooking *appliances* equipped with downdraft exhaust systems shall be permitted to be constructed of Schedule 40 PVC pipe and fittings provided that the installation complies with all of the following:
    2.1. The duct shall be installed under a concrete slab poured on grade.
    2.2. The underfloor trench in which the duct is installed shall be completely backfilled with sand or gravel.
    2.3. The PVC duct shall extend not more than 1 inch (25 mm) above the indoor concrete floor surface.
    2.4. The PVC duct shall extend not more than 1 inch (25 mm) above grade outside of the building.
    2.5. The PVC ducts shall be solvent cemented.

505.7 Group I-1 Occupancies. In Group I-1 Occupancies, hood installations over domestic cooking equipment installed in accordance with Section 420.9 of the International Building Code shall comply with the following:

1. Range hoods shall have a minimum air flow rate of 500 cfm. (14,000 L/min).
2. Mechanical ventilation shall be provided to the rooms or spaces containing the domestic cooking equipment in accordance with Section 403.3.1.
3. Range hood exhaust shall discharge to the outdoors.

    Exception: A listed and labeled ductless range hood shall be permitted where a charcoal filter is provided in the hood to reduce smoke and odors.

505.8 Group I-2 Occupancies. In Group I-2 Occupancies, hood installations over domestic cooking equipment installed in accordance with Section 407.2.7 of the International Building Code shall comply with the following:

1. Range hoods shall have a minimum air flow rate of 500 cfm. (14,000 L/min).
2. Mechanical ventilation shall be provided to the rooms or spaces containing the domestic cooking equipment in accordance with Section 403.3.1.
3. Range hood exhaust shall discharge to the outdoors.

    Exception: A listed and labeled ductless range hood shall be permitted where a charcoal filter is provided in the hood to reduce smoke and odors.

506.2 Corrosion protection. Ducts and exhaust equipment exposed to the outside atmosphere or subject to a corrosive environment shall be protected against corrosion in an *approved* manner.

506.3 ~~Ducts serving Type I hoods~~ Grease duct systems. ~~Type I exhaust ducts shall be independent of all other exhaust systems except as provided in Section 506.3.5. Commercial kitchen~~ *Grease* duct systems ~~serving Type I hoods~~ shall be designed, constructed and installed in accordance with Sections 506.3.1 through 506.3.13.3.

~~**506.3.1 Duct materials.** Ducts serving Type I hoods shall be constructed of materials in accordance with Sections 506.3.1.1 and 506.3.1.2.~~

~~**506.3.1.1**~~ **506.3.1 Grease duct materials**. Grease ducts ~~serving Type I hoods~~ shall be constructed of steel having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) or stainless steel not less than 0.0450 inch (1.14 mm) (No. 18 gage) in thickness.

Exception: Factory-built commercial kitchen grease ducts *listed* and *labeled* in accordance with UL 1978 and installed in accordance with Section 304.1.

506.3.2 Joints, seams and penetrations of grease ducts. Joints, seams and penetrations of grease ducts shall be made with a continuous liquid- tight weld or braze made on the external surface of the grease duct system.

Exceptions:

1. Penetrations shall not be required to be welded or brazed where sealed by devices that are *listed* for the application.
2. Internal welding or brazing shall not be prohibited provided that the joint is formed or ground smooth and is provided with ready access for inspection.
3. Factory-built commercial kitchen grease ducts *listed* and *labeled* in accordance with UL 1978 and installed in accordance with Section 304.1.

506.3.2.1 Grease ~~Duct~~ duct joint types. Grease duct ~~Duct~~ joints shall be butt joints, welded flange joints with a maximum flange depth of $^1/_2$ inch (12.7 mm) or overlapping duct joints of either the telescoping or bell type. Overlapping joints shall be installed to prevent ledges and obstructions from collecting grease or interfering with gravity drainage to the intended collection point. The difference between the inside cross-sectional dimensions of overlapping sections of duct shall not exceed $^1/_4$ inch (6.4 mm). The length of overlap for overlapping duct joints shall not exceed 2 inches (51 mm).

506.3.2.2 Grease ~~Duct~~ duct-to-hood joints. Grease ~~Duct~~ duct-to-hood joints shall be made with continuous internal or external liquid-tight welded or brazed joints. Such joints shall be smooth, ~~accessible~~ available for inspection, and without grease traps.

Exceptions: This section shall not apply to:

1. A vertical duct-to-hood collar connection made in the top plane of the hood in accordance with all of the following:
   1.1. The ~~hood duct opening~~ the exhaust outlet of the hood shall have a 1-inch-deep (25 mm), full perimeter, welded flange turned down into the hood interior at an angle of 90 degrees (1.57 rad) from the plane of the opening.
   1.2. The grease duct shall have a 1-inch-deep (25 mm) flange made by a 1-inch by 1-inch (25 mm by 25 mm) angle iron welded to the full perimeter of the grease duct not less than 1 inch (25 mm) above the bottom end of the duct.
   1.3. A gasket rated for use at not less than 1,500ºF (816ºC) is installed between the grease duct flange and the top of the hood.
   1.4. The grease duct-to-hood joint shall be secured by stud bolts not less than $^1/_4$ inch (6.4 mm) in diameter welded to the hood with a spacing not greater than 4 inches (102 mm) on center for the full perimeter of the opening. The bolts and nuts shall be secured with lockwashers.
2. *Listed* and *labeled* *grease* duct-to-hood collar connections installed in accordance with Section 304.1.

506.3.2.3 Grease ~~Duct~~ duct-to-exhaust fan connections. Grease ~~Duct~~ duct-to-exhaust fan connections shall be flanged and gasketed at the base of the fan for vertical discharge fans; shall be flanged, gasketed and bolted to the inlet of the fan for side-inlet utility fans; and shall be flanged, gasketed and bolted to the inlet and outlet of the fan for in-line fans. Gasket and sealing materials shall be rated for continuous duty at a temperature of not less than 1,500ºF (816ºC).

506.3.2.4 Vibration isolation. A vibration isolation connector for connecting a grease duct to a fan shall consist of noncombustible packing in a metal sleeve joint of *approved* design or shall be a coated-fabric flexible grease duct connector

listed and *labeled* for the application. Vibration isolation connectors shall be installed only at the connection of a grease duct to a fan inlet or outlet.

506.3.2.5 Grease duct test. A field test shall be performed ~~Prior~~ prior to the use or concealment of any portion of a grease duct system~~, a leakage test shall be performed~~. Grease ducts ~~Ducts~~ shall be considered to be concealed where installed in shafts or covered by coatings or wraps that prevent the ~~ductwork~~ grease ducts 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. ~~A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of ductwork grease ducts to be tested. The lamp shall be open so as to emit light equally in all directions perpendicular to the duct walls.~~

A test shall be performed for the entire grease duct system, including the hood-to-duct connection. The grease duct ~~work~~ system shall be permitted to be tested in sections, provided that every joint is tested. For *listed* factory-built grease ducts, this test shall be limited to duct joints assembled in the field and shall exclude factory welds. The test shall be performed in accordance with either Section 506.3.2.5.1 or Section 506.3.2.5.2.

506.3.2.5.3.1 Light test. A duct test shall be performed by passing a lamp having not less than 1600 lumens, through the entire section of ductwork to be tested. The lamp shall be open so as to emit light equally in all directions perpendicular to the duct walls. A successful test shall be where the light from the lamp is not visible at any point on the exterior of the duct.

506.3.2.5.2 Water spray test. A duct test shall be performed by simulating a cleaning operation, of the interior of the duct. A water pump, capable of a flowing outlet pressure of not less than 1200 psi (8,274 kPa) shall be used, along with any necessary hoses and spray nozzles, to apply high pressure water to the inside surfaces of the duct. A successful test shall be where there is no evidence of cleaning water at any point on the exterior of the duct.

506.3.3 Grease duct supports. Grease duct bracing and supports 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*. Bolts, screws, rivets and other mechanical fasteners shall not penetrate grease duct walls.

506.3.4 Air velocity. Grease duct systems ~~serving a Type I hood~~ shall be designed and installed to provide an air velocity within the grease duct system of not less than 500 feet per minute (2.5 m/s).

> **Exception:** The velocity limitations shall not apply within grease duct transitions utilized to connect grease ducts to differently sized or shaped openings in hoods and fans, provided that such transitions do not exceed 3 feet (914 mm) in length and are designed to prevent the trapping of grease.

506.3.5 Separation of grease duct system. A separate grease duct system shall be provided for each Type I hood. A separate grease duct system is not required where all of the following conditions are met:

1. All interconnected hoods are located within the same story.
2. All interconnected hoods are located within the same room or in adjoining rooms.
3. Interconnecting grease ducts do not penetrate assemblies required to be fire-resistance rated.
4. The grease duct system does not serve solid-fuel-fired *appliances*.

506.3.7 Prevention of grease accumulation in grease ducts. ~~Duct~~ Grease duct systems serving a Type I hood shall be constructed and installed so that grease cannot collect in any portion thereof, and the system shall slope not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) toward the hood or toward a grease reservoir designed and installed in accordance with Section 506.3.7.1. Where horizontal grease ducts exceed 75 feet (22 860 mm) in length, the slope shall be not less than one unit vertical in 12 units horizontal (8.3-percent slope).

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

506.3.7.1 Grease duct reservoirs. Grease duct reservoirs shall:

1. Be constructed as required for the grease duct they serve.
2. Be located on the bottom of the horizontal grease duct or the bottommost section of the grease duct riser.
3. Extend across the full width of the grease duct and have a length of not less than 12 inches (305 mm).
4. Have a depth of not less than 1 inch (25 mm).

5. Have a bottom that slopes to a drain.
6. Be provided with a cleanout opening constructed in accordance with Section 506.3.8 and installed to provide direct access to the reservoir. The cleanout opening shall be located on a side or on top of the grease duct so as to permit cleaning of the reservoir.
7. Be installed in accordance with the manufacturer's instructions where manufactured devices are utilized.

506.3.8 Grease duct cleanouts and openings. Grease duct cleanouts and openings shall comply with all of the following:

1. Grease ducts shall not have openings except where required for the operation and maintenance of the system.
2. Sections of grease ducts that are inaccessible from the hood or discharge openings shall be provided with cleanout openings spaced not more than 20 feet (6096 mm) apart and not more than 10 feet (3048 mm) from changes in direction greater than 45 degrees (0.79 rad).
3. Cleanouts and openings shall be equipped with tight-fitting doors constructed of steel having a thickness not less than that required for the grease duct.
4. Cleanout doors shall be installed liquid tight.
5. Door assemblies including any frames and gaskets shall be approved for the application and shall not have fasteners that penetrate the grease duct.
6. Gasket and sealing materials shall be rated for not less than 1,500ºF (816ºC).
7. Listed door assemblies shall be installed in accordance with the manufacturer's instructions.

506.3.8.1 Personnel entry. Where a grease duct ~~ductwork~~ is large enough to allow entry of personnel, not less than one *approved* or *listed* opening having dimensions not less than 22 inches by 20 inches (559 mm by 508 mm) shall be provided in the horizontal sections, and in the top of vertical risers. Where such entry is provided, the grease duct and its supports shall be capable of supporting the additional load, and the cleanouts specified in Section 506.3.8 are not required.

506.3.8.2 Cleanouts serving in-line fans. A cleanout shall be provided for both the inlet side and outlet side of an in-line fan except where a grease duct does not connect to the fan. Such cleanouts shall be located within 3 feet (914 mm) of the fan duct connections.

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

1. Be spaced not more than 20 feet (6096 mm) apart.
2. Be located not more than 10 feet (3048 mm) from changes in direction that are greater than 45 degrees (0.79 rad).
3. Be located on the bottom only where other locations are not available and shall be provided with internal damming of the opening such that grease will flow past the opening without pooling. Bottom cleanouts and openings shall be approved for the application and installed liquid tight.
4. Not be closer than 1 inch (25 mm) from the edges of the grease duct.
5. Have opening dimensions of not less than 12 inches by 12 inches (305 mm by 305 mm). Where such dimensions preclude installation, the opening shall be not less than 12 inches (305 mm) on one side and shall be large enough to provide access for cleaning and maintenance.
6. ~~Shall be~~ Be located at grease reservoirs.
7. Be located within 3 feet (914 mm) of horizontal discharge fans.

506.3.10 Underground grease duct installation. Underground grease duct installations shall comply with all of the following:

1. Underground grease ducts shall be constructed of steel having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) and shall be coated to provide protection from corrosion or shall be constructed of stainless steel having a minimum thickness of 0.0450 inch (1.140 mm) (No. 18 gage).
2. The underground grease duct system shall be tested and approved in accordance with Section 506.3.2.5 prior to coating or placement in the ground.

3. The underground grease duct system shall be completely encased in concrete with a minimum thickness of 4 inches (102 mm).
4. Ducts shall slope toward grease reservoirs.
5. A grease reservoir with a cleanout to allow cleaning of the reservoir shall be provided at the base of each vertical grease duct riser.
6. Cleanouts shall be provided with access to permit cleaning and inspection of the grease duct in accordance with Section 506.3.
7. Cleanouts in horizontal grease ducts shall be installed on the topside of the grease duct.
8. Cleanout locations shall be legibly identified at the point of access from the interior space.

506.3.11 Grease duct enclosures. A commercial kitchen grease duct serving a Type I hood that penetrates a ceiling, wall, floor or any concealed space shall be enclosed from the point of penetration to the outlet terminal. In-line exhaust fans not located outdoors shall be enclosed as required for grease ducts. A grease duct shall penetrate exterior walls only at locations where unprotected openings are permitted by the *International Building Code*. The grease duct enclosure shall serve a single grease duct and shall not contain other ducts, piping or wiring systems. Grease duct ~~Duct~~ enclosures shall be a shaft enclosure in accordance with Section 506.3.11.1, a field-applied enclosure assembly in accordance with Section 506.3.11.2 or a factory-built grease duct enclosure assembly in accordance with Section 506.3.11.3. Grease duct ~~Duct~~ enclosures shall have a fire-resistance rating of not less than that of the assembly penetrated and not less than 1 hour. Fire dampers and smoke dampers shall not be installed in grease ducts.

> **Exception:** A grease duct enclosure shall not be required for a grease duct that penetrates only a nonfire-resistance-rated roof/ceiling assembly.

506.3.11.1 Shaft enclosure. Grease ducts constructed in accordance with Section 506.3.1 shall be permitted to be enclosed in accordance with the *International Building Code* requirements for shaft construction. Such grease duct systems and exhaust *equipment* shall have a *clearance* to combustible construction of not less than 18 inches (457 mm), and shall have a *clearance* to noncombustible construction and gypsum wallboard attached to noncombustible structures of not less than 6 inches (152 mm). Shaft ~~Duct~~ enclosures shall be sealed around the grease duct at the point of penetration and vented to the outside of the building through the use of weather-protected openings.

506.3.11.2 Field-applied grease duct enclosure. Grease ducts constructed in accordance with Section 506.3.1 shall be enclosed by a *listed* and *labeled* field-applied grease duct enclosure material, systems, product, or method of construction specifically evaluated for such purpose in accordance with ASTM E2336. The surface of the grease duct shall be continuously covered on all sides from the point at which the grease duct originates to the outlet terminal. Grease duct ~~Duct~~ penetrations shall be protected with a through-penetration firestop system tested and *listed* in accordance with ASTM E814 or UL 1479 and having a “F” and “T” rating equal to the fire-resistance rating of the assembly being penetrated. The grease duct enclosure and firestop system shall be installed in accordance with the listing and the manufacturer’s instructions. Partial application of a field-applied grease duct enclosure shall not be installed for the sole purpose of reducing *clearances* to combustibles at isolated sections of grease duct. Exposed duct-wrap systems shall be protected where subject to physical damage.

506.3.11.3 Factory-built grease duct enclosure assemblies. Factory-built grease ducts incorporating integral enclosure materials shall be *listed* and *labeled* for use as grease duct enclosure assemblies specifically evaluated for such purpose in accordance with UL 2221. Grease duct ~~Duct~~ penetrations shall be protected with a through-penetration firestop system tested and *listed* in accordance with ASTM E814 or UL 1479 and having an "F" and "T" rating equal to the fire-resistance rating of the assembly being penetrated. The grease duct enclosure assembly and firestop system shall be installed in accordance with the listing and the manufacturer’s instructions.

506.3.12 Grease duct fire-resistive access opening. Where cleanout openings are located in grease ducts within a fire-resistance-rated enclosure, access openings shall be provided in the enclosure at each cleanout point. Access openings shall be equipped with tight-fitting sliding or hinged doors that are equal in fire-resistive protection to that of the shaft or enclosure. An *approved* sign shall be placed on access opening panels with wording as follows: “ACCESS PANEL. DO NOT OBSTRUCT.”

506.3.13 Exhaust outlets ~~serving Type I hoods~~. Exhaust outlets for grease ducts ~~serving Type I hoods~~ shall conform to the requirements of Sections 506.3.13.1 through 506.3.13.3.

506.5.1 Exhaust fans. Exhaust fan housings serving a Type I hood shall be constructed as required for grease ducts in accordance with Section 506.3.1.1.

Exception: Fans listed and labeled in accordance with ~~UL 762~~ UL 705.

506.5.1.2 In-line fan location. Where enclosed grease duct systems are connected to in-line fans not located outdoors, the fan shall be located in a room or space having the same fire-resistance rating as the grease duct enclosure. Access shall be provided for servicing and cleaning of fan components. Such rooms or spaces shall be ventilated in accordance with the fan manufacturer's installation instructions.

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 ~~1978~~ 8782.
2. Fans serving pollution-control units shall be *listed* and *labeled* in accordance with ~~UL 762~~ UL 705.
3. ~~Pollution~~ Bracing and supports for pollution-control units shall be ~~mounted and secured in accordance with the manufacturer's installation instructions and~~ 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. ~~4.~~ Pollution-control units located indoors shall be *listed* and *labeled* for such use. ~~Where enclosed grease duct systems, as required by Section 506.3.11, are connected to a pollution control unit, such unit shall be located in a room or space having the same fire-resistance rating as the duct enclosure. Access shall be provided for servicing and cleaning of the unit. The space or enclosure shall be ventilated in accordance with the manufacturer's installation instructions.~~
5. Clearances shall be maintained between the pollution-control unit and combustible material in accordance with the listing. Where enclosed duct systems, as required by Section 506.3.11, are connected to a pollution control unit installed indoors, all of the following shall apply:
    - 5.5 The unit shall be listed and labeled, in accordance with UL 2221 or ASTM E2336, for location in an enclosure.
    - 5.6 The unit shall be installed in a dedicated room or space enclosure, constructed as required by Section 506.3.11, having the same fire-resistance rating as the duct enclosure.
    - 5.7 Access shall be provided for servicing and cleaning of the unit.
    - 5.8 The dedicated room or space enclosure shall be ventilated in accordance with the manufacturer's installation instructions.
6. ~~A clearance of not less than 18 inches (457 mm)~~ *Clearances* shall be maintained between the pollution-control unit and combustible material in accordance with the listing.
7. 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.
8. Exhaust outlets for pollution-control units shall be in accordance with Section 506.3.13.
9. 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.
10. Pollution-control units shall be provided with a factory-installed fire suppression system.
11. Service space shall be provided in accordance with the manufacturer's instructions for the pollution control unit and the requirements of Section 306.
12. 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.
13. Protection from freezing shall be provided for the water supply and fire suppression systems where such systems are subject to freezing.

14. Grease duct ~~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). Grease ducts ~~Ducts~~ shall transition to the full size of the unit's inlet and outlet openings.

15. 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.

16. Pollution-control units shall be maintained in accordance with the manufacturer's instructions.

506.5.4 Exhaust fan mounting. Upblast fans serving Type I hoods and installed in a vertical or horizontal position shall be hinged, supplied with a flexible weatherproof electrical cable to permit inspection and cleaning and shall be equipped with a means of restraint to limit the swing of the fan on its hinge. The grease duct system ~~ductwork~~ shall extend not less than 18 inches (457 mm) above the roof surface.

507.1 General. Commercial kitchen exhaust hoods shall comply with the requirements of this section. Hoods shall be Type I or II and shall be designed to capture and confine cooking vapors and residues. A Type I hood shall be installed at or above appliances in accordance with Section 507.2. ~~or~~ A Type II hood shall be installed at or above *appliances* in accordance with ~~Sections 507.2 and~~ Section 507.3. Where any cooking *appliance* under a single hood requires a Type I hood, a Type I hood shall be installed. Where a Type II hood is required, a Type I or Type II hood shall be installed. ~~Where a Type I hood is installed, the installation of the entire system, including the hood, ducts, exhaust equipment and makeup air system shall comply with the requirements of Sections 506, 507, and 508 and 509.~~

Exceptions:

1. Factory-built commercial exhaust hoods that are *listed* and *labeled* in accordance with UL 710, and installed in accordance with Section 304.1, shall not be required to comply with Sections 507.1.5, 507.1.6, 507.2.3, 507.2.5, 507.2.8, 507.2.10, 507.3.1, and 507.3.3.~~, 507.4 and 507.5.~~

2. A hood shall not be required at or above any of the following:

   2.1 Factory-built commercial cooking recirculating systems ~~that are~~ *listed* and *labeled* in accordance with UL 710B, and installed in accordance with Section 304.1~~, shall not be required to comply with Sections 507.1.5, 507.1.6, 507.2.3, 507.2.5, 507.2.8, 507.2.10, 507.3.1, and 507.3.3, 507.4 and 507.5~~. Spaces in which such systems are located shall be considered to be kitchens and shall be ventilated in accordance with Table 403.3.1.1. For the purpose of determining the floor area required to be ventilated, each individual *appliance* shall be considered as occupying not less than 100 square feet (9.3 m^2).

   2.2 ~~Where c~~ Cooking *appliances* are equipped with integral down-draft exhaust systems and such *appliances* and exhaust systems are *listed* and *labeled* for the application in accordance with NFPA 96~~, a hood shall not be required at or above them~~.

   2.3 Smoker ovens with integral exhaust systems that are listed and tested for the application.

3. Ovens listed and labeled for use with wood fuel in accordance with UL 2162 and vented in accordance with the manufacturer's instructions.

4. An electric cooking appliance listed and labeled in accordance with UL 197 for reduced grease emissions.

5. Commercial electric dishwashers incorporating a self-contained condensing system listed and labeled in accordance with UL 921.

6. Where the heat and moisture loads from dishwashers and appliances that produce heat or moisture and do not produce grease or smoke as a result of the cooking process are incorporated into the HVAC system design or into the design of a separate removal system. Spaces containing such 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 m3/(s • m^2)].

507.1.1 Operation. Commercial kitchen exhaust hood systems shall operate during the cooking operation. The hood exhaust rate shall comply with either the listing of the hood Section 507.2.10, or ~~shall comply with~~ Section 507.3.4 ~~507.5~~. The exhaust fan serving a Type I hood shall have automatic controls that will activate the fan when any *appliance* that requires such Type I hood is turned on, or a means of interlock shall be provided that will prevent operation of such *appliances* when the exhaust fan is not turned on. Where one or more temperature or radiant energy sensors are used to activate a Type I hood exhaust fan, the fan shall activate not more than 15 minutes after the first *appliance* served by that hood has been turned on. A method of interlock between an exhaust hood system and *appliances* equipped with standing pilot burners shall not cause the pilot burners to be extinguished. A method of interlock between an exhaust hood system and cooking *appliances* shall not involve or depend on any component of a fire-extinguishing system.

The net exhaust volumes for hoods shall be permitted to be reduced during part-load cooking conditions, where engineered or *listed* multispeed or variable speed controls automatically operate the exhaust system to maintain capture and removal of cooking effluents as required by this section. Reduced volumes shall not be below that required to maintain capture and removal of effluents from the idle cooking *appliances* that are operating in a standby mode.

507.1.2 Domestic cooking appliances used for commercial purposes. Domestic cooking *appliances* utilized for commercial purposes shall be provided with either Type I or Type II hoods as required for the type of *appliances* and processes in accordance with Sections 507.2 and 507.3. Domestic cooking *appliances* utilized for domestic cooking shall comply with Section 505.

~~**507.1.3 Fuel-burning appliances.** Where vented fuel-burning appliances are located in the same room or space as the hood, provisions shall be made to prevent the hood system from interfering with normal operation of the appliance vents.~~

507.1.3 Fuel-burning appliances. Appliances equipped with draft hoods or atmospheric burners shall not be located in the same room or space containing a Type I or Type II hood except where the appliance is located in a sealed enclosure equipped with a self-closing device with combustion air obtained from the outdoors or from other spaces in the building in accordance with Chapter 7 or the International Fuel Gas code.

~~507.4~~ **507.1.6 Hood size and location**. Hoods shall comply with the overhang, setback and height requirements in accordance with Sections ~~507.4.1~~ 507.6.1 and ~~507.4.2~~ 507.1.6.2, based on the type of hood.

~~507.4.1~~ **507.1.6.1 Canopy size and location**. The inside lower edge of canopy-type Type I and II commercial hoods shall overhang or extend a horizontal distance of not less than 6 inches (152 mm) beyond the edge of the top horizontal surface of the *appliance* on all open sides. The vertical distance between the front lower lip of the hood and such surface shall not exceed 4 feet (1219 mm).

> **Exception:** The hood shall be permitted to be flush with the outer edge of the cooking surface where the hood is closed to the *appliance* side by a noncombustible wall or panel.

~~507.4.2~~ **507.1.6.2 Noncanopy size and location**. Noncanopy-type hoods shall be located not greater than 3 feet (914 mm) above the cooking surface. The edge of the hood shall be set back not greater than 1 foot (305 mm) from the edge of the cooking surface.

~~507.6~~ **507.1.7 Performance test**. A performance test shall be conducted upon completion and before final approval of the installation of a ventilation system serving *commercial cooking appliances*. The test shall verify the rate of exhaust airflow required by Section ~~507.5~~ 507.2.10 or Section 507.3.4, makeup airflow required by Section 508 and proper operation as specified in this chapter. The permit holder shall furnish the necessary test *equipment* and devices required to perform the tests.

~~507.6.1~~ **507.1.7.1 Capture and containment test**. The permit holder shall verify capture and containment performance of the exhaust system. This field test shall be conducted with all *appliances* under the hood at operating temperatures, with all sources of outdoor air providing *makeup air* for the hood operating and with all sources of recirculated air providing conditioning for the space in which the hood is located operating. Capture and containment shall be verified visually by observing smoke or steam produced by actual or simulated cooking, such as that provided by smoke generators.

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*.

> ~~**Exception:** A Type I hood shall not be required for an electric cooking appliance where an approved testing agency provides documentation that the appliance effluent contains 5 mg/m or less of grease when tested at an exhaust flow rate of 500 cfm (0.236 m /s) in accordance with UL 710B.~~

507.2.4 Type I supports. Type I hoods shall be secured in place by noncombustible supports. Type I hood supports shall be adequate for the applied load of the hood, the unsupported grease duct system ~~ductwork~~, the effluent loading and the possible weight of personnel working in or on the hood.

~~507.5~~ 507.2.10 **Capacity of Type I hoods**. Commercial food service hoods shall exhaust a minimum net quantity of air determined in accordance with this section and Sections ~~507.5.1~~ 507.2.10.1 through ~~507.5.5~~ 507.2.10.4. The net quantity of *exhaust air* shall be calculated by subtracting any airflow supplied directly to a hood cavity from the total exhaust flow rate of a hood. Where any combination of *heavy-duty*, *medium-duty* and *light-duty cooking appliances* are utilized under a single hood, the exhaust rate required by this section for the heaviest duty *appliance* covered by the hood shall be used for the entire hood.

~~507.5.1~~ 507.2.10.1 **Extra-heavy-duty cooking appliances**. The minimum net airflow for hoods~~, as determined by Section 507.1,~~ used for *extra- heavy-duty cooking appliances* shall be determined as follows:

Type of Hood	CFM per linear foot of hood
Backshelf/pass-over	Not allowed
Double island canopy (per side)	550
Eyebrow	Not allowed
Single island canopy	700
Wall-mounted canopy	550

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

~~507.5.1~~ 507.2.10.2 **Heavy-duty cooking appliances**. The minimum net airflow for hoods~~, as determined by Section 507.1,~~ used for *heavy-duty cooking appliances* shall be determined as follows:

Type of Hood	CFM per linear foot of hood
Backshelf/pass-over	400
Double island canopy (per side)	400
Eyebrow	Not allowed
Single island canopy	600
Wall-mounted canopy	400

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

~~507.5.1~~ 507.2.10.3 **Medium-duty cooking appliances**. The minimum net airflow for hoods~~, as determined by Section 507.1,~~ used for *medium-duty cooking appliances* shall be determined as follows:

Type of Hood	CFM per linear foot of hood
Backshelf/pass-over	300
Double island canopy (per side)	300
Eyebrow	250
Single island canopy	500
Wall-mounted canopy	300

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

~~509.1~~ 507.2.11 ~~**Where required**~~ **Fire suppression systems**. ~~Cooking appliances required by Section 507.2 to have~~ a Type I hood shall be provided with an *approved* automatic fire suppression system complying with Section 904.12 of the *International Building Code* and the *International Fire Code*.

507.3 Type II hoods. Type II hoods shall be installed above *light-duty cooking appliances* 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 *appliances* that produce products of combustion and do not produce grease or smoke as a result of the cooking process. A Type I hood shall be permitted to be installed for a required Type II hood provided that the Type I hood installation complies with all of the requirements for a Type I hood installation. Where such a Type I hood serves only dishwashers and appliances that require a Type II hood, the Type I hood shall not be required to have fire suppression or grease filters. ~~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 m3/(s • m2). 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 m2). Such additional square footage shall be provided with exhaust at a rate of 0.70 cfm per square foot [0.00356 m3/(s • m2)].~~

507.3.4 Capacity of Type II hoods. Type II hoods shall exhaust a minimum net quantity of air determined in accordance with this section and Sections 507.3.4.1 through 507.3.4.2. The net quantity of exhaust air shall be calculated by subtracting any airflow supplied directly to a hood cavity from the total exhaust flow rate of a hood.

~~**507.5.4**~~ **507.3.4.1 Light-duty cooking appliances**. The minimum net airflow for hoods~~, as determined by Section 507.1,~~ used for *light-duty* cooking *appliances* and food service preparation shall be determined as follows:

Type of Hood	CFM per linear foot of hood
Backshelf/pass-over	250
Double island canopy (per side)	250
Eyebrow	250
Single island canopy	400
Wall-mounted canopy	200

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

~~**507.5.4**~~ **507.3.4.2 Dishwashing appliances**. The minimum net airflow for Type II hoods used for dishwashing *appliances* shall be 100 cfm per linear foot (155 L/s per linear meter) of hood length.

~~**Exception:** Dishwashing *appliances* and *equipment* installed in accordance with Section 507.3.~~

~~**508.1.1 Makeup air temperature**. The temperature differential between *makeup air* and the air in the conditioned space shall not exceed 10°F (6°C) except where the added heating and cooling loads of the *makeup air* do not exceed the capacity of the HVAC system.~~

508.1.1 Makeup air temperature. HVAC systems that serve the kitchen space shall have the additional capacity necessary for the latent and sensible loads that are introduced by the makeup air supplied to the kitchen space, or the makeup air shall be conditioned by dedicated systems such that the difference in temperature between the makeup air supplied to the kitchen space and the design setpoint temperature in the kitchen space is not greater than 10 degrees F (6 degrees C).

Exception: Makeup air supplied to a compensating hood shall not not be required to be conditioned.

**Section 508.1.2 relocated from before 506.3.2 Joints, seams, and penetrations of grease ducts.

~~**506.3.1.2**~~ **508.1.2 Makeup air ducts**. *Makeup air* ducts connecting to or within 18 inches (457 mm) of a Type I hood shall be constructed and installed in accordance with Sections 603.1, 603.3, 603.4, 603.9, 603.10 and 603.12. Duct insulation installed within 18 inches (457 mm) of a Type I hood shall be noncombustible or shall be *listed* for the application.

~~**510.4 Independent system.** Hazardous exhaust systems shall be independent of other types of exhaust systems.~~

~~**511.1.5**~~ **510.1.5 Explosion ~~relief vents~~ control**. ~~A safety or explosion relief vent~~ Explosion control shall be provided in accordance with the requirements of the International Fire Code on all systems that convey combustible dust or combustible refuse or stock ~~of an explosive nature,~~ that produces combustible dusts in such a manner that the concentration and conditions could create a fire or explosion hazard. Determination of concentrations or conditions that are deemed to not create a fire or explosion hazard shall be based on a Dust Hazard Analysis prepared in accordance with ~~the requirements~~ Section 2203.2 of the International ~~Building~~ Fire Code.

510.6.5 Makeup air. Makeup air from all sources shall be provided during operations at a rate approximately equal to the rate that air is exhausted by the hazardous exhaust system. Makeup air shall be provided by gravity or mechanical means or both. Mechanical makeup air systems shall be automatically controlled to start and operate simultaneously with the exhaust system. The makeup air shall not reduce the effectiveness of the exhaust system. Makeup air intakes shall be located in accordance with Section 401.4.

511.1 Dust, stock and refuse conveying systems. Dust, stock and refuse conveying systems shall comply with the provisions of Section 510 and Sections 511.1.1 through 511.2 and the Fire Code of New York State.

[F] ~~513.6.1~~ 512.6.1 Minimum pressure difference. The pressure difference across a smoke barrier used to separate smoke zones shall be not less than 0.05-inch water gage (12.4 Pa) in *buildings* equipped throughout with automatic sprinkler systems.

In *buildings* permitted to not be equipped throughout with automatic sprinkler systems, the smoke control system shall be designed to achieve pressure differences not less than two times the maximum calculated pressure difference produced by the design fire.

514.2 Prohibited applications. Energy recovery ventilation systems shall not be used in the following systems:

1. Hazardous exhaust systems covered in Section 510.
2. Dust, stock and refuse systems that convey explosive or flammable vapors, fumes or dust.
3. Smoke control systems covered in Section 513.
4. Commercial kitchen exhaust systems serving Type I ~~or Type II~~ hoods.
5. Clothes dryer exhaust systems covered in Section 504.

Exception: The application of ERV equipment that recovers sensible heat only utilizing coil-type heat exchangers shall not be limited by this section.

Chapter 6 – Duct Systems

[BE] 601.2 Air movement in egress elements. Corridors shall not serve as supply, return, exhaust, relief or ventilation air ducts.

Exceptions:

1. Use of a corridor as a source of makeup air for exhaust systems in rooms that open directly onto such corridors, including toilet rooms, bathrooms, dressing rooms, smoking lounges and janitor closets, shall be permitted, provided that each such corridor is directly supplied with outdoor air at a rate greater than the rate of makeup air taken from the corridor.
2. Where located within a dwelling unit, the use of corridors for conveying return air shall not be prohibited.
3. Where located within tenant spaces of 1,000 square feet (93 m2) or less in area, use of corridors for conveying return air is permitted.
4. ~~Incidental air movement from pressurized rooms within health care facilities, provided that the corridor is not the primary source of supply or return to the room.~~ Transfer air movement required to maintain pressurization difference within health care facilities in accordance with ASHRAE 170.

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 or draft hood of another *appliance* located in the same room or space.
2. Return air for heating or air-conditioning systems shall not be taken from a hazardous or insanitary location or a refrigeration room as defined in this code.

3. The amount of return air taken from any room or space shall be not greater than the flow rate of supply air delivered to such room or space.
4. Return and transfer openings shall be sized in accordance with the *appliance* or *equipment* manufacturer's installation instructions, ACCA Manual D or the design of the registered design professional.
5. Return air taken from one *dwelling unit* shall not be discharged into another *dwelling unit*.
6. Taking return air from a crawl space shall not be accomplished through a direct connection to the return side of a forced air furnace. Transfer openings in the crawl space enclosure shall not be prohibited.
7. Return air for heating or air-conditioning systems shall not be taken from a ~~closet,~~ bathroom, toilet room, kitchen, garage, boiler room, furnace room or unconditioned attic.
8. Return air from a closet shall serve only the closet and shall not require a dedicated closet supply duct.
9. Return air taken from a closet smaller than 30 ft (2.8 m) shall require the closet door be undercut not less than 1-1/2 inches (38 mm), or have either a louvered door or include an air transfer grille both having a net free area of not less than 30 square inches (19355 mm^2).
10. Return air for heating or air-conditioning systems shall not be taken from indoor swimming pool enclosures and associated deck areas.

    Exceptions:

    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.

Exceptions:

1. Taking return air for heating or air-conditioning systems 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 for heating or air-conditioning systems 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.

602.1 General. Supply, return, exhaust, relief and ventilation air *plenums* shall be in accordance with this section. ~~limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces, mechanical equipment rooms and the framing cavities addressed in Section 602.3. Plenums shall be limited to one fire area. Air systems shall be ducted from the boundary of the fire area served directly to the air-handling equipment.~~ Fuel-fired appliances shall not be installed within a *plenum*.

602.1.1 Locations limited. Plenums shall be limited to uninhabited crawl spaces, above a ceiling or below the floor, attic spaces, mechanical equipment rooms and the framing cavities addressed in Section 602.2.

602.1.2 Limited to a fire area. Plenums shall be limited to one fire area. Air systems shall be ducted directly from the boundary of the fire area served directly to the air-handling equipment.

602.1.3 Fuel fired appliances. Fuel-fired appliances shall not be installed within a plenum.

602.2 Construction of plenums. *Plenum* enclosure construction materials that are exposed to the airflow shall comply with the requirements of Section 703.3 of the International Building Code or such materials shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

The use of gypsum boards to form *plenums* shall be limited to systems where the air temperatures do not exceed 125ºF (52ºC) and the building and mechanical system design conditions are such that the gypsum board surface temperature will be maintained above the airstream dew-point temperature. ~~Air~~ Supply air *plenums* formed by gypsum boards shall not be incorporated in air-handling systems utilizing *direct evaporative* ~~coolers~~ *cooling* systems.

~~602.3~~ 602.2.1 **Stud cavity and joist space plenums**. Stud wall cavities and the spaces between solid floor joists to be utilized as air *plenums* shall comply with the following conditions:

1. Such cavities or spaces shall not be utilized as a *plenum* for supply air.
2. Such cavities or spaces shall not be part of a required fire-resistance-rated assembly.
3. Stud wall cavities shall not convey air from more than one floor level.
4. Stud wall cavities and joist space *plenums* shall comply with the floor penetration protection requirements of the *International Building Code*.
5. Stud wall cavities and joist space *plenums* shall be isolated from adjacent concealed spaces by *approved* fireblocking as required in the *International Building Code*.
6. Stud wall cavities in the outside walls of building envelope assemblies shall not be utilized as air *plenums*.

~~**602.2.1.4 Electrical equipment in plenums**. Electrical *equipment* exposed within a *plenum* shall comply with Sections 602.2.1.4.1 and 602.2.1.4.2.~~

~~**602.2.1.4.1 Equipment in metallic enclosures**. Electrical *equipment* with metallic enclosures exposed within a *plenum* shall be permitted.~~

~~**602.2.1.4.2 Equipment in combustible enclosures**. Electrical *equipment* with combustible enclosures exposed within a *plenum* shall be *listed* and *labeled* for such use in accordance with UL 2043.~~

602.2.1.8 602.3.9 Pipe and duct insulation within plenums. Pipe and duct insulation contained within plenums, including insulation adhesives, shall have a flame spread index of not more than 25 and a smoke developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723, using the specimen preparation and mounting procedures of ASTM E2231. Pipe and duct insulation shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F(121°C). Pipe and duct insulation shall be listed and labeled. Pipe and duct insulation shall not be used to reduce the maximum flame spread and smoke-developed indexes specified in Section 602.2.1.7 except where tested as a composite assembly of the pipe, tubing, insulation, coatings and adhesives in accordance with ASTM E84 or UL 723.A

~~**602.2.1**~~ **602.3 Materials within plenums**. ~~Except as required by Sections 602.2.1.1 through 602.2.1.8, m~~ Materials within *plenums* shall be noncombustible or shall be in compliance with the applicable requirements in Sections 602.3.1 through 602.3.10. ~~listed and labeled as having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.~~

Exceptions:

1. ~~Rigid and flexible ducts and connectors shall conform to Section 603.~~ Materials exposed within plenums in one- and two-family dwellings.
2. ~~Duct coverings, linings, tape and connectors shall conform to Sections 603 and 604.~~ Combustible materials fully enclosed within one of the following:
3. ~~This section shall not apply to materials exposed within plenums in one- and two-family dwellings.~~
4. ~~This section shall not apply to smoke detectors.~~
5. ~~Combustible materials fully enclosed within one of the following:~~

    2.1 Continuous noncombustible raceways or enclosures.

    2.2 Approved gypsum board assemblies.

    2.3 Materials *listed* and *labeled* for installation within a plenum and listed for the application.

3. Materials in Group H, Division 5 fabrication areas and the areas above and below the fabrication area that share a common air recirculation path with the fabrication area.

602.3.1 Ducts, connectors, duct coverings, linings, and tape. Rigid and flexible ducts and connectors shall conform to Section 603. Duct coverings, linings, tape and connectors shall conform to Sections 603 and 604.

602.3.2 Smoke detectors. Smoke detectors shall be *listed* and *labeled*.

~~**602.2.1.1**~~ **602.3.3 Wiring.** Combustible electrical wires and cables and optical fiber cables exposed within a *plenum* shall be *listed* and *labeled* as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and

a flame spread distance not greater than 5 feet (1524 mm) when tested in accordance with NFPA 262, or shall be installed in metal raceways or metal sheathed cable. Combustible optical fiber and communication raceways exposed within a *plenum* shall be *listed* and *labeled* as having a peak optical density not greater than 0.5, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet (1524 mm) when tested in accordance with UL 2024. Only plenum-rated wires and cables shall be installed in plenum-rated raceways.

~~602.2.1.2~~ 602.3.4 **Fire sprinkler piping**. Plastic fire sprinkler piping exposed within a *plenum* shall be used only in wet pipe systems and shall be *listed* and *labeled* as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet (1524 mm) when tested in accordance with UL 1887.

~~602.2.1.3~~ 602.3.5 **Pneumatic tubing**. Combustible pneumatic tubing exposed within a *plenum* shall be *listed* and *labeled* as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet (1524 mm) when tested in accordance with UL 1820.

~~602.2.1.5~~ 602.3.6 **Discrete electrical, plumbing and mechanical products in plenums**. Where discrete electrical, plumbing and mechanical products and appurtenances are located in a *plenum* and have exposed combustible material, they shall be *listed* and *labeled* for such use in accordance with UL 2043.

Exception: Electrical equipment with metallic enclosures exposed within a plenum.

~~602.2.1.6~~ 602.3.7 **Foam plastic in plenums as interior finish or interior trim**. Foam plastic in *plenums* used as interior wall or ceiling finish or interior trim shall exhibit a flame spread index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, and shall be tested in accordance with NFPA 286 and meet the acceptance criteria of Section 803.1.2 of the International Building Code. As an alternative to testing to NFPA 286, the foam plastic shall be approved based on tests conducted in accordance with Section 2603.9 of the International Building Code.

Exceptions:

1. Foam plastic in *plenums* used as interior wall or ceiling finish or interior trim shall exhibit a flame spread index of 75 or less and a smoke- developed index of 450 or less when tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, where it is separated from the airflow in the *plenum* by a thermal barrier complying with Section 2603.4 of the International Building Code.
2. Foam plastic in *plenums* used as interior wall or ceiling finish or interior trim, shall exhibit a flame spread index of 75 or less and a smoke- developed index of 450 or less when tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, where it is separated from the airflow in the *plenum* by corrosion-resistant steel having a base metal thickness of not less than 0.0160 inch (0.4 mm).
3. Foam plastic in *plenums* used as interior wall or ceiling finish or interior trim, shall exhibit a flame spread index of 75 or less and a smoke- developed index of 450 or less when tested in accordance with ASTM E84 or UL 723 at the maximum thickness and density intended for use, where it is separated from the airflow in the *plenum* by not less than a 1-inch (25 mm) thickness of masonry or concrete.

~~602.2.1.7~~ 602.3.8 **Plastic plumbing piping and tubing**. Plastic piping and tubing used in plumbing systems shall be *listed* and *labeled* as having a flame spread index not greater than 25 and a smoke-developed index not greater than 50 when tested in accordance with ASTM E84 or UL 723.

Exception: Plastic water distribution piping and tubing *listed* and *labeled* in accordance with UL 2846 as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet (1524 mm), and installed in accordance with its listing.

~~602.2.1.8~~ 602.3.9 **Pipe and duct insulation within plenums**. Pipe and duct insulation contained within *plenums*, including insulation adhesives, shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723, using the specimen preparation and mounting procedures of ASTM E2231. Pipe and duct insulation shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C). Pipe and duct insulation shall be *listed* and *labeled*. Pipe and duct insulation shall not be used to reduce the maximum flame spread and smoke-developed indices except where the pipe or duct and its related insulation, coatings, and adhesives are tested as a composite assembly in accordance with Section 602.3.9.

602.3.10 Other combustible materials. Other combustible materials not covered by Section 602.3 shall be listed and labeled as having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

603.5.1 Gypsum ducts. The use of gypsum boards to form air shafts (ducts) shall be limited to return air systems where the air temperatures do not exceed 125°F (52°C) and the gypsum board surface temperature is maintained above the airstream dew-point temperature. ~~Air~~ Supply air ducts formed by gypsum boards shall not be incorporated in air-handling systems utilizing direct evaporative ~~coolers~~ cooling systems.

604.3 Coverings and linings. Duct coverings and linings, including adhesives where used, shall have a flame spread index not more than 25 and a smoke-developed index not more than 50, when tested in accordance with ASTM E84 or UL 723, using the specimen preparation and mounting procedures of ASTM E2231. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C). Coverings and linings shall be *listed* and *labeled*.

Exceptions:

1. Polyurethane foam insulation that is spray applied to the exterior of ducts in attics and crawl spaces shall be subject to all of the following requirements:
   - 1.1 The foam plastic insulation shall have a flame spread index not greater than 25 and a smoke-developed index not greater than 450, when tested in accordance with ASTM E84 or UL 723, using the specimen preparation and mounting procedures of ASTM E2231.
   - 1.2 The foam plastic insulation shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C).
   - 1.3 The foam plastic insulation complies with the requirements of Section 2603 of the International Building Code.
   - 1.4 The foam plastic insulation is protected against ignition in accordance with the requirements of Section 2603.4.1.6 of the International Building Code.
2. Duct coverings added to the outside of ducts and not contained in plenums, including adhesives where used, shall have a flame spread index not more than 25 and a smoke-developed index not more than 450, when tested in accordance with ASTM E84 or UL 723, using the specimen preparation and mounting procedures of ASTM E2231. Duct coverings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C). Coverings shall be *listed* and *labeled*.

[NY] 605.1.1 Clean Air Delivery Capability. In Groups A, B, E, M, and I occupancies, each mechanical system shall meet the requirements in Section 605.1.1.1.

Exception: Occupiable spaces where 100% of the supply air meets High-efficiency Particulate Air (HEPA) filtration. Air Filters shall be listed and labeled in accordance with ISO 29463, MIL-STD-282, IEST-RP-CC00, or IEST-RP-CC007.

[NY] 605.1.1.1 Airflow for Increased Filtration. Mechanical systems shall be sized to accommodate a design airflow at a total static pressure drop which assumes the utilization of a supply air filter with a Minimum Efficiency Reporting Value (MERV) of no less than 13. Air Filters shall be listed and labeled in accordance with ASHRAE 52.2.

[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 requirements of this section, and~~ the manufacturer's instructions, ~~and~~ the dampers' listing and Sections 607.2.1 through 607.2.3.

[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.

[BF] 607.2.4 Mechanical, electrical and plumbing controls. Mechanical, electrical and plumbing controls shall not be installed in air duct systems.

Exception: Controls shall be permitted to be installed in air duct systems only if the wiring is directly associated with the air distribution system. The wiring shall comply with the requirements of Section 602 and the total length of such wiring shall not exceed 4 feet (1.2 m).

[BF] 607.2.4.1 Controls not permitted to be installed through dampers. Mechanical, electrical and plumbing controls shall not be installed through fire dampers, smoke dampers, combination fire/smoke dampers or ceiling radiation dampers unless otherwise permitted by the manufacturer and the listing.

[BF] 607.3.1 Damper testing. *Dampers* shall be *listed* and *labeled* in accordance with the standards in this section. *Fire dampers* shall comply with the requirements of UL 555. ~~Only *fire dampers* labeled for use in dynamic systems shall be installed in heating, ventilating and air-conditioning systems designed to operate with fans on during a fire.~~ *Smoke dampers* shall comply with the requirements of UL 555S. *Combination fire/smoke dampers* shall comply with the requirements of both UL 555 and UL 555S. *Ceiling radiation dampers* shall comply with the requirements of UL 555C or shall be tested as part of a fire-resistance-rated floor/ceiling or roof/ceiling assembly in accordance with ASTM E119 or UL 263. ~~Only *ceiling radiation dampers* labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire.~~ Corridor dampers shall comply with requirements of both UL 555 and UL 555S. Corridor dampers shall demonstrate acceptable closure performance when subjected to 150 feet per minute (0.76 m/s) velocity across the face of the damper using the UL 555 fire exposure test.

[BF] 607.3.3.1 Fire damper actuation ~~device~~. ~~The fire damper actuation device~~ Primary heat-responsive devices used to actuate fire dampers shall meet one of the following requirements:

1. The operating temperature shall be approximately 50°F (28°C) above the normal temperature within the duct system, but not less than 160°F (71°C).
2. The operating temperature shall be not more than 350°F (177°C) where located in a smoke control system complying with Section 909 of the International Building Code.

[BF] 607.4 Access and identification. ~~Fire~~ Access and identification of fire and smoke dampers shall ~~be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts. 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 points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch (12.7 mm) in height reading: FIRE/SMOKE DAMPER, SMOKE DAMPER or FIRE DAMPER. Access doors in ducts shall be tight fitting and suitable for the required duct construction.~~ comply with Sections 607.4.1 through 607.4.2.

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.

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.

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.

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

[BF] 607.5.2 Fire barriers. Ducts and air transfer openings that penetrate fire barriers shall be protected with *listed* fire dampers installed in accordance with their listing. Ducts and air transfer openings shall not penetrate enclosures for interior exit stairways and ramps and exit passageways except as permitted by Sections 1023.5 and 1024.6, respectively, of the *International Building Code*.

Exception: Fire dampers are not required at penetrations of fire barriers where any of the following apply:

1. Penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.
2. Ducts are used as part of an *approved* smoke control system in accordance with Section 513 and where the fire damper would interfere with the operation of the smoke control system.

3. Such walls are penetrated by fully ducted HVAC systems, have a required fire-resistance rating of 1 hour or less, are in areas of other than Group H and are in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 of the *International Building Code*. For the purposes of this exception, a fully ducted HVAC system shall be a duct system for the structure's HVAC system. Such a duct system shall be constructed of sheet steel not less than 26 gage [0.0217 inch (0.55 mm)] thickness and shall be continuous from the air-handling *appliance* or *equipment* to the air outlet and inlet terminals. Flexible air connectors shall be permitted in a fully ducted system, limited to the following installations:

   3.1 Nonmetallic flexible connections that connect a duct to an air handling unit or *equipment* located within a mechanical room in accordance with Section 603.9.

   3.2 Nonmetallic flexible air connectors in accordance with Section 603.6.2 that connect an overhead metal duct to a ceiling diffuser where the metal duct and ceiling diffuser are located within the same room.

[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. ~~provided that there is a continuous airflow upward to the outdoors.~~

   1.2 Penetrations are tested in accordance with ASTM E119 or UL 263 as part of the fire-resistance-rated assembly.

   1.3 Ducts are used as part of an approved smoke control system designed and installed in accordance with Section 909 and where the fire damper will interfere with the operation of the smoke control system.

   1.4 The penetrations are in parking garage exhaust or supply shafts that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.

2. In Group B and R occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 of the International Building Code, smoke dampers are not required at penetrations of shafts where kitchen, clothes dryer, bathroom and toilet room exhaust openings with steel exhaust subducts, having a ~~minimum~~ wall thickness of not less than 0.0187 inch (0.4712 mm), extend not less than 22 inches (559 mm) vertically and the exhaust fan at the upper terminus is powered continuously in accordance with the provisions of Section 909.11 of the International Building Code, and maintains airflow upward to the outdoors.
3. Smoke dampers are not required at penetration of exhaust or supply shafts in parking garages that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.
4. Smoke dampers are not required at penetrations of shafts where ducts are used as part of an *approved* mechanical smoke control system designed in accordance with Section 909 of the *International Building Code* and where the smoke damper will interfere with the operation of the smoke control system.
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.

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

[BF] 607.6.1 Through penetrations. ~~In occupancies other than Groups I-2 and I-3~~A duct constructed of *approved* materials in accordance with Section 603 that penetrates a fire-resistance-rated floor/ceiling assembly that connects not more than two stories is permitted without shaft enclosure protection provided that a *listed* fire damper is installed at the floor line or the duct is protected in accordance with Section 714.5 of the *International Building Code*. For air transfer openings, see Item 6, Section 712.1.9 of the *International Building Code*.

Exception:In occupancies other than Groups I-2 and I-3, a duct is permitted to penetrate three floors or less without a fire damper at each floor provided that it meets all of the following requirements:

1. The duct shall be contained and located within the cavity of a wall and shall be constructed of steel having a minimum thickness of 0.0187 inch (0.4712 mm) (No. 26 gage).
2. The duct shall open into only one *dwelling unit* or *sleeping unit* and the duct system shall be continuous from the unit to the exterior of the *building*.
3. The duct shall not exceed a 4-inch (102 mm) nominal diameter and the total area of such ducts shall not exceed 100 square inches for any 100 square feet (64 516 mm^2 per 9.3 m^2) of the floor area.
4. The annular space around the duct is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E119 or UL 263 time-temperature conditions under a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.
5. Grille openings located in a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with a *listed ceiling radiation damper* installed in accordance with Section 607.6.2.1.

[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 labeled for use in dynamic systems.

[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.

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.

Chapter 8 – Chimneys and Vents

801.21 Blocked vent switch. Oil-fired *appliances* shall be equipped with a device that will stop burner operation in the event that the venting system is obstructed. Such device shall have a manual reset and shall be installed in accordance with the manufacturer's instructions.

Chapter 9 – Specific Appliances, Fireplaces, and Solid Fuel-Burning Equipment

905.1 General. Fireplace stoves and solid-fuel-type room heaters shall be listed and labeled and shall be installed in accordance with the conditions of the listing. Fireplace stoves shall be tested in accordance with UL 737. Solid-fuel-type

room heaters shall be tested in accordance with UL 1482. Fireplace inserts intended for installation in fireplaces shall be listed and labeled in accordance with the requirements of UL 1482 and shall be installed in accordance with the manufacturer's instructions. New Wood Burning Residential Hydronic Heaters shall be EPA certified.

907.1 General. Factory-built cremation furnaces and commercial direct-fed incinerators shall be *listed* and *labeled* in accordance with UL 2790. Factory-built incinerators for domestic applications shall be *listed* and *labeled* in accordance with UL 791. Incinerators and cremation furnaces shall be installed in accordance with the manufacturer's instructions.

908.1 General. A cooling tower used in conjunction with an air-conditioning appliance shall be installed in accordance with the manufacturer's instructions. Factory-built cooling towers shall be listed in accordance with UL 1995, or UL/CSA 60335-2-40.

SECTION 912 ~~INFRARED RADIANT~~ ELECTRIC SPACE HEATERS.

912.1 General. Permanently installed electric ~~infrared radiant~~ space heaters shall ~~comply~~ be listed and labeled in accordance with ~~UL 499~~ UL 2021, and installed in accordance with the manufacturer's instructions.

912.2 Support. ~~Infrared radiant~~ Electric space heaters shall be fixed in a position independent of ~~fuel and~~ electric supply lines. Hangers and brackets shall be noncombustible material.

916.1 General. Pool and spa heaters shall be installed in accordance with the manufacturer's instructions. Oil-fired pool and spa heaters shall be tested in accordance with UL 1261. Pool and spa heat pump water heaters shall comply with UL 1995, or UL/CSA 60335-2-40, or CSA C22.2 No. 236.

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

918.1 Forced-air furnaces. Oil-fired furnaces shall be tested in accordance with UL 727. Electric furnaces shall be tested in accordance with UL 1995, or UL/CSA 60335-2-40. Solid fuel furnaces shall be tested in accordance with UL 391. Forced-air furnaces shall be installed in accordance with the listings and the manufacturer's instructions.

918.2 Heat pumps. Electric heat pumps shall be tested in accordance with UL 1995, or UL/CSA 60335-2-40.

920.4 Prohibited Uses. In Group I-2 and ambulatory care facilities, suspended-type unit heaters are prohibited in corridors, exit access stairways and ramps, exit stairways and ramps and patient sleeping areas.

[NY] 922.2 Approved portable kerosene heater. Unvented portable kerosene-fired heaters tested and listed in accordance with UL 647 are approved by the Secretary of State for use in New York State if packaged for sale with all provisions required in New York State Real Property Law Article 7A Section 239-a(7). Unvented portable kerosene-fired heaters shall not be located in, or obtain combustion air from, any of the following rooms or spaces: sleeping rooms, bathrooms, toilet rooms, or storage closets. Portable kerosene heaters shall be prohibited in buildings of occupancy groups A, E, I, R-1, R-2, R-3, ~~and~~ R-4 (except for one- and two-family homes and townhouses), and ambulatory care facilities. The use of unvented portable kerosene-fired heaters is further regulated by New York State Real Property Law Article 7A.

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 UL1370 and shall be installed in accordance with the conditions of the listing, manufacturer's installation instructions, and Chapter 3.

SECTION ~~929~~ 930 ~~HIGH VOLUME~~ LARGE-DIAMETER CEILING FANS

~~929.1~~ **930.1 General**. Where provided, ~~high volume~~ 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.

SECTION 931 STEAM BATH EQUIPMENT.

931.1 General. Steam bath equipment shall be *listed* and *labeled* in accordance with UL 499 and shall be installed in accordance with their listing and the manufacturer's instructions.

Chapter 10 – Boilers, Water Heaters, and Pressure Vessels

1001.1 Scope. This chapter shall govern the installation, *alteration* and repair of boilers, water heaters and pressure vessels.

Exceptions:

1. Pressure vessels used for unheated water supply.
2. Portable unfired pressure vessels and Interstate Commerce Commission containers.
3. Containers for bulk oxygen and medical gas.
4. Unfired pressure vessels having a volume of 5 cubic feet (0.14 m^3) or less operating at pressures not exceeding 250 pounds per square inch (psi) (1724 kPa) and located within *occupancies* of Groups B, F, H, M, R, S and U.
5. Pressure vessels used in refrigeration systems that are regulated by Chapter 11 of this code.
6. Pressure tanks used in conjunction with coaxial cables, telephone cables, power cables and other similar humidity control systems.
7. Any boiler or pressure vessel subject to inspection by federal or state inspectors.
8. Pressure vessels used in specific appliances and equipment that are regulated by Chapter 9 of this code.

1002.4 Water heater pan required. Where a storage type water heater or a hot water storage tank is installed in a location where water leakage from the tank will cause damage, the tank shall be installed in a pan constructed by one of the following:

1. Galvanized steel or aluminum of not less than 0.0236 inch (0.6010 mm) in thickness.
2. Plastic of not less than 0.036 inch (0.9 mm) in thickness constructed of material having a flame spread index of 25 or less and a smoked developed index of 450 or less when tested in accordance with ASTM E-84 or UL-723.
3. Other approved materials.

1004.1 Standards. Boilers shall be designed, constructed and certified in accordance with the ASME Boiler and Pressure Vessel Code, Section I or IV. Controls and safety devices for boilers with fuel input ratings of less than 12,500,000 Btu/hr (3,662,500 W) ~~or less~~ shall meet the requirements of ASME CSD-1. Controls and safety devices for boilers with inputs greater than or equal to 12,500,000 Btu/hr (3,662,500 W) shall meet the requirements of NFPA 85. Packaged oil-fired boilers shall be listed and labeled in accordance with UL 726. Packaged electric boilers shall be listed and labeled in accordance with UL 834. Solid-fuel-fired boilers shall be listed and labeled in accordance with UL 2523.

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*.
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 visible and observable by the building occupants. If the discharge termination point is not readily visible and observable, a device for leak detection monitoring with alarm notification (and not automatic shut-off) is required.
8. Not be trapped.
9. Be installed so as to flow by gravity.
10. ~~Not terminate~~ Terminate not more than 6 inches (152 mm) above the floor or flood level rim of the 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.~~ Utilize piping material complying with Section 1202.

Chapter 11 – Refrigeration

1101.1 Scope. This chapter shall govern the design, installation, construction and repair of *refrigeration systems* ~~that vaporize and liquefy a fluid during the refrigerating cycle~~. ~~Refrigerant piping design and installation, including pressure vessels and pressure relief devices, shall conform to this code.~~ 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 ANSI/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.

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.

~~**1101.6 General**. Refrigeration systems shall comply with the requirements of this code and, except as modified by this code, ASHRAE 15. Ammonia refrigerating systems shall comply with this code and, except as modified by this code, ASHRAE 15, IIAR 2, IIAR 3, IIAR 4 and IIAR 5.~~

~~**1101.7**~~ **1101.6 Maintenance**. ~~Mechanical r~~*Refrigeration systems* shall be maintained in proper operating condition, free from accumulations of oil, dirt, waste, excessive corrosion, other debris and leaks.

~~**1101.8 Change in refrigerant type**. The type of refrigerant in refrigeration systems having a refrigerant circuit containing more than 220 pounds (99.8 kg) of Group A1 or 30 pounds (13.6 kg) of any other group refrigerant shall not be changed without prior notification to the code official and compliance with the applicable code provisions for the new refrigerant type.~~

1101.7 Changing Refrigerant. Changes of refrigerant in an existing system to a refrigerant with a different *refrigerant designation* shall only be allowed where in accordance with the following:

1. The owner or the owner's authorized agent shall be notified prior to making a change of refrigerant, and the change of refrigerant shall not be made where the owner objects to the change.
2. The change in refrigerant shall be in accordance with one of the following.
   2.1 Written instructions of the original equipment manufacturer.
   2.2 An evaluation of the system by a registered design professional or by an approved agency that validates safety and suitability of the replacement refrigerant.
   2.3 *Approved* by the code official.
3. Where the replacement refrigerant is classified into the same safety group, requirements that were applicable to the existing system shall continue to apply.
4. Where the replacement refrigerant is classified into a different safety group, the system shall comply with the requirements of this standard for a new installation, and the change of refrigerant shall require code official approval.

1102.1 General. The refrigeration system classification, allowable refrigerants, maximum quantity, enclosure requirements, location limitations, and field pressure test requirements shall be determined as follows:

1. Determine the *refrigeration system's* classification, in accordance with Section 1103.3.
2. Determine the refrigerant classification in accordance with Section 1103.1.
3. Determine the maximum allowable quantity of refrigerant in accordance with Section 1104, based on type of refrigerant, *refrigeration system* classification and *occupancy*.
4. Determine the *refrigeration system* enclosure requirements in accordance with Section 1104.
5. Refrigeration *equipment* and *appliance* location and installation shall be subject to the limitations of Chapter 3.
6. Nonfactory-tested, field-erected *equipment* and *appliances* shall be pressure tested in accordance with Section 1108.

~~**1102.2.1 Mixing.** Refrigerants, including refrigerant blends, with different designations in ASHRAE 34 shall not be mixed in a system.~~

~~**Exception:** Addition of a second refrigerant is allowed where permitted by the *equipment* or *appliance* manufacturer to improve oil return at low temperatures. The refrigerant and amount added shall be in accordance with the manufacturer's instructions.~~

1102.2.1 Mixing. Refrigerants with different *refrigerant designations* shall only be mixed in a system in accordance with both of the following:

1. The addition of a second refrigerant is allowed by the equipment manufacturer and is in accordance with the manufacturer's written instructions.
2. The resulting mixture does not change the refrigerant safety group.

TABLE 1103.1 REFRIGERANT CLASSIFICATION, AMOUNT AND OEL

The remaining portion of the table is unchanged and omitted for clarity.

CHEMICAL REFRIGERANT	FORMULA	CHEMICAL NAME OF BLEND	REFRIG-ERANT SAFETY GROUP CLASSI-FICATION	AMOUNT OF REFRIGERANT PER OCCUPIED SPACE							[F] DEGREES OF HAZARD[a]
				RCL			LFL			OEL[d]	
				~~Pounds per 1,000 cubic feet~~ lb/ MCf	ppm	g/m³	lb/ MCf	ppm	g/m³	~~OEL~~ ppm	
R-11[d] [c]	CCl_3F	trichlorofluoromethane	A1	0.39	1,100	~~6.2~~ 6.1				~~C~~ 1,00	2-0-0[b]
R-12[d] [c]	CCl_2F_2	dichlorodifluoromethane	A1	5.6	18,000	90				1,000	2-0-0 [b]
R-13[d] [c]	$CClF_3$	chlorotrifluoromethane	A1	—	—	—				1,000	2-0-0[b]
R-13B1[d] [c]	$CBrF_3$	bromotrifluoromethane	A1	—	—	—				1,000	2-0-0[b]
R-13I1	CF_3I	trifluoroiodomethane	A1	1.0	2,000	16				500	—
R-31	CH_2ClF	chlorofluoromethane	—	—	—	—				—	—
R-32	CH_2F_2	difluoromethane (methylene fluoride)	A2L ~~A2[e]~~	4.8	36,000	77	19.1	144,000	306	1,000	1-4-0
R-41	CH_3F	fluoromethane (methyl fluoride)	—	—	—	—				—	—
R-50	CH_4	methane	A3	—	—	—		50,000		1,000	—
R-113[d] [c]	CCl_2FCClF_2	1,1,2-trichloro-1,2,2-trifluoroethane	A1	1.2	2,600	20				1,000	2-0-0 b
R-114[d] [c]	$CClF_2CClF_2$	1,2-dichloro-1,1,2,2-tetrafluoroethane	A1	8.7	20,000	140				1,000	2-0-0 b
R-141b	CH_3CCl_2F	1,1-dichloro-1-fluoroethane	—	0.78	2,600	12	17.8	60,000	287	500	2-1-0
R-142b	CH_3CClF_2	1-chloro-1,1-difluoroethane	A2	5.1	20,000	~~83~~ 82	20.4	80,000	329	1,000	2-4-0
R-143a	CH_3CF_3	1,1,1-trifluoroethane	~~A2[f]~~ A2L	~~4.5~~ 4.4	21,000	70	17.5	82,000	282	1,000	2-0-0[b]
R-152a	CH_3CHF_2	1,1-difluoroethane	A2	2.0	12,000	32	8.1	48,000	130	1,000	1-4-0
R-170	CH_3CH_3	ethane	A3	0.54	7,000	~~8.7~~ 8.6	2.4	31,000	38	1,000	2-4-0
R-E170	CH_3OCH_3	Methoxymethane (dimethyl ether)	A3	1.0	8,500	16	4.0	34,000	64	1,000	—
R-290	$CH_3CH_2CH_3$	propane	A3	~~0.56~~ 0.59	5,300	9.5	2.4	21,000	38	1,000	2-4-0
R-C318	-(CF2)4-	octafluorocyclobutane	A1	41	80,000	~~660~~ 650				1,000	—
R-400[d] [c]	zeotrope	R-12/114 (50.0/50.0)	A1	10	28,000	160				1,000	2-0-0 b

R-400~~d~~ c	zeotrope	R-12/114 (60.0/40.0)	A1	11	30,000	170				1,000	—
R-403B	zeotrope	R-290/22/218 (5.0/56.0/39.0)	A1	18	~~70,000~~ 68,000	290				1,000	2-0-0 b
R-406A	zeotrope	R-22/600a/142b (55.0/4.0/41.0)	A2	4.7	21,000	~~25~~ 75	18.8	82,000	301.9	1,000	—
R-407G	zeotrope	R-32/125/134a (2.5/2.5/95.0)	A1	13	52,000	210				1,000	–
R-407H	zeotrope	R-32/125/134a (32.5/15.0/52.5)	A1	19	92,000	300				1,000	–
R-407I	zeotrope	R-32/125/124a (19.5/8.5/72.0)	A1	16	71,100	250				1,000	—
R-408A	zeotrope	R-125/143a/22 (7.0/46.0/47.0)	A1	21	~~95,000~~ 94,000	~~340~~ 330				1,000	2-0-0 b
R-411A	zeotrope	R-127/22/152a (1.5/87.5/11.0)	A2	2.9	14,000	46	11.6	55,000	185.6	~~990~~ 970	—
R-411B	zeotrope	R-1270/22/152a (3.0/94.0/3.0)	A2	2.8	13,000	45	14.8	70,000	238.3	~~980~~ 940	—
R-412A	zeotrope	R-22/218/142b (70.0/5.0/25.0)	A2	5.1	22,000	82	20.5	87,000	328.6	1,000	—
R-413A	zeotrope	R-218/134a/600a (9.0/88.0/3.0)	A2	5.8	22,000	~~94~~ 93	23.4	88,000	374.9	1,000	—
R-418A	zeotrope	R-290/22/152a (1.5/96.0/2.5)	A2	4.8	22,000	77	19.2	89,000	308.4	1,000	—
R-419A	zeotrope	R-125/134a/E170 (77.0/19.0/4.0)	A2	4.2	15,000	67	16.7	60,000	268.6	1,000	—
R-419B	zeotrope	R-125/134a/E170 (48.5/48.0/3.5)	A2	4.6	17,000	74	18.5	69,000	297.3	1,000	—
R-420A	zeotrope	R-134a/142b (88.0/12.0)	A1	12	~~45,000~~ 44,000	~~190~~ 180				1,000	2-0-0 b
R-421A	zeotrope	R-125/134a (58.0/42.0)	A1	17	61,000	280				1,000	2-0-0b
R-421B	zeotrope	R-125/134a (85.0/15.0)	A1	21	69,000	330				1,000	2-0-0b
R-423A	zeotrope	R-134a/227ea (52.5/47.5)	A1	19	59,000	~~310~~ 300				1,000	2-0-0c
R-424A	zeotrope	R-125/134a/600a/600/601a (50.5/47.0/0.9/1.0/0.6)	A1	6.2	23,000	100				~~970~~ 990	2-0-0 b
R-428A	zeotrope	R-125/143a/290/600a (77.5/20.0/0.6/1.9)	A1	23	~~83,000~~ 84,000	370				1,000	—
R-429A	zeotrope	R-E170/152a/600a (60.0/10.0/30.0)	A3	0.81	6,300	13	3.2	25,000	83.8	1,000	—
R-430A	zeotrope	R-152a/600a (76.0/24.0)	A3	1.3	8,000	21	5.2	32,000	44.0	1,000	—
R-431A	zeotrope	R-290/152a (71.0/29.0)	A3	~~0.69~~ 0.68	5,500	11	2.7	22,000	38.6	1,000	—

R-432A	zeotrope	R-1270/E170 (80.0/20.0)	A3	0.13	1,200	2.1	2.4	22,000	39.2	~~700~~ 550	—
R-433A	zeotrope	R-1270/290 (30.0/70.0)	A3	0.34	3,100	5.5	2.4	20,000	32.4	~~880~~ 760	—
R-433B	zeotrope	R-1270/290 (5.0-95.0)	A3	~~0.51~~ 0.39	~~4,500~~ 3,500	~~8.1~~ 6.3	2.0	18,000	32.1	950	—
R-433C	zeotrope	R-1270/290 (25.0-75.0)	A3	0.41	~~3,600~~ 3,700	~~6.6~~ 6.5	2.0	18,000	83.8	790	—
R-435A	zeotrope	R-E170/152a (80.0/20.0)	A3	1.1	8,500	17	4.3	34,000	68.2	1,000	—
R-436A	zeotrope	R-290/600a (56.0/44.0)	A3	0.50	4,000	8.1	2.0	16,000	32.3	1,00	—
R-436B	zeotrope	R-290/600a (52.0/48.0)	A3	0.51	4,000	~~8.1~~ 8.2	2.0	16,000	32.7	1,000	—
R-436C	zeotrope	R-290/600a (95.0/5.0)	A3	0.57	5,000	9.1	2.3	20,000	36.5	1,000	—
R-437A	zeotrope	R-125/134a/600/601 (19.5/78.5/1.4/0.6)	A1	~~5.0~~ 5.1	19,000	82				990	—
R-439A	zeotrope	R-32/125/600a (50.0/47.0/3.0)	A2	4.7	26,000	76	18.9	104,000	303.3	~~990~~ 1,000	—
R-440A	zeotrope	R-290/134a/152a (0.6/1.6/97.8)	A2	1.9	12,000	31	7.8	46,000	124.7	1,000	—
R-441A	zeotrope	R-170/290/600a/600 (3.1/54.8/6.0/36.1)	A3	0.39	3,200	6.3	2.0	16,000	31.7	1,000	—
R-443A	zeotrope	R-1270/290/600a (55.0/40.0/5.0)	A3	0.19	1,700	3.1	2.2	20,000	35.6	~~580~~ 640	—
R-444A	zeotrope	R-32/152a/1234ze(E) (12.0/5.0/83.0)	A2L~~A2~~[e]	5.1	21,000	81	19.9	82,000	324.8	850	—
R-444B	zeotrope	R-32/152a/1234ze(E) (41.5/10.0/48.5)	A2L~~A2~~[e]	4.3	23,000	69	17.3	93,000	277.3	~~890~~ 930	—
R-445A	zeotrope	R-744/134a/1234ze(E) (6.0/9.0/85.0)	A2L~~A2~~[e]	4.2	16,000	67	2.7	63,000	347.4	930	—
R-446A	zeotrope	R-32/1234ze(E)/600 (68.0/29.0/3.0)	A2L~~A2~~[e]	2.5	16,000	39	13.5	62,000	217.4	960	—
R-447A	zeotrope	R-32/125/1234ze(E) (68.0/3.5/28.5)	A2L~~A2~~[e]	2.6	16,000	42	18.9	65,000	303.5	~~900~~ 960	—
R-447B	zeotrope	R-32/125/1234ze(E) (68.0/8.0/24.0)	A2L	2.6	16,000	42	20.6	121,000	312.7	970	—
R-448A	zeotrope	R-32/125/1234yf/134a/1234ze (E) (26.0/26.0/20.0/21.0/7.0)	A1	24	110,000	390				~~890~~ 860	—
R-449A	zeotrope	R-32/125/1234yf/134a (24.3/24.7/25.3/25.7)	A1	23	100,000	370				~~830~~ 840	—
R-449B	zeotrope	R-32/125/1234yf/134a (25.2/24.3/23.2/27.3)	A1	23	100,000	370				850	–

R-449C	zeotrope	R-32/125/1234yf/134a (20.0/20.0/31.0/29.0)	A1	23	98,000	360				800	–
R-451A	zeotrope	R-1234yf/134a (89.8/10.2)	A2L~~A2[e]~~	~~5.3~~5.0	18,000	81	20.3	70,000	326.6	~~520~~ 530	—
R-451B	zeotrope	R-1234yf/134a (88.8/11.2)	A2L~~A2[e]~~	~~5.3~~5.0	18,000	81	20.3	70,000	326.6	530	—
R-452A	zeotrope	R-32/125/1234yf (11.0/59.0/30.0)	A1	27	~~10,000~~ 100,000	440				~~780~~ 790	—
R-452B	zeotrope	R-32/125/1234yf (67.0/7.0/26.0)	A2L	4.8	30,000	77	19.3	119,000	310.5	870	—
R-452C	zeotrope	R-32/125/1234yf (12.5/61.0/26.5)	A1	27	100,000	430				810	—
R-453A	zeotrope	R-32/125/134a/227ea /600/601a(20.0/20.0/53.8/ 5.0/0.6/0.6)	A1	7.8	34,000	120				1,000	–
R-454A	zeotrope	R-32/1234yf (35.0/65.0)	A2L	3.2	16,000	52	18.3	63,000	293.9	690	—
R-454B	zeotrope	R-32/1234yf (68.9/31.1)	A2L	3.1	19,000	49	22.0	77,000	352.6	850	—
R-454C	zeotrope	R-32/1234yf (21.5/78.5)	A2L	4.4	19,000	71	18.0	62,000	289.5	620	—
R-455A	zeotrope	R-744/32/1234yf (3.0/21.5/75.5)	A2L	4.9	22,000	79	26.9	118,000	432.1	650	—
R-456A	zeotrope	R-32/134a/1234ze(E) (6.0/45.0/49.0)	A1	20	77,000	320				900	–
R-457A	zeotrope	R-32/1234yf/152a (18.0/70.0/12.0)	A2L	3.4	15,000	54	13.5	60,000	216.3	650	—
R-457B	zeotrope	R-32/1234yf/152a (35.0/55.0/10.0)	A2L	3.7	19,000	59	14.9	76,000	239	730	—
R-458A	zeotrope	R-32/125/134a/227ea /236fa (20.5/4.0/61.4 /13.5/0.6)	A1	18	76,000	280				1,000	–
R-459A	zeotrope	R-32/1234yf/1234ze(E) (68.0/26.0/6.0)	A2L	4.3	27,000	69	17.4	107,000	278.7	870	—
R-459B	zeotrope	R-32/1234yf/1234ze(E) (21.0/69.0/10.0)	A2L	30	25,000	92	23.3	99,000	373.5	640	—
R-460A	zeotrope	R-32/125/134a/1234ze(E) (12.0/52.0/14.0/22.0)	A1	24	92,000	380				950	—
R-460B	zeotrope	R-32/125/134a/1234ze(E) (28.0/25.0/20.0/27.0)	A1	25	120,000	400				950	–
R-460C	zeotrope	R-32/125/134a/1234ze(E) (2.5/2.5/46.0/49.0)	A1	20	73,000	310				900	—
R-461A	zeotrope	R-125/143a/134a/227ea /600a (55.0/5.0/32.0 /5.0/3.0)	A1	17	61,000	270				1,000	–
R-462A	zeotrope	R-32/125/143a/134a/600 (9.0/42.0/2.0/44.0/3.0)	A2	3.9	16,000	62	16.6	105,000	265.8	1,000	—
R-463A	zeotrope	R-744/32/125/1234yf/134a (6.0/36.0/30.0/14.0/14.0)	A1	19	98,000	300				990	

R-464A	zeotrope	R-32/125/1234ze(E)/227ea (27.0/27.0/40.0/6.0)	A1	27	120,000	430				930	—
R-465A	zeotrope	R-32/290/1234yf (21.0/7.9/71.1)	A2	2.5	12,000	40	10.0	98,000	160.9	660	—
R-466A	zeotrope	R-32/125/13I1 (49.0/11.5/39.5)	A1	6.2	30,000	99				860	—
R-467A	zeotrope	R-32/125/134a/600a (22.0/5.0/72.4/0.6)	A2L	6.7	31,000	110				1,000	—
R-468A	zeotrope	R-1132a/32/1234yf (3.5/21.5/75.0)	A2L	4.1	18,000	66				610	—
R-469A	zeotrope	R-744/R-32/R-125 (35.0/32.5/32.5)	A1	8	53,000					1,600	—
R-470A	zeotrope	R-744/32/125/134a/1234ze(E) /227ea (10.0/17.0/19.0/7.0/44.0/3.0)	A1	17	77,000	270				1,100	—
R-470B	zeotrope	R-744/32/125/134a/1234ze(E) /227ea (10.0/17.0/19.0/7.0/44.0/3.0)	A1	16	72,000	270				1,100	—
R-471A	zeotrope	R-1234ze(E)/227ea/1336mzz (E) (78.7/4.3/17.0)	A1	9.7	31,000	160				710	—
R-472A	zeotrope	R-744/32/134a (69.0/12.0/19.0)	A1	4.5	35,000	72				2,700	—
R-500[e] [d]	azeotrope	R-12/152a (73.8/26.2)	A1	~~7.6~~ 7.4	~~30,000~~ 29,000	120				1,000	2-0-0[b]
R-501[d] [c]	azeotrope	R-22/12 (75.0/25.0)	A1	13	54,000	210				1,000	—
R-502[e] [d]	azeotrope	R-22/115 (48.8/51.2)	A1	21	73,000	330				1,000	2-0-0 [b]
R-503[e] [d]	azeotrope	R-23/13 (40.1/59.9)	—	—	—	—				1,000	2-0-0[b]
R-504[d] [c]	azeotrope	R-32/115 (48.2/51.8)	—	28	140,000	450				1,000	—
R-507A	azeotrope	R-125/143a (50.0/50.0)	A1	32	130,000	~~520~~ 510				1,000	2-0-0[b]
R-508A	azeotrope	R-23/116 (39.0/61.0)	A1	14	55,000	~~220~~				1,000	2-0-0 [b]
R-508B	azeotrope	R-23/116 (46.0/54.0)	A1	13	52,000	~~200~~				1,000	2-0-0[b]
R-509A	azeotrope	R-22/218 (44.0/56.0)	A1	24	75,000	~~390~~ 380				1,000	2-0-0[b]
R-510A	azeotrope	R-E170/600a (88.0/12.0)	A3	0.87	7,300	14	3.5	29,000	56.1	1,000	—
R-511A	azeotrope	R-290/E170 (95.0/5.0)	A3	0.59	5,300	9.5	2.4	21,000	38.0	1,000	—
R-512A	azeotrope	R-134a/152a (5.0/95.0)	A2	1.9	11,000	31	7.7	45,000	123.9	1,000	—
R-513B	azeotrope	R-1234yf/134a (58.5/41.5)	A1	21	74,000	330				640	–
R-514A	azeotrope	R-1336mzz(S)/1130(E) (74.7/25.3)	B1	0.86	2,400	14				320	–

R-515A	azeotrope	R-1234ze(E)/227ea (88.0/12.0)	A1	19	63,000	300				810	—
R-515B	azeotrope	R-1234ze(E)/227ea (91.1/8.9)	A1	18	61,000	290				810	—
R-516A	azeotrope	R-1234yf/134a/152a (77.5/8.5/14.0)	A2	3.2	13,000	52	13.1	50,000	210.1	590	—
R-600	$CH_3CH_2CH_2CH_3$	butane	A3	0.15	1,000	2.4	3.0	20,000	48	1,000	1-4-0
R-600a	$CH(CH_3)_2CH_3$	2-methylpropane (isobutane)	A3	0.59	4,000	~~9.6~~ 9.5	2.4	16,000	38	1,000	2-4-0
R-601	$CH_3CH_2CH_2CH_2CH_3$	pentane	A3	0.18	1,000	2.9	2.2	12,000	35	600	—
R-601a	$(CH_3)_2CHCH_2CH_3$	2-methylbutane (isopentane)	A3	0.18	1,000	2.9	2.4	13,000	38	600	—
R-717	NH_3	ammonia	B2[f]	0.014	320	0.22				25	3-3-0[c]
R-718	H_2O	water	A1	—	—	—				—	0-0-0
R-744	CO_2	carbon dioxide	A1	4.5	40,000	72				5,000	2-0-0[b]
R-1130(E)	CHCl=CHCl	trans-1,2-dichloroethene	B2	0.25	1,000	4	16	65,000	258	200	—
R-1132a	$CF_2=CH_2$	1,1-difluoroethylene	A2	2.0	13,000	33	8.1	50,000	131	500	—
R-1150	$CH_2=CH_2$	ethene (ethylene)	A3	—	—	—	2.2	31,000	36	200	1-4-2
R-1224yd(Z)	$CF_3CF=CHCl$	(Z)-1-chloro-2,3,3,3-tetrafluoroethylene	A1	23	60,000	370				1,000	—
R-1234yf	$CF_3CF=CH_2$	2,3,3,3-tetrafluoro-1-propene	A2L~~A2~~[e]	~~4.7~~ 4.5	16,000	75	18.0	62,000	289	500	—
R-1234ze(E)	~~$CF_3CH=CHF$~~ $CF_3CH=CFH$	trans-1,3,3,3-tetrafluoro-1- propene	A2L~~A2~~[e]	4.7	16,000	~~75~~ 76	18.8	65,000	303	800	—
R-1270	$CH_3CH=CH_2$	Propene (propylene)	A3	0.1	1,000	1.7				500	1-4-1
R-1336mzz(E)	$CF_3CHCHCF_3$	trans 1,1,1,4,4,4-hexafluoro-2- butene	A1	3.0	7,200	48				400	—
R-1336mzz(Z)	$CF_3CHCHCF_3$	cis-1,1,1,4,4,4-hexaflouro-2- butene	A1	5.2	13,000	84				500	—

For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.0283m^3

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. For installations that are entirely outdoors, use 3-1-0.~~

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

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

~~f. The ASHRAE Standard 34 flammability classification for this refrigerant is 2L, which is a subclass of Class 2.~~

SECTION 1104 REFRIGERATION SYSTEM APPLICATION REQUIREMENTS

1104.2 Machinery room. Except as provided in Sections 1104.2.1 and 1104.2.2, all components containing the refrigerant shall be located either outdoors or in a *machinery room* where the quantity of refrigerant in an independent circuit of a *refrigeration system* exceeds the amounts shown in Table 1103.1. For refrigerant blends not listed in Table 1103.1, the same requirement shall apply where the amount for any blend component exceeds that indicated in Table 1103.1 for that component. This requirement shall also apply where the combined amount of the blend components exceeds a limit of 69,100 parts per million (ppm) by volume. *Machinery rooms* required by this section shall be constructed and maintained in accordance with Section 1105 for Group A1 and B1 refrigerants and in accordance with Sections 1105 and 1106 for Group A2, B2, A3 and B3 refrigerants.

Exceptions:

1. *Machinery rooms* are not required for *listed equipment* and *appliances* containing not more than 6.6 pounds (3 kg) of refrigerant, regardless of the refrigerant's safety classification, where installed in accordance with the *equipment's* or *appliance's* listing and the *equipment* or *appliance* manufacturer's installation instructions.
2. Piping in compliance with Section 1107 is allowed in other locations to connect components installed in a *machinery room* with those installed outdoors.

1104.2.2 Industrial occupancies and refrigerated rooms. This section applies only to rooms and spaces that: are within industrial occupancies; contain a refrigerant evaporator; are maintained at temperatures below 68°F (20°C); and are used for manufacturing, food and beverage preparation, meat cutting, other processes and storage. Where a *machinery room* would otherwise be required by Section 1104.2, a *machinery room* shall not be required where all of the following conditions are met:

1. The space containing the machinery is separated from other occupancies by tight construction with tight-fitting doors.
2. Access is restricted to authorized personnel.
3. Refrigerant detectors are installed as required for *machinery rooms* in accordance with Section 1105.3.

   ~~**Exceptions**~~ **Exception:**

   ~~1.~~ Refrigerant detectors are not required in unoccupied areas that contain only continuous piping that does not include valves, valve assemblies, *equipment* or *equipment* connections.

   ~~2. Where approved alternatives are provided, refrigerant detectors for ammonia refrigeration are not required for rooms or areas that are always occupied, and for rooms or areas that have high humidity or other harsh environmental conditions that are incompatible with detection devices.~~
4. Surfaces having temperatures exceeding 800°F (427°C) and open flames are not present where any Group A2, B2, A3 or B3 refrigerant is used (see Section 1104.3.4).
5. All electrical *equipment* and appliances conform to Class I, Division 2, *hazardous location* classification requirements of NFPA 70 where the quantity of any Group A2, B2, A3 or B3 refrigerant ~~other than ammonia,~~ in a single independent circuit would exceed 25 percent of the lower flammability limit (LFL) upon release to the space.
6. All refrigerant-containing parts in refrigeration systems with a total connected compressor power exceeding 100 horsepower (hp) (74.6 kW), except evaporators used for refrigeration or dehumidification, condensers used for heating, control and pressure relief valves for either, low-probability pumps and connecting piping, are located either outdoors or in a *machinery room*.

1104.3.1 Air conditioning for human comfort. ~~In other than industrial occupancies where the quantity in a single independent circuit does not exceed the amount in Table 1103.1, Group B1, B2 and B3 refrigerants shall not be used in high-probability systems for 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*.

1104.3.2 ~~Nonindustrial occupancies~~ Group A2, A3, B2, and B3 refrigerants~~. Group A2 and B2 refrigerants shall not be used in high-probability systems where the quantity of refrigerant in any independent refrigerant circuit exceeds the amount shown in Table 1104.3.2.~~ 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*.

~~Exception~~ Exceptions: This section does not apply to:

1. ~~laboratories~~ 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.

~~**TABLE 1104.3.2 MAXIMUM PERMISSIBLE QUANTITIES OF REFRIGERANTS**~~

	~~**MAXIMUM POUNDS FOR VARIOUS OCCUPANCIES**~~			
~~**TYPE OF REFRIGERATION SYSTEM**~~	~~**Institutional**~~	~~**Public assembly**~~	~~**Residential**~~	~~**All other occupancies**~~
~~Sealed absorption system~~				
~~In exit access~~	~~0~~	~~0~~	~~3.3~~	~~3.3~~
~~In adjacent outdoor locations~~	~~0~~	~~0~~	~~22~~	~~22~~
~~In other than exit access~~	~~0~~	~~6.6~~	~~6.6~~	~~6.6~~
~~Unit systems~~				
~~In other than exit access~~	~~0~~	~~0~~	~~6.6~~	~~6.6~~

~~For SI: 1 pound = 0.454 kg.~~

1104.3.3 All occupancies. The total of all Group A2, B2, A3 and B3 refrigerants ~~other than R-717, ammonia,~~ shall not exceed 1,100 pounds (499 kg) except where *approved*.

1104.3.4 Protection from refrigerant decomposition. Where any device having an open flame or surface temperature greater than 800°F (427°C) is used in a room containing more than 6.6 pounds (3 kg) of refrigerant in a single independent circuit, a hood and exhaust system shall be provided in accordance with Section 510. Such exhaust system shall exhaust *combustion products* to the outdoors.

Exception: A hood and exhaust system shall not be required where any of the following apply:

1. The refrigerant is R-~~717,~~ R-718 (water) or R-744 (carbon dioxide).
2. The *combustion air* is ducted from the outdoors in a manner that prevents leaked refrigerant from being combusted.
3. A refrigerant detector is used to stop the *combustion* in the event of a refrigerant leak (see Sections 1105.3 and 1105.5).

1105.6.3 Ventilation rate. ~~For other than ammonia systems, the mechanical~~ Mechanical ventilation systems shall be capable of exhausting the minimum quantity of air both at normal operating and emergency conditions, as required by Sections

1105.6.3.1 and 1105.6.3.2. ~~The minimum required emergency ventilation rate for ammonia shall be 30 air changes per hour in accordance with IIAR2.~~ Multiple fans or multispeed fans shall be allowed to produce the emergency ventilation rate and to obtain a reduced airflow for normal ventilation.

~~**1105.8 Ammonia discharge**. Pressure relief valves for ammonia systems shall discharge in accordance with ASHRAE 15.~~

[F] ~~1105~~.91105.8 Emergency pressure control system. ~~Permanently installed refrigeration systems containing more than 6.6 pounds (3 kg) of flammable, toxic or highly toxic refrigerant or ammonia~~ Emergency pressure control systems shall be provided ~~with an emergency pressure control system~~ in accordance with Section 605.10 of the International Fire Code.

1105.9 [BE] 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.

~~**1106.3 Ammonia room ventilation**. Ventilation systems in ammonia machinery rooms shall be operated continuously at the ventilation rate specified in Section 1105.6.3.~~

~~**Exceptions:**~~

~~1. Machinery rooms equipped with a vapor detector that will automatically start the ventilation system at the ventilation rate specified in Section 1105.6.3, and that will actuate an alarm at a detection level not to exceed 1,000 ppm.~~

~~2. Machinery rooms conforming to the Class 1, Division 2, hazardous location classification requirements of NFPA 70.~~

1106.3 ~~Flammable~~ 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.

~~**Exception:** *Machinery rooms* for systems containing Group A2L *refrigerants* that are provided with ventilation in accordance with Section 1106.4.~~

~~**1106.5 Special requirements for Group A2L refrigerant machinery rooms.** Machinery rooms for systems containing Group A2L refrigerants shall comply with Sections 1106.5.1 through 1106.5.3.~~

~~**Exception:** Machinery rooms conforming to the Class I, Division 2, hazardous location classification requirements of NFPA 70 are not required to comply with Sections 1106.5.1 and 1106.5.2.~~

1106.4 Group A2L and B2L Refrigerant. *Machinery rooms* for Group A2L and B2L refrigerant shall comply with Sections 1106.4.1 through Section 1106.4.3.

~~**1106.4.1 Ventilation system activation.** Ventilation shall be activated by the refrigerant detection system in the *machinery room*. Refrigerant detection systems shall be in accordance with Section 605.8 of the International Fire Code and all of the following:~~

~~1. The detectors shall activate at or below a refrigerant concentration of 25 percent of the LFL.~~

~~2. Upon activation, the detection system shall activate the emergency ventilation system required by Section 1106.4.2.~~

~~3. The detection, signaling and control circuits shall be supervised.~~

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.

~~**1106.4.2 Emergency ventilation system.** An emergency ventilation system shall be provided at the minimum exhaust rate specified in ASHRAE 15 or Table 1106.4.2. Shutdown of the emergency ventilation system shall be by manual means.~~

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.

TABLE 1106.4.2 GROUP A2L and B2L DETECTOR ACTIVATION

Activation Level	Maximum Response Time (seconds)	ASHRAE 15 Ventilation Level	Alarm Reset	Alarm Type
Less than or equal to the OEL in Table 1103.1	300	1	Automatic	Trouble
Less than or equal to the refrigerant concentration level in Table 1103.1	15	2	Manual	Emergency

~~**TABLE 1106.4.2 MINIMUM EXHAUST RATES**~~

~~REFRIGERANT~~	~~Q(m/sec)~~		~~Q(cfm)~~
~~R32~~	~~15.4~~		~~32,600~~
~~R143~~	~~13.6~~		~~28,700~~
~~R444A~~	~~6.46~~		~~13,700~~
~~R444B~~	~~10.6~~		~~22,400~~
~~R445A~~	~~7.83~~		~~16,600~~
~~R446A~~	~~23.9~~		~~50,700~~
~~R447A~~	~~23.8~~		~~50,400~~
~~R451A~~	~~7.04~~		~~15,000~~
~~R451B~~	~~7.05~~		~~15,000~~
~~R1234yf~~	~~7.80~~		~~16,600~~
~~R1234ze(E)~~	~~5.92~~		~~12,600~~

~~**1106.4.3 Emergency ventilation system discharge**. The emergency ventilation system point of discharge to the atmosphere shall be located outside of the structure at not less than 15 feet (4572 mm) above the adjoining grade level and not less than 20 feet (6096 mm) from any window, *ventilation* opening or *exit*.~~

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

Section 1107 is deleted and replaced in its entirety. For clarity, only the new text is shown.

SECTION 1107 PIPING MATERIAL

1107.1 Piping. Refrigerant piping material shall conform to the requirements in this section.

1107.2 Used Materials. Used pipe, fittings, valves and other materials that are to be reused shall be clean and free of 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 *refrigeration system*. Materials shall be suitable for the type of refrigerant and type of lubricant in the *refrigeration 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).

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.

1107.4.1 Steel pipe Group 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 inch 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.

TABLE 1107.5 REFRIGERANT PIPE FITTINGS

FITTING MATERIAL	STANDARD
Aluminum	ASTM B361
Copper and Copper Alloy (Brass)	ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.24, ASME B16.26, ASME B16.50
Steel	ASTM A105, ASTM A181, ASTM A193, ASTM A234, ASTM A420, ASTM A707

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.

TABLE 1107.5.1 COPPER BRAZED SWAGED CUP DEPTHS

Fitting Size (Inch)	Minimum Depth (Inch)	Maximum Depth (Inch)
1/8	0.15	0.23
3/16	0.16	0.24
1/4	0.17	0.26
3/8	0.20	0.30

1/2	0.22	0.33
5/8	0.24	0.36
3/4	0.25	0.38
1	0.28	0.42
1-1/4	0.31	0.47
1-1/2	0.34	0.51
2	0.40	0.60
2-1/2	0.47	0.71
3	0.53	0.80
3-1/2	0.59	0.89
4	0.64	0.96

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

Section 1108 is deleted and replaced in its entirety. For clarity, only the new text is shown.

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 refrigeration 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 of 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.

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. 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 and a maximum pressure of 3.0 psi. 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 refrigeration systems using Group A1 refrigerant and having a pressure of less than or equal to 200 psi (1378 kPa).

1108.3.4 Threaded joints. Threads shall conform to ASME B1.20.1, ASME B1.20.3, ASME B1.13M, or ASME B1.1. Thread lubricant, pipe-joint compound, or thread tape shall be applied on the external threads only and shall be approved for application on the piping material.

1108.3.5 Welded joints. Joint surfaces to be welded shall be cleaned by an approved procedure. Joints shall be welded with an approved filler metal.

1108.4 Aluminum tube. Joints between aluminum tubing or fittings shall be brazed, mechanical, press-connect, or welded joints conforming to Section 1108.3.

1108.6 Copper pipe. Joints between copper or copper-alloy pipe or fittings shall be brazed, mechanical, press-connect, soldered, threaded, or welded joints conforming to Section 1108.3.

1108.7 Copper tube. Joints between copper or copper-alloy tubing or fittings shall be brazed, flared, mechanical, press-connect, or soldered joints.

1108.8 Steel pipe. Joints between steel pipe or fittings shall be mechanical joints, threaded, press-connect, or welded joints conforming to Section 1108.3.

1108.9 Steel tube. Joints between steel tubing or fittings shall be flared, mechanical, press-connect, or welded joints conforming to Section 1108.3.

SECTION 1109 REFRIGERANT PIPE INSTALLATION

1109.1 General. Refrigerant piping installations 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 1109.2.6. Refrigerant piping for group A2L and B2L shall also comply with the requirements of Section 1109.3. Refrigerant piping for group 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.

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

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. Refrigerant piping installed in concrete floors shall be encased in pipe, conduit, or ducts. The piping shall be protected to prevent damage from vibration, stress and corrosion.

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.

1109.2.6 Exposed piping surface temperature. Exposed piping having surface temperatures greater than 120°F (49°C) or less than 5°F (-15°C) with *ready access* to nonauthorized *personnel* shall be protected from contact or shall have thermal insulation that limits the exposed insulation surface temperature to a range of 5°F (-15°C) to 120°F (49°C).

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 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."

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

1109.3.1 Protection against physical damage. In addition to the requirements of Section 305.5, aluminum, copper and steel tube used for Group A2, A3, B2, and B3 refrigerants and located in concealed locations where tubing is installed in studs, joists, rafters or similar member spaces, and located less than $1^1/_4$ inches (38 mm) from the nearest edge of the member, shall be continuously protected by shield plates. Protective steel shield plates shall cover the area of the tube plus the area extending not less than 2 inches (51 mm) beyond both sides of the tube.

1109.3.1.1 Shield plates. Shield plates shall be of steel material having a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 gage).

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 (sq. in.)	Minimum Ventilation Velocity (feet per minute)
≤ 20	100
> 20 - ≤ 250	200
> 250 - ≤ 1250	300
> 1250	400

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

1109.5 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, 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.

1109.6 Stress and strain. Refrigerant piping shall be installed so as to prevent strains and stresses that exceed the structural strength of the pipe. Where necessary, provisions shall be made to protect piping from damage resulting from vibration, expansion, contraction, and structural settlement.

1109.8 Stop valves. Stop valves shall be installed in specified locations in accordance with Sections 1109.8.1 and 1109.8.2. Stop valves shall be supported in accordance with Section 1109.8.3 and identified in accordance with Section 1109.8.4.

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 pump out of the refrigerant using either portable or permanently installed refrigerant recovery equipment.
3. Self-contained listed and labeled systems.

1109.8.1 Refrigeration systems containing more than 6.6 pounds (3.0 kg) of refrigerant. Stop valves shall be installed in the following locations on refrigeration 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.

1109.8.2 Refrigeration systems containing more than 100 pounds (45 kg) of refrigerant. In addition to stop valves required by Section 1109.8.1, refrigeration 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. Refrigeration systems utilizing nonpositive displacement compressors.

1109.8.3 Stop valve support. Stop valves shall be supported to prevent detrimental stress and strain on the refrigerant piping system. The piping system shall not be utilized to support stop valves on copper tubing or aluminum tubing 1 inch (25.4 mm) OD or larger in diameter.

1109.8.4 Identification. Stop valves shall be identified where their intended purpose is not obvious. Where valves are identified by a numbering or lettering system, legend(s) or key(s) for the valve identification shall be located in the room containing the indoor refrigeration equipment. The minimum height of lettering of the identification label shall be ½ inch (12.7 mm).

SECTION 1110 REFRIGERANT PIPING SYSTEM TEST

1110.1 General. Refrigerant piping systems that are erected in the field, shall be pressure tested for strength and leak tested for tightness, in accordance with the requirements of this section, after installation and before being placed in operation, Tests shall include both the high and low-pressure sides of each system.

> **Exception:** Listed and labeled equipment, including compressors, condensers, vessels, evaporators, gas bulk storage tanks, safety devices, pressure gauges and control mechanisms, shall not be required to be tested.

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 Field test gases. The medium used for field pressure testing the refrigeration system shall be one of the following inert gases: oxygen-free nitrogen, helium argon or premixed nonflammable oxygen-free nitrogen with a tracer gas of hydrogen or helium. For R-744 refrigeration systems, carbon dioxide shall be allowed as the test medium. For R-718 refrigeration systems, water shall be allowed as the test medium.

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.

1110.4 Factory test procedure. Factory tests shall be performed with dry nitrogen or other nonflammable, nonreactive, dried gas. Oxygen, air or mixtures containing them shall not be used. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gauge on the outlet side. The pressure-relief device shall be set above the test pressure but low enough to prevent permanent deformation of the refrigeration system's components.

Exceptions:

1. Mixtures of dry nitrogen, inert gases or a combination of them with Class 1 refrigerant in concentrations of a refrigerant weight fraction (mass fraction) not exceeding 5 percent shall be permitted for tests.
2. Mixtures of dry nitrogen, inert gases or a combination of them with Class 2L, Class 2 and Class 3 refrigerants in concentrations not exceeding the lower of a refrigerant weight fraction (mass fraction) of 5 percent or 25 percent of the LFL shall be permitted for tests.
3. Compressed air without added refrigerants shall be permitted for tests, provided that the refrigeration system is subsequently evacuated to less than 1,000 microns (0.1333 kPa) before charging with refrigerant. The required evacuation level is atmospheric pressure for refrigeration systems using R-718 (water) or R-744 (carbon dioxide) as the refrigerant.
4. Systems erected on the premises using Group A1 refrigerant and with copper tubing not exceeding 0.62 of an inch (15.7 mm) outside diameter shall be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at not less than 68°F (20°C).

1110.5 Test apparatus. The means used to pressurize the refrigerant piping system shall have on its outlet side, a test pressure measuring device and either a pressure-limiting device or a pressure-reducing device. The test pressure measuring device shall have an accuracy of ±3 percent or less of the test pressure, and shall have a resolution of 5% or less of the test pressure.

1110.6 Piping system strength test. Refrigerating system components and refrigerant piping shall be tested in accordance with ASME B31.5 or this section. Separate tests for isolated portions of the system are permitted provided that all required portions are tested at least once. Pressurize with test gas for a minimum of 10 minutes to not less than the lower of (a) the lowest design pressure for any system component, or (b) the lowest value of set pressure for any pressure relief devices in the system. The design pressures for determination of test pressure shall be the pressure identified on the label nameplate of the condensing unit, compressor, compressor unit, pressure vessel, or other system component with a nameplate. A passing test result shall have no rupture or structural failure of any system component or refrigerant piping. Refrigerant piping and tubing greater than 3/4 inches in diameter shall be tested in accordance with ASHRAE 15.

1110.8 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 refrigeration 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 refrigeration 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.

Chapter 12 – Hydronic Piping

1201.1 Scope. The provisions of this chapter shall govern the construction, installation, *alteration* and repair of hydronic piping systems. This chapter shall apply to hydronic piping systems that are part of heating, ventilation and air-conditioning systems. Such piping systems shall include steam, hot water, radiant heating, radiant cooling, chilled water, steam condensate, ~~and~~ ground source heat pump loop systems and snow- and ice-melting. Potable cold and hot water distribution systems shall be installed in accordance with the *International Plumbing Code*.

TABLE 1202.4 HYDRONIC PIPE

MATERIAL	STANDARD (see Chapter 15)
Acrylonitrile butadiene styrene (ABS) plastic pipe	~~ASTM D1527;~~ ASTM F2806
Chlorinated polyvinyl chloride (CPVC) plastic pipe	ASTM D2846; ASTM F441; ASTM F442
Chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC)	ASTM F2855
Copper or copper-alloy pipe	ASTM B42; ASTM B43; ASTM B302
Copper or copper-alloy tube (Type K, L or M)	ASTM B75; ASTM B88; ASTM B135; ASTM B251
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pressure pipe	ASTM F1281; CSA CAN/CSA-B-137.10
Cross-linked polyethylene (PEX) tubing	ASTM F876; ASTM F3253; CSA B137.5
Ductile iron pipe	AWWA C115/A21.15; AWWA C151/A21.51
~~Lead pipe~~	~~FS WW-P-325B~~
Polyethylene/aluminum/polyethylene (PE-AL-PE) pressure pipe	ASTM F1282; CSA B137.9
Polypropylene (PP) plastic pipe	ASTM F2389
Polyvinyl chloride (PVC) plastic pipe	ASTM D1785; ASTM D2241
Raised temperature polyethylene (PE-RT)	ASTM F2623; ASTM F2769; CSA B137.18

Steel pipe	ASTM A53; ASTM A106
Steel tubing	ASTM A254
Stainless Steel pipe	ASTM A269; ASTM A312; ASTM A778
Stainless Steel tubing	ASTM A269; ASTM A312; ASTM A778

TABLE 1202.5 HYDRONIC PIPE FITTINGS

MATERIAL	STANDARD (see Chapter 15)
Copper and copper alloys	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.24; ASME B16.26; ASME B16.51; ASSE 1061; ASTM F1974; ASTM F3226
CPVC	ASSE 1061; ASTM D2846; ASTM F438; ASTM F439
Ductile iron and gray iron	ANSI/AWWA C110/A21.10; ASTM A395; ASTM A536; ASTM F1476; ASTM F1548; AWWA C153/A21.53
Ductile iron	ANSI/AWWA C153/A21.53
Gray iron	ASTM A126
Malleable iron	ASME B16.3
PE-RT fittings	ASSE 1061; ASTM D3261; ASTM F1807; ASTM F2098; ASTM F2159; ASTM F2735; ASTM F2769; ASTM F3347; ASTM F3348; CSA B137.1; CSA B137.18
PEX fittings	ASSE 1061; ASTM F877; ASTM F1807; ASTM F1960; ASTM F2080; ASTM F2159; ASTM F3253; ASTM F3347; ASTM F3348
Plastic	ASTM D2466; ASTM D2467; ~~ASTM F438; ASTM F439;~~ ASTM D2846; ASTM F877; ASTM F2389; ASTM F2735
Steel	ASME B16.5; ASME B16.9; ASME B16.11; ASME B16.28; ASTM A53; ASTM A106; ASTM A234; ASTM A395; ASTM A420; ASTM A536; ASTM F1476; ASTM F1548; ASTM F3226
Stainless Steel	ASTM A269; ASTM A312; ASTM A778; ASTM F3226

1203.3.4 Solvent-cemented joints. Joint surfaces shall be clean and free from moisture. An *approved* primer shall be applied to CPVC and PVC pipe-joint surfaces. Joints shall be made while the cement is wet. Solvent cement conforming to the following standards shall be applied to all joint surfaces:

1. ASTM D2235 for ABS joints.
2. ASTM F493 for CPVC joints.
3. ASTM D2564 for PVC joints.

CPVC joints shall be made in accordance with ASTM D2846.

Exception: For CPVC pipe joint connections, a primer is not required where all of the following conditions apply:

1. The solvent cement used is third-party certified as conforming to ASTM F493.
2. The solvent cement is yellow or green in color.
3. The solvent cement is used only for joining $^{1}/_{2}$-inch (12.7 mm) through 2-inch (51 mm) diameter CPVC pipe and fittings.
4. The CPVC pipe ~~and~~ or fittings are manufactured in accordance with ASTM D2846.

1203.7 CPVC plastic pipe. Joints between CPVC plastic pipe or fittings shall be mechanical, solvent-cemented or threaded joints conforming to Section 1203.3.

1203.8 CPVC/AL/CPVC plastic pipe. Joints between CPVC/AL/CPVC plastic pipes or fittings shall be mechanical, solvent-cemented or threaded joints conforming to Section 1203.3

~~**1203.8 Polybutylene plastic pipe and tubing.** Joints between polybutylene plastic pipe and tubing or fittings shall be mechanical joints conforming to Section 1203.3 or heat-fusion joints conforming to Section 1203.8.1.~~

~~**1203.8.1 Heat-fusion joints.** Joints shall be of the socket-fusion or butt-fusion type. Joint surfaces shall be clean and free from moisture. Joint surfaces shall be heated to melt temperatures and joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM D3309.~~

1203.9.3 Push-fit ~~joints~~ fittings. Push-fit ~~joints that create a seal on the outside diameter of the tubing shall not~~ fittings shall comply with ASSE 1061 and be used with ~~tubing that has an ethylene vinyl alcohol copolymer (EVOH) oxygen barrier layer~~ PEX tubing that is rated for use with such fittings by the tubing manufacturer.

1203.13 Stainless Steel Pipe. Joints between stainless steel pipe or fittings shall be mechanical joints that are made with an approved elastomeric seal, or shall be threaded or welded joints conforming to Section 1203.3.

1203.14 Stainless Steel Tubing. Joints between stainless steel tubing or fittings shall be mechanical or welded joints conforming to Section 1203.3.

~~**1203.14.3**~~ **1203.16.3Push-fit ~~joints~~ fittings**. Push-fit ~~joints that create a seal on the outside diameter of the tubing shall not be used with tubing that has an ethylene vinyl alcohol copolymer (EVOH) oxygen barrier layer~~ fittings shall comply with ASSE 1061 and be used with PE-RT tubing that is rated for use with such fittings by the tubing manufacturer.

1205.1 Where required. Shutoff valves shall be installed in hydronic piping systems in the locations indicated in Sections 1205.1.1 through 1205.1.6. Access shall be provided to all full open valves and shutoff valves.

1209.1 Materials. Piping for heating panels shall be standard-weight steel pipe, Type L copper tubing, ~~polybutylene~~ or ~~other~~ *approved* plastic pipe or tubing rated at 100 psi (689 kPa) at 180°F (82°C).

~~**1209.3.3 Polybutylene joints.** Polybutylene pipe and tubing shall be installed in continuous lengths or shall be joined by heat fusion in accordance with Section 1203.9.1.~~

1209.5 ~~Thermal barrier~~ Insulation and thermal break required. Radiant floor heating systems shall be provided with insulation and a thermal ~~barrier~~ break in accordance with Sections 1209.5.1 and 1209.5.2. Insulation R-values for slab-on-grade and suspended floor installation shall be in accordance with the International Energy Conservation Code.

> **Exception:** Insulation shall not be required in engineered systems where it can be demonstrated that the insulation will decrease the efficiency or have a negative effect on the installation.

1209.5.2 ~~Thermal barrier~~ Insulation material marking. Insulating materials utilized in ~~thermal barriers~~ radiant floor heating systems shall be installed such that the manufacturer's R-value mark is readily observable upon inspection.

1209.6 Radiant tubing placement. Hydronic tubing to be embedded for the purpose of radiant heating or cooling shall be installed in accordance with the manufacturer's instructions and with the tube layout and spacing in accordance with the system design. Individual tubing circuit lengths shall be installed with a variance of not more than ±10 percent from the design.

1209.6.1 Radiant tubing circuit length. The maximum circuit length of radiant tubing from a supply-and-return manifold shall not exceed the lengths specified by the system design or, in the absence of manufacturer's specifications, the lengths specified in Table 1209.6.1.

TABLE 1209.6.1 MAXIMUM CIRCUIT LENGTH OF RADIANT TUBING FROM A SUPPLY-AND-RETURN MANIFOLD ARRANGEMENT

NOMINAL TUBE SIZE	MAXIMUM CIRCUIT LENGTH (FEET)
1/4	125
5/16	200
3/8	250

1/2	300
5/8	400
3/4	500
1	750

For SI units: 1 foot = 304.8 mm

1209.6.2 Radiant tubing circuit tags. Each individual radiant tubing circuit shall have a tag or label securely affixed to each manifold outlet to indicate the length of each circuit and the areas served.

1209.6.3 Radiant tubing drawings. The radiant tubing drawings and design report shall be provided to the *building* owner or the designated representative of the *building* owner.

1209.7 Snow- and ice-melt tubing placement. Hydronic tubing to be embedded for the purpose of snow- and ~~&~~ ice-melt systems shall be installed in accordance with the manufacturer's installation instructions and with the tube layout and spacing in accordance with the system design.

1209.7.1 Snow-and ice-melt tubing circuit length. The maximum circuit length of snow- and ice-melt tubing from a supply-and-return manifold shall not exceed the lengths specified by the system design or, in the absence of manufacturer's specifications, the lengths specified in Table 1209.7.1. Individual tubing circuit lengths shall be installed with a variance of not more than ±10 percent from the design.

TABLE 1209.7.1 MAXIMUM CIRCUIT LENGTH OF SNOW- AND ICE-MELT TUBING FROM A SUPPLY-AND-RETURN MANIFOLD ARRANGEMENT

NOMINAL TUBE SIZE	MAXIMUM CIRCUIT LENGTH (FEET)
1/2	140
5/8	250
3/4	325
1	475

For SI units: 1 foot = 304.8 mm

1209.7.2 Snow- and ice-melt tubing drawings. The snow- and ice-melt tubing drawings and design report shall be provided to the *building* owner or the designated representative of the *building* owner.

TABLE 1210.4 GROUND-SOURCE LOOP PIPE

MATERIAL	STANDARD (see Chapter 15)
Chlorinated polyvinyl chloride (CPVC)	ASTM D2846; ASTM F441; ASTM F442
Cross-linked polyethylene (PEX)	ASTM F876; ASTM F3253; CSA B137.5; CSA C448; NSF 358-3
Polyethylene/aluminum/polyethylene (PE-AL-PE) pressure pipe	ASTM F1282; CSA B137.9
High-density polyethylene (HDPE)	ASTM D2737; ASTM D3035; ASTM F714; AWWA C901; CSA B137.1; CSA C448; NSF 358-1
Polypropylene (PP-R)	ASTM F2389; CSA B137.11; NSF 358-2
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2241
Raised temperature polyethylene (PE-RT)	ASTM F2623; ASTM F2769; CSA B137.18; CSA C448; NSF 358-4

TABLE 1210.5 GROUND-SOURCE LOOP PIPE FITTINGS

PIPE MATERIAL	STANDARD (see Chapter 15)
Chlorinated polyvinyl chloride (CPVC)	ASTM D2846; ASTM F437; ASTM F438; ASTM F439; CSA B137.6
Cross-linked polyethylene (PEX)	ASTM F877; ASTM F1807; ASTM F1960; ASTM F2080; ASTM F2159; ASTM F2434; ASTM F3347; ASTM F3348; CSA B137.5; CSA C448; NSF 358-3
Polyethylene/aluminum/polyethylene (PE-AL-PE)	ASTM F1282; ASTM F2434; CSA B137.9
High-density polyethylene (HDPE)	ASTM D2683; ASTM D3261; ASTM F1055; CSA B137.1; CSA C448; NSF 358-1
Polypropylene (PP-R)	ASTM F2389; CSA B137.11; NSF 358-2
Polyvinyl chloride (PVC)	ASTM D2464; ASTM D2466; ASTM D2467; CSA B137.2; CSA B137.3
Raised temperature polyethylene (PE-RT)	ASTM D3261; ASTM F1807; ASTM F2098; ASTM F2159; ASTM F2735; ASTM F2769; ASTM F3347; ASTM F3348; CSA B137.1; CSA B137.18; CSA C448; NSF 358-4

1210.6 Joints. Joints and connections shall be of an *approved* type. Joints and connections shall be tight for the pressure of the ground-source loop system. Joints used underground shall be of an *approved* type for buried applications.

1210.6.2 Preparation of pipe ends. Pipe shall be cut square~~, be reamed,~~ and be free of burrs and obstructions. ~~CPVC, PE, and PVC pipe shall be chamfered.~~ Pipe ends shall have full-bore openings and shall ~~not be undercut.~~be prepared in accordance with manufacturer's instructions.

1210.8 Installation. Piping, valves, fittings, and connections shall be installed in accordance with ANSI/CSA/IGSHPA C448 and the ~~conditions of approval~~ manufacturer's instructions.

Chapter 13 – Fuel Oil Piping and Storage

1301.4 Fuel tanks, piping, fittings and valves. The tank, piping, fittings and valves for *appliances* burning oil shall be installed in accordance with the requirements of this chapter. Where an oil burner is served by a tank, any part of which is above the level of the burner inlet connection and where the fuel supply line is taken from the top of the tank, an *approved* antisiphon valve or other siphon-breaking device shall be installed in lieu of the shutoff valve.

TABLE 1302.3 FUEL OIL PIPING AND FITTINGS

MATERIAL	STANDARD
Copper or copper-alloy pipe and fittings	ASTM B42; ASTM B43; ASTM B302; ASTM F3226
Copper or copper-alloy tubing and fittings (Type K, L or M)	ASTM B75; ASTM B88; ASTM B280; ASME B16.51; ASTM F3226
Labeled pipe	(See Section 1302.4)
Nonmetallic pipe	ASTM D2996
Steel and stainless steel pipe and fittings	ASTM A53; ASTM A106; ASTM A312; ASTM F3226

Steel and stainless steel tubing and fittings	ASTM A254; ASTM A539; ASTM A269; ASTM F3226

1302.8 Flexible connectors and hoses. Flexible connectors and hoses shall be listed and labeled ~~in accordance with UL 536~~ as being acceptable for the intended application for flammable and combustible liquids.

1302.9 Piping systems. Above-ground piping systems shall be listed and labeled in accordance with UL 1369. Underground piping systems shall be listed and labeled in accordance with UL 971A.

1303.3 Joint preparation and installation. Where required by Sections 1303.4 through 1303.9, the preparation and installation of brazed, mechanical, threaded, press-connect and welded joints shall comply with Sections 1303.3.1 through ~~1303.3.4.~~1303.3.5.

1303.3.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. ~~Press-connect joints shall conform to one of the standards listed in Table 1302.3.~~

1303.3.5 Press-Connect joints. *Press-connect joints* shall be installed in accordance with the manufacturer's instructions and shall conform to one of the standards listed in Table 1302.3.

1303.4 Copper or copper-alloy pipe. Joints between copper or copper-alloy pipe or fittings shall be brazed, mechanical, threaded, press-connect or welded joints complying with Section 1303.3.

1303.5 Copper or copper-alloy tubing. Joints between copper or copper-alloy tubing or fittings shall be brazed, mechanical ~~joints complying with Section 1303.3~~, or press-connect joints ~~that conform to one of the standards in Table 1302.3 or flared joints. Flared joints shall be made by a tool designed for that operation~~ complying with Section 1303.3.

1303.7 Steel and stainless steel pipe. Joints between steel or stainless steel pipe or fittings shall be threaded, press-connect or welded joints complying with Section 1303.3 or mechanical joints complying with Section 1303.7.1.

1303.7.1 Mechanical joints. Joints shall be made with an approved elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical joints shall be installed outdoors, underground, unless otherwise approved.

1303.8 Steel and stainless steel tubing. Joints between steel or stainless steel tubing or fittings shall be mechanical, press-connect or welded joints complying with Section 1303.3.

Chapter 14 – Solar Thermal Systems

1404.1 Collectors. Factory-built solar thermal collectors shall bear a label showing the manufacturer's name and ~~address, model number and~~ serial number or certification number.

1402.8.1.2 Rooftop-mounted solar thermal collectors and systems. The roof shall be constructed to support the loads imposed by roof-mounted solar collectors. Where mounted on or above the roof covering, the collector array ~~and supporting construction~~, mounting systems and their attachments to the roof shall be constructed of noncombustible materials or fire-retardant-treated wood conforming to the International Building Code to the extent required for the type of roof construction of the building to which the collectors are accessory.

Chapter 15 – Reference Standards

ACCA

ANSI/ACCA 10 Manual SPS - 2010 RA 2017: HVAC Design for Swimming Pools and Spas

ASHRAE

~~170—2017~~ 170-2021 Ventilation of Health Care Facilities

ASTM

A269-15: Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A312-17: Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A333-18: Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and other Applications with required Notch Toughness

ASTM A554-16: Standard Specification for Welded Stainless Steel Mechanical Tubing

ASTM A778/A778M-16: Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

F2855—12: Standard Specification for Chlorinated Poly(Vinyl Chloride)/Aluminum/Chlorinated Poly(Vinyl Chloride) (CPVC-AL-CPVC) Composite Pressure Tubing

F3226-16: Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems

F3253—2017: Standard Specification for Crosslinked Polyethylene (PEX) Tubing with Oxygen Barrier for Hot - and Cold - Water Hydronic Distribution Systems

F3347-20a: Standard Specification for Metal Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross- linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing

ASTM F3348-20b: Standard Specification for Plastic Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing

CSA

ANSI/CSA/IGSHPA C448 Series—16:

IIAR

ANSI/IIAR CO2-2021: Safety Standard for Closed-Circuit Carbon Dioxide Refrigeration Systems

ANSI/IIAR 6-2019: Standard for Inspection, Testing, and Maintenance of Closed-Circuit Ammonia Refrigeration Systems

NSF

NSF 358-4-2017: Polyethylene of raised temperature (PE-RT) pipe and fittings for water-based ground-source (geothermal) heat pump systems

UL

921-20: Standard for Commercial Dishwashers

UL1370-11: Unvented Alcohol Fuel Burning Decorative Appliances, with revisions through March 25, 2016

2021-15: Fixed and Location-Dedicated Electric Room Heaters (with revisions through December 14, 2016)

8782-17: Outline of Investigation for Pollution Control Units for Commercial Cooking

UL/CSA 60335-2-40—~~17~~ 2019: Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers

UL 60335-2-89-17: Household and Similar Electrical Appliances - Safety - Part 2-89: Particular Requirements for Commercial Refrigerating Appliances with an Incorporated or Remote Refrigerant Unit or Compressor

[NY]Appendix C –Reserved ~~Board of Appeals~~

[NY]APPENDIX C RESERVED ~~BOARD OF APPEALS~~

~~SECTION A101 GENERAL~~

~~**A101.1 Scope**. A board of appeals shall be established within the jurisdiction for the purpose of hearing applications for modification of the requirements of this code pursuant to the provisions of Section 109 (Means of Appeals). The board shall be established and operated in accordance with this section, and shall be authorized to hear evidence from appellants and the code official pertaining to the application and intent of this code for the purpose of issuing orders pursuant to these provisions.~~

~~**A101.2 Application for appeal**. Any person shall have the right to appeal a decision of the code official to the board. An application for appeal shall be based on a claim that the intent of this code or the rules legally adopted hereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The application shall be filed on a form obtained from the code official within 20 days after the notice was served.~~

~~**A101.2.1 Limitation of authority**. The board shall not have authority to waive requirements of this code or interpret the administration of this code.~~

~~**A101.2.2 Stays of enforcement.** Appeals of notice and orders, other than Imminent Danger notices, shall stay the enforcement of the notice and order until the appeal is heard by the board.~~

~~[A] 109.2 A101.3 Membership of board. The board of appeals shall consist of five voting members appointed by the chief appointing authority as follows: one for 5 years; one for 4 years; one for 3 years; one for 2 years; and one for 1 year. Thereafter, each new of the jurisdiction. Each member shall serve for 5 [INSERT NUMBER OF YEARS] years or until a successor has been appointed. The board member's terms shall be staggered at intervals, so as to provide continuity. The code official shall be an ex officio member of said board but shall not vote on any matter before the board.~~

~~[A] 109.2.1 A101.3.1 Qualifications. The board of appeals shall consist of five individuals, who are qualified by experience and training to pass on matters pertaining to building construction and are not employees of the jurisdiction. one from each of the following professions or disciplines.~~

~~1.Registered design professional who is a registered architect; or a builder or superintendent of building construction with not less than 10 years' experience, 5 of which shall have been in responsible charge of work.~~

~~2.Registered design professional with structural engineering or architectural experience.~~

~~3.Registered design professional with mechanical and plumbing engineering experience; or a mechanical contractor with not less than 10 years' experience, 5 of which shall have been in responsible charge of work.~~

~~4.Registered design professional with electrical engineering experience; or an electrical contractor with not less than 10 years' experience, 5 of which shall have been in responsible charge of work.~~

~~5.Registered design professional with fire protection engineering experience; or a fire protection contractor with not less than 10 years' experience, 5 of which shall have been in responsible charge of work.~~

~~[A] 109.2.2 A101.3.2 Alternate members. The chief appointing authority shall is authorized to appoint two alternate members who shall be called by the board chairman chairperson to hear appeals during the absence or disqualification of a member. Alternate members shall possess the qualifications required for board membership, and shall be appointed for 5 years, the same term or until a successor has been appointed.~~

~~A101.3.3 Vacancies. Vacancies shall be filled for an unexpired term in the same manner in which original appointments are required to be made.~~

~~[A] 109.2.3 A101.3.4 Chairman. Chairperson. The board shall annually select one of its members to serve as chairman. chairperson.~~

~~[A] 109.2.5 A101.3.5 Secretary. The chief administrative officer appointing authority shall designate a qualified clerk to serve as secretary to the board. The secretary shall file a detailed record of all proceedings in the office of the chief administrative officer. which shall set forth the reasons for the board's decision, the vote of each member, the absence of a member and any failure of a member to vote.~~

[A] 109.2.4 A101.3.6 Disqualification Conflict of member. interest. A member shall not hear an appeal in which that member has a with any personal, professional or financial interest in a matter before the board shall declare such interest and refrain from participating in discussions, deliberations and voting on such matters.

[A] 109.2.6 A101.3.7 Compensation of members. Compensation of members shall be determined by law.

A101.3.8 Removal from the board. A member shall be removed from the board prior to the end of their terms only for cause. Any member with continued absence from regular meeting of the board may be removed at the discretion of the chief appointing authority.

[A] 109.4.1 A101.4 Procedure. Rules and procedures. The board shall adopt and make available to the public through the secretary procedures under which a hearing will be conducted. establish policies and procedures necessary to carry out its duties consistent with the provisions of this code and applicable state law. The procedures shall not require compliance with strict rules of evidence, but shall mandate that only relevant information be received. presented.

[A] 109.3 A101.5 Notice of meeting. The board shall meet upon notice from the chairman chairperson, within 10 days of the filing of an appeal, or at stated periodic meetings. intervals.

[A] A101.5.1 Open hearing. All hearings before the board shall be open to the public. The appellant, the appellant's representative, the code official and any person whose interests are affected shall be given an opportunity to be heard.

A101.5.2 Quorum. Three members of the board shall constitute a quorum.

[A] 109.5 A101.5.3 Postponed hearing. When five members are not present to hear an appeal, either the appellant or the appellant's representative shall have the right to request a postponement of the hearing.

A101.6 Legal counsel. The jurisdiction shall furnish legal counsel to the board to provide members with general legal advice concerning matters before them for consideration. Members shall be represented by legal counsel at the jurisdiction's expense in all matters arising from service within the scope of their duties.

[A] 109.6 A101.7 Board decision. The board shall only modify or reverse the decision of the code official by a concurring vote of three or more members.

[A] 109.6.1 A101.7.1 Resolution. The decision of the board shall be by resolution. Certified copies shall be Every decision shall be promptly filed in writing in the office of the code official within three days and shall be open to the public for inspection. A certified copy shall be furnished to the appellant or the appellant's representative and to the code official.

[A] 109.6.2 A101.7.2 Administration. The code official shall take immediate action in accordance with the decision of the board.

[A] 109.7 A101.8 Court review. Any person, whether or not a previous party of the appeal, shall have the right to apply to the appropriate court for a writ of certiorari to correct errors of law. Application for review shall be made in the manner and time required by law following the filing of the decision in the office of the chief administrative officer.

[NY] Appendix D – RESERVED Clean Air Delivery

[NY]Appendix D - RESERVED Clean Air Delivery

***User Note**. The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

***About this appendix**: Appendix D provides criteria for an increased protection level for occupant health by delivering clean air in occupied areas of certain buildings.*

D101 Clean Air Delivery Capability. In Groups A, B, E and I occupancies, each mechanical system shall meet the requirements in Section D101.1.

Exception: Occupiable spaces where 100% of the supply air meets High-efficiency Particulate Air filtration.

D101.1 Airflow for Increased Filtration. Mechanical systems shall be sized to accommodate a design airflow at a total static pressure drop which assumes the utilization of a supply air filter with a Minimum Efficiency Reporting Value (MERV) of no less than 13.

[NY] Appendix E – RESERVED Clean Air Delivery and Monitoring

[NY] Appendix E - RESERVED Clean Air Delivery and Monitoring

***User Note**. The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

***About this appendix**: Appendix D provides criteria for an increased protection level for occupant health by delivering and monitoring clean air in occupied areas of the certain buildings.*

E101.1 Demand control ventilation. Group A, B, E and I occupancies shall be equipped with a minimum of one carbon dioxide sensor for every 500 square feet of occupiable space. Carbon dioxide sensors installed in accordance with this section shall meet the requirements in Sections E101.1.1 and E101.1.3. Mechanical equipment serving each zone(s) shall be equipped with controls which meet the requirements in Section D101.2.

> **Exception:** Occupiable zones less than 500 square feet.

E101.1.1 Carbon dioxide sensor performance specifications. Each carbon dioxide sensor installed in accordance with Section E101.1 shall meet the following carbon dioxide measurement specifications as certified by the equipment manufacturer:

1. Range lower bound less than or equal to 400 parts per million
3. Range upper bound greater than or equal to 2,000 parts per million
4. Accuracy within ±75 parts per million at a reading of 1,000 parts per million
5. Output resolution less than or equal to 20 parts per million

E101.1.2 Mechanical system controls. Controls for the mechanical equipment installed in accordance with Section E101 shall:

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

E101.1.3 Carbon dioxide detection threshold level. The default detection threshold level for carbon dioxide measurement above which triggers an alert in accordance with Section E101.1.4 shall be set to 1,100 parts per million. The end user can modify the detection threshold level based on specific operations and needs.

E101.1.4 Carbon dioxide detection threshold level exceeded. When carbon dioxide levels exceed the detection threshold level established in Section E101.1.3, the mechanical equipment shall modify the outdoor airflow rate as required in Section E101.1.2. When the carbon dioxide concentration remains above the detection threshold level for a period of 30 minutes or more, the occupants in the zone shall be alerted by approved audible and visual notification devices or through a building monitoring system.