North Carolina State Building Code

Volume III – MECHANICAL
1991/1992 Edition

INSTRUCTIONS

Items needed for a complete 1992 North Carolina State Building Code, Volume III – Mechanical.

1. 1988 Standard Mechanical Code, and
2. 1991/92 North Carolina Revisions.

Place the 1988 Standard Mechanical Code in the binder. Replace the white sheets with the 1991–92 NC Revisions (blue sheets) by page number. Place all blue sheets in the Code, even it the sheet contains only information about white sheets to be removed. When this is complete, you have a 1992 NC Edition.

CHAPTER 2
DEFINITIONS

201 GENERAL

201.1 Tense, Gender And Number

For the purpose of this Code, certain abbreviations, terms, phrases, words, and their derivatives, shall be construed as set forth in this Section.

Words used in the present tense include the future. Words in the masculine gender include the fèminine and neuter. Words in the feminine and neuter gender include the masculine. The singular number includes the plural and the plural number includes the singular.

201.2 Words Not Defined

Words not defined herein shall have the meanings stated in the Standard Building Code, Standard Plumbing Code, Standard Gas Code or Standard Fire Prevention Code. Words not defined in the Standard Codes shall have the meanings stated in the Webster's Ninth New Collegiate Dictionary, as revised.

202 DEFINITIONS

ABSORPTION SYSTEM–a refrigerating system in which the gas evolved in the evaporator is taken up by an absorber.

ACCESSIBLE–having access to but which first may require the removal of a panel, door or similar covering of the item described.

ACTIVE SYSTEM–a solar heating or cooling system using circulated liquid, air or other fluid to transfer energy within a structure.

ADMINISTRATIVE AUTHORITY–the individual official, board, department, or agency established and authorized by a state, county, city or other political subdivision created by law to administer and enforce the provisions of the mechanical code as adopted or amended.

AGGREGATE AMOUNT OF HEAT INPUT–the total heat input, in British thermal units per hour, of all boilers connected to one common header, except that any boiler which is permanently blanked off and discontinued from service, shall not be a factor in determining the "Aggregate Amount of Heat Input."

AIR–all air supplied to mechanical equipment for combustion, ventilation, cooling, etc. Standard air is air at standard temperature and pressure, namely 60° F and 29.92 in of mercury.

AIR CONDITIONING–the process of treating air to control its temperature, humidity, cleanliness and distribution to meet the requirements for the conditioned space.

AIR CONDITIONING SYSTEM–consists of heat exchangers, blowers, filters, supply exhaust and return ducts, and shall include any apparatus installed in connection therewith.

AIR (FOR COMBUSTION)–the amount of air required for the safe and proper combustion of fuel in fuel-fired appliances.

AIR DUCT–a conduit or passageway for conveying air to or from heating, cooling, air conditioning, or ventilating equipment but not including the plenum.

AIR DUCT MATERIAL:

1. Class 0–Air duct materials and connectors having a fire-hazard classification of zero (flame spread and smoke developed).
2. Class 1–Air-duct materials and connectors having a flamespread rating of not over 25 without evidence of continued progressive combustion and a smoke developed rating of not over 50.
3. Class 2–Air duct materials and connectors having a flamespread rating of not over 50 without evidence of continued progressive combustion and a smoke developed rating of not over 50 for the inside surface and not over 100 for the outside surface.

AIR WASHER–water spray system or device for cleaning, humidifying, or dehumidifying the air.

ALTERATION–a change in an air conditioning, heating, ventilating or refrigeration system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

AND/OR–in a choice of two code provisions, signifies that use of both provisions will satisfy the code requirement and use of either provision is acceptable also.

APPLIANCE–utilization equipment normally built in standardized sizes which is installed or connected as a unit to perform one or more functions.

APPROVED–approved by the Mechanical Official or other authority having jurisdiction.

ATTIC FAN–generally propeller type fans used during summer to draw cool night air through the structure and discharge into the attic where it escapes through louvers, soffit vents or ridge vents to the exterior of the building.

BOILER–any vessel used for generating steam or hot water for power or heating purposes to be used external to the vessel.

BOILER, HEATING (LOW PRESSURE)–hot water boilers operating at pressures not in excess of 160 psi and 250°F or steam boilers operating at pressures not in excess of 15 psi, used for heating buildings or structures. (See also High Pressure and Low Pressure.)

BOILER ROOM–Any room where a boiler is located. This equipment may be producing hot water or steam. For the purposes of this code, this definition shall not include rooms containing domestic type water heaters of less than 120 gallons storage capacity or rooms containing boilers in one and two family residential occupancies (see also ``Furnace room'' and "Mechanical equipment room'').

BRAZED JOINT–a gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at a temperature above 800° F but lower than the melting temperature of the parts to be joined.

BREECHING (FLUE CONNECTION)–a passage for conducting the products of combustion from a fuel fired appliance to the vent or chimney. (See also Chimney Connector and Vent Connector.)

BRIDGE WALL–a partition wall between chambers over which pass the products of combustion.

BRINE–a liquid, used for the transmission of heat without a change in its state, having no flash point or flash point above 150°F as determined in an approved manner.

coating(s), film and jacket used to cover the outside surface of a duct, fan casing or duct plenum.
DUCT LINING–includes materials such as adhesive, insulation, coating and film used to line the inside surface of a duct, fan casing or duct plenum.
DUCT MATERIAL–see Air Duct Material.
DUCT SYSTEM–a continuous passageway for the transmission of air, which, in addition to ducts, may include duct fittings, dampers, plenums, fans and accessory air handling equipment.

ELECTRIC SPACE HEATERS, PORTABLE–heaters not intended for permanent connection to a structure or to electric wiring.
ELECTRIC SPACE HEATERS, STATIONARY–heaters permanently mounted in a structure (air duct system) and which are permanently connected to electric wiring.
EVAPORATOR–that part of the system in which liquid refrigerant is vaporized to produce refrigeration.
EXHAUST SYSTEM–an assembly of connected ducts, plenums, fittings, registers, grilles and hoods, through which air is conducted from the space or spaces and exhausted to the outside atmosphere.

FILTER, AIR–a device used to remove air-borne solids from heating, ventilating, or air conditioning duct systems.
FIRE DAMPER–a listed assembly arranged to restrict the passage of air flow automatically in the event of fire.
FLAME SAFEGUARD–a device which will automatically shut off the fuel supply to a main burner or group of burners when the means of ignition of such burners become inoperative.
FLAMESPREAD RATING–the numerical value assigned to a material tested in accordance with ASTM E 84.
FLUE CONNECTION (BREECHING)–a passage for conducting the products of combustion from a fuel fired appliance to the vent or chimney. (See also Chimney Connector and Vent Connector.)
FURNACE–a completely self-contained unit that produces heat by utilizing electric energy or by burning fuel.
FURNACE, CENTRAL–a self-contained indirect-fired or electrically heated appliance designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.
FURNACE ROOM–A room primarily used for the installation of fuel-fired-heating equipment other than boilers (see also "Boiler room" and "Mechanical equipment room").

GENERATOR–any device equipped with a heating element used in the refrigerating system to increase the pressure of refrigerant in its gas or vapor state for the purpose of liquefying the refrigerant.

HEAT EXCHANGERS–a device used for the transfer of heat from one medium to another.

HEATER, ROOM (SPACE)–a free-standing heating unit burning solid, liquid or gas fuel for direct heating of the space in and adjacent to that in which the unit is located.

HEATING SYSTEM, CENTRAL WARM AIR–a heating system consisting of an air heating appliance from which the heated air is distributed by means of ducts, pipes, or plenums including any accessory apparatus and equipment installed in connection therewith.

HIGH PRESSURE (AND TEMPERATURE):

1. Steam: any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing steam for heating, power and processing, operating at pressures of 15 psi or more.
2. Hot water: any boiler, generator, pressure vessel, system, piping, or equipment used for purposes of heating or distributing hot water for heating or processing, operating at pressures in excess of 160 psi and temperatures in excess of 250°F.

INSOLATION–the total amount of solar energy reaching a surface per unit of time.

LABELED–devices, equipment or materials to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above labeled items and by whose label the manufacturer attests to compliance with applicable nationally recognized standards.

LANGLEY–standard unit of insolation, 1 langley/minute = 221 Btu/hr/sq ft.

LISTED–equipment or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner. The means for identifying listed equipment may vary for each testing laboratory, inspection agency, or other organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

LOW PRESSURE (AND TEMPERATURE)–

1. Steam: any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing steam for heating, power and processing, operating at pressures of 15 psi or less.
2. Hot water: any boiler, generator, pressure vessel, system, piping, or equipment used for the purposes of heating or distributing hot water for heating or processing, operating at 160 psi and 250°F or less.

MECHANICAL EQUIPMENT ROOM–A room or space in which non-fuel-fired equipment is located (see also "Boiler room" and "Furnace room").
MECHANICAL OFFICIAL–see Administrative Authority.

MINIATURE BOILER–any power boiler which does not exceed the following limits:

1. An inside shell diameter of 16 inches.

pendently or on his own building, all chimneys, smokestacks, and smoke flues of an adjoining building which are within 10 ft of any portion of the wall extending above such chimney or flue. The construction of such chimney shall conform to all requirements of this Code. The chimney shall be carried up simultaneously with the walls.

306.2.7 It shall be the duty of the owner of the building to be erected, enlarged or raised, to notify, in writing, at least 10 days before such work is to begin, the owner of the chimney affected, of his intention to carry up such chimney.

306.3 Factory-Built Chimneys

306.3.1 Factory-built chimneys shall be listed and shall be installed in accordance with the conditions of the listing and the manufacturer's instructions.

306.3.2 Factory-built chimneys for use with closed combustion wood-burning appliances shall comply with the Type HT requirements of UL 103.

306.3.3 Chimneys for use with factory-built fireplaces shall meet the requirements of UL 127.

306.3.4 Nothing contained in this Code shall be construed as prohibiting the use of insulated suspended factory-built chimneys provided such assemblies have been tested and approved by a recognized laboratory for the use intended and are installed in accordance with their approval.

306.3.5 Factory-built chimneys may be installed with zero clearance on wood structural members, such as framing, roof rafters, floor and ceiling joists and other component structural members, when it has been determined by test reports of recognized and approved testing laboratories that the unit does not transmit heat to the supporting combustible members of more than 90°F above room temperature. All chimney installations shall conform with the height requirements of this Code.

306.3.6 Supports for such chimneys attached to ceiling or floor joists shall be permitted provided the joists are of adequate size to support additional load.

306.4 – 306.9

(Reserved For Future Use)

306.10 Metal Chimneys (Smokestacks) ★

306.10.1 Metal chimneys shall be of adequate thickness based on good engineering practice, properly riveted or welded, and securely supported. When selecting the thickness of metal chimneys consideration should be given to factors such as location, maintenance, use, etc., as well as engineering design factors. As a guide the following are thicknesses of uncoated sheet steel for given cross-sectional areas:

Thickness (in)	Area (sq in)
0.0598 (16 ga)	Up to 154
0.07477 (14 ga)	154 to 201
0.105 (12 ga)	201 to 254
0.135 (10 ga)	Larger than 254

306.10.2 Metal chimneys shall not be carried up inside of ventilating ducts unless such ducts are constructed and installed as required by this Code for chimneys and the ventilating ducts are used solely for exhaust of air from the room or space in which the appliance served by the metal chimney is located.

306.10.3 Metal chimneys shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection and maintenance operations on the chimneys and to avoid danger of burns to persons.

306.11 Metal Chimneys For Low Heat Appliances

306.11.1 Metal chimneys for residential type low heat appliances without an exhauster shall extend at least 3 ft above the highest point where they pass through the roof of a building and at least 2 ft higher than any portion of a building within 10 ft. The outlet of a metal chimney for residential type and low heat appliances equipped with an exhauster may terminate at a location not less than 3 ft from an adjacent building or building opening and at least 10 ft above grade or walkways. In any case, the outlet shall be so arranged that the flue gases are not directed so as to jeopardize people, overheat combustible structures, or enter building openings in the vicinity of the outlet.

306.11.2 Exterior metal chimneys used only for residential type low heat appliances as defined in Table 306A shall have a clearance of not less than 6 inches from a wall of wood frame construction and from any combustible material.

306.11.3 Exterior metal chimneys over 18 inches in diameter shall have a clearance of not less than 4 inches, and those 18 inches or less in diameter a clearance of not less than 2 inches from a building wall of other than wood frame construction.

306.11.4 An exterior metal chimney shall not be nearer than 24 inches to any door or window or to any walkway, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

306.11.5 Where a metal chimney extends through any story above that in which the appliances connected to the chimney are located, it shall be enclosed in such upper stories with walls of noncombustible construction having a fire resistance of not less than 1 hour.

306.11.6 The enclosure shall provide a space on all sides of the chimney sufficient to permit inspection and repair.

306.11.7 The enclosing walls shall be without openings, except doorways equipped with approved self-closing fire doors at various floor levels for inspection purposes.

306.11.8 Where a metal chimney used for residential type construction as defined in Table 306A is located in the same story of a building as that in which the appliances connected thereto are located, it shall have a clearance of not less than 18 inches from a wall of wood frame construction and from any combustible material.

306.11.9 Where a metal chimney serving only low heat appliances as defined in Table 306A passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of noncombustible material, of galvanized iron or approved corrosion resistant metal, extending not less than 9 inches below and 9 inches above the roof construction, and of a size to provide not less than 6 inches clearance on all sides of the chimney; or the combustible material in the roof construction shall be cut away so as to provide not less than 18 inches clearance on all sides of the chimney, with noncombustible material used to close up such opening entirely.

306.12 Metal Chimney For Medium Heat Appliances

306.12.1 Metal chimneys for medium heat appliances shall extend not less than 10 ft higher than any portion of any building within 25 ft.

306.12.2 Exterior metal chimneys used for medium heat appliances as defined in Table 306A shall have a clearance of not less than 24 inches from a wall of wood frame construction and from any combustible material.

306.12.3 Exterior metal chimneys over 18 inches in diameter shall have a clearance of not less than 4 inches and those 18 inches or less in diameter a clearance of not less than 2 inches from a building wall other than wood frame construction.

306.12.4 Portions of an exterior metal chimney shall not be nearer than 24 inches to any door or window or to any walkway, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

306.12.5 Where a metal chimney extends through any story of a building above that story in which the appliances connected to the chimney are

306.15.3 Length. A connector shall be as short and straight as possible. The appliance shall be located as close as practical to the chimney, vent, or venting system. The horizontal run of an uninsulated connector to a natural-draft chimney, or vent, shall be not more than 75% of the height of the vertical portion of the chimney or vent above the connector, unless part of an engineered venting system.

306.15.4 Size. The connector, for its entire length, shall not be smaller than the flue collar of the appliance unless otherwise recommended by the appliance, chimney, or vent manufacturer.

306.15.5 Clearance.
306.15.5.1 Clearance from combustible materials for chimney connectors shall be 18 inches for residential type appliances, and commercial-industrial type low heat appliances. The clearance for commercial-industrial type medium heat appliances shall be 36 inches.
306.15.5.2 Vent connector clearances for gas appliances not equipped with draft hoods, except clothes dryers, shall be 18 inches. This distance may be 6 inches for listed gas appliances equipped with draft hoods, and for boilers and furnaces equipped with listed conversion burners and with draft hoods. A vent connector of listed Type B or Type L venting material may be used with listed appliances and may be installed in accordance with their listing.
306.15.5.3 Vent connectors serving direct vent appliances utilizing a condensing system may be installed in accordance with the furnace manufacturer's instructions.

306.15.6 Location. When the connector used for a gas appliance having a draft hood must be located in or pass through a crawl space or other cold area, that portion of the connector shall be of listed Type B or Type L vent material or be provided with equivalent means of insulation.
306.15.7 Installation.
306.15.7.1 A connector to a masonry chimney shall extend through the wall to the inner face or liner but not beyond, and shall be firmly cemented to masonry. A thimble may be used to facilitate removal of the chimney connector for cleaning, in which case the thimble shall be permanently cemented in place with high-temperature cement.
306.15.7.2 A chimney connector or a vent connector shall not pass through any floor or ceiling.
306.15.7.3 Connectors for listed low heat gas appliances with draft hoods except incinerators may pass through walls or partitions constructed of combustible material if:

1. Made of listed Type B or Type L material and installed with not less than listed clearances to combustible material.
2. Made of single wall metal pipe and guarded by a ventilated metal thimble not less than 4 inches larger in diameter than the vent connector.

306.15.7.4 Connectors for Residential appliances as defined in Table 306A may pass through walls or partitions constructed of combustible material if one of the following applies:

1. The connector is listed for wall pass through and installed according to the listing.
2. The connector is put through a device listed for wall pass through.
3. The connector has a diameter no larger than 10 inches and is installed according to one of the methods in Table 306C. Concealed metal parts of the pass through system in contact with flue gases shall be of stainless steel or equivalent material that resists corrosion, softening, or cracking up to 1800°F.

306.15.7.5 Connectors of low heat appliances except listed residential and low heat gas appliances with draft hoods (Table 306B, Column 1) shall not pass through walls or partitions constructed of combustible material unless thay are guarded at the point of passage by:

1. Metal ventilated thimbles not less than 12 inches larger in diameter than the connector.
2. Metal or burned fire clay thimbles built in brickwork or other approved fireproofing materials extending not less than 8 inches beyond all sides of the thimble.

306.15.7.6 In lieu of thimbles all combustible material in the wall or partition shall be cut away from the connector a sufficient distance to provide the clearance required from such connector. Any material used to close up such openings shall be noncombustible insulating material.

306.15.7.7 A connector of any medium or high heat appliance classified in Table 306A shall not pass through any wall or partition constructed of combustible material.

306.15.7.8 Connectors shall maintain a pitch of rise of at least 1/4 inch per foot (horizontal length of pipe) from the appliance to the chimney.

306.15.7.9 Connectors shall be installed so as to avoid sharp turns or other construction features which would create excessive resistance to the flow of flue gases. A device which will obstruct the free flow of flue gases shall not be installed in a connector, chimney, or vent. This shall not be construed to prohibit the use of devices specifically listed for installation in a connector, such as heat reclaimers, draft regulators, and safety controls.

306.15.7.10 Connectors shall be securely supported and joints fastened with sheet-metal screws, rivets, or other approved means.

306.15.7.11 The entire length of a connector shall be readily accessible for inspection, cleaning, and replacement, unless listed materials are used and previous approval has been obtained from the Mechanical Official.

306.15.7.12 A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace opening is sealed or the chimney flue which vents the fireplace is permanently sealed below the connection.

306.15.8 Interconnection.

306.15.8.1 Connectors shall not be connected to a chimney, vent, or venting system served by a power exhauster unless the connection is made in the negative pressure side of the exhauster.

306.15.8.2 Two or more fuel-burning appliances may be connected to a single chimney or vent provided sufficient draft is available for safe combustion in each appliance and removal of all the products of combus-tion safely to the outdoors. Gas and oil appliances so connected shall be equipped with primary safety controls.

306.15.9 Dampers.

306.15.9.1 Manually operated dampers shall not be placed in chimneys, vents or connectors of stoker fired, or liquid or gas-burning appliances. Fixed baffles on the appliance side of draft hoods and draft regulators shall not be classified as dampers.

306.15.9.2 A listed automatic vent damper device may be installed on an existing appliance installation provided the appliance is listed and equipped with a draft hood and provided the device is installed by a qualified agency in accordance with the terms of its listing. The name of the installer and date of installation shall be marked on a label affixed to the damper device.

306.15.9.3 On gas appliances in excess of 800,000 Btu input having more than two draft hoods, fixed manual baffles may be used in the connectors between draft hoods and the common breeching as a means of equalizing the available draft pull.

306.15.10 Draft Hoods. For information concerning the use and installation of draft hoods, refer to the Standard Gas Code.

306.16 Draft Regulators

306.16.1 Gas appliances connected to chimneys, other than those required by the Standard Gas Code to be installed with draft hoods, may be installed with draft regulators if in accordance with the appliance manufacturer's instruction.

306.16.2 For information concerning the use and installation of draft regulators with oil-burning appliances, refer to NFiPA 31.

306.16.3 Solid fuel-burning appliances may be installed with draft regulators to reduce draft intensity. Such regulators shall be installed and set in accordance with the instructions furnished with the appliance or the draft regulator.

306.16.4 A barometric draft regulator, if used, shall be installed in the same room or enclosure as the appliance in such a manner that a difference in pressure between the air in the vicinity of the regulator and the combustion air supply will not be permitted.

306.17 Fireplaces

306.17.1 Factory-built Fireplaces. Factory-built fireplaces shall be listed and shall be installed in accor-dance with the conditions of the listing. Factory-built fireplaces shall also be required to be installed in accordance with 306.17.3.6 and 306.17.3.9. The factory-built fireplaces shall be tested in accordance with and meet the requirements of UL 127.

306.17.2 Factory-built Fireplace Stoves. Factory-built fireplace stoves and solid fuel type room heaters shall be listed and shall be installed in accordance with the conditions of the listing. The factory-built fireplace stoves shall be tested in accordance with and meet the requirements of UL 737. The solid fuel type room heaters shall be tested in accordance with and meet the requirements of UL 1482.

306.17.3 Masonry Fireplaces.

306.17.3.1 Fireplaces shall be constructed of solid masonry or of reinforced concrete with back and sides of the thickness specified in this paragraph, except as provided in 306.17.1. Where a lining of firebrick at least 2 inches thick or other approved lining is provided, the total thickness of back and sides, including the lining, shall be not less than 8 inches of solid masonry or reinforced concrete. Where no such lining is provided, the thickness of back and sides shall be not less than 12 inches of solid masonry or reinforced concrete.

306.17.3.2 Steel fireplace units incorporating a firebox liner of not less than 1/4 inch thick steel and an air chamber may be installed with masonry to provide a total thickness at the back and sides of not less than 8 inches, not less than 4 inches of which shall be solid masonry.

306.17.3.3 Warm air ducts employed with steel fireplace units of circulating air type shall be constructed of metal or masonry.

306.17.3.4 Fireplace hearth extensions shall be provided of approved noncombustible material for all fireplaces. Where the fireplace opening is less than 6 sq ft, the hearth extension shall extend at least 16 inches to the front of, and at least 8 inches beyond each side of the fire place opening. Where the fireplace opening is 6 sq ft or larger, the hearth extension shall extend at least 20 inches to the front of and at least 12 inches beyond each side of the fireplace opening. Where a fireplace is elevated above or overhangs a floor, the hearth extension shall also extend over the area under the fireplace.

306.17.3.5 Fireplaces constructed of masonry or reinforced concrete shall have hearth extensions of brick, concrete, stone, tile or other approved noncombustible material properly supported and with no combustible material against the underside thereof. Wooden forms or centers used during the construction of hearth and hearth extension shall be removed when the construction is completed.

306.17.3.6 Hearth extensions of approved factory-built fireplaces and fireplace stoves shall be installed in accordance with 804.1.3 of the Standard Building Code.

306.17.3.7 All wood beams, joists and studs shall be trimmed away from fireplaces. Headers supporting trimmer arches at fireplaces shall not be less than 20 inches from the face of the chimney breast. Trimmers shall not be less than 6 inches from the inside face of the nearest flue lining.

306.17.3.8 Woodwork shall not be placed within 4 inches of the back of a fireplace but this shall not prevent plastering directly on the masonry or on metal lath and metal furring.

306.17.3.9 Woodwork shall not be placed within 6 inches of a fireplace opening. Woodwork above and projecting more than 1 1/2 inches from a fireplace opening shall not be placed less than 12 inches from the top of a fireplace opening.

306.17.4 False Fireplaces False fireplaces may be used in connection with listed gas or electric heaters, provided such fireplaces are constructed of noncombustible materials.

TABLE 306A
CHIMNEY SELECTION CHART

Chimneys for RESIDENTIAL TYPE Appliances	Chimneys for LOW HEAT Appliances	Chimneys for MEDIUM HEAT Appliances	Chimneys for HIGH HEAT Appliances
1. Factory built (residential)[6] 2. Masonry (residential)[4]	1. Factory built (low heat) 2. Masonry (low heat type)[4] 3. Metal (smokestack)[5]	1. Factory built (medium heat type) 2. Masonry (med. heat type)[4] 3. Metal (smokestack)[5]	1. Masonry (high heat type) 2. Metal (smokestack)[5]

TYPES OF APPLIANCES TO BE USED WITH EACH TYPE CHIMNEY

Column I	Column II	Column III	Column IV
A. Residential appliances such as: 1. Ranges 2. Warm air furnaces 3. Water heaters 4. Hot water heating boilers 5. Low pressure steam heating boilers (not over 15 psig) 6. Domestic incinerators 7. Floor furnaces 8. Wall furnaces 9. Room heaters 10. Fireplace stoves	A. All appliances shown in Column I B. Nonresidential type building heating appliances for heating a total volume of space exceeding 25,000 cu ft* C. Appliances such as: 1. Annealing baths for hard glass (fats, paraffin, salts, or metals) 2. Bake ovens (in bakeries)	All appliances shown in Columns I and II, and appliances such as: 1. Alabaster gypsum kilns 2. Annealing furnaces (glass or metal) 3. Charcoal furnaces 4. Cold stirring furnaces 5. Feed driers (direct fire heated) 6. Fertilizer driers (direct fire heated) 7. Galvanizing furnaces 8. Gas producers	All appliances shown in Columns I, II and III, and appliances[2] such as: 1. Bessemer retorts 2. Billet and bloom furnaces 3. Blast furnaces 4. Bone calcining furnaces 5. Brass furnaces 6. Carbon point furnaces 7. Cement brick and tile kilns 8. Ceramic kilns 9. Coal and water

TABLE 306A (Continued)
CHIMNEY SELECTION CHART

Column I	Column II	Column III	Column IV
B. Fireplaces	3. Boiling vats, for wood fibre, straw, lignin, etc.	9. Hardening furnaces (cherry to pale red)	10 Cupolas 11. Earthenware kilns
5. Coffee roasting	4. Candy furnace 5. Coffee Roasting 6. Core ovens 7. Cruller furnaces 8. Feed drying ovens 9. Fertilizer drying 10. Fireplaces, other than residential type 11. Forge furnaces (solid fuel) 12. Gypsum kilns 13. Hardening furnaces (below dark red) 14. Hot air engine furnaces 15. Ladle drying furnaces 16. Lead melting furnaces 17. Nickel plate (drying) furnaces 18. Paraffin furnaces 19. Recuperative furnaces (spent materials) 20. Rendering furnaces 21. Rosin melting furnaces 22. Steam boilers operating at not over 50 psi; pressing machine boilers	10. Incinerators: commercial and industrial type 11. Lehrs and glory holes 12. Lime kilns 13. Linseed oil boiling furnaces 14. Porcelain bircuit kilns 15. Pulp driers (direct fire heated) 16. Steam boilers operating at over 50 lb. per sq. in. gage pressure except pressing machine boilers 17. Water-glass kiln 18. Wood-distilling furnaces 19. Wood-gas retorts	12. Glass blow furnaces 13. Glass furnaces (smelting) 14. Glass kilns 15. Open hearth furnaces 16. Ore roasting furnaces 17. Porcelain baking and glazing kilns 18. Pot-arches 19. Puddling furnaces 20. Regenerative furnaces 21. Reverberatory furnaces 22. Stack, carburetor or superheating furnaces (in water gas works) 23. Vitreous enameling ovens (ferrous metals) 24. Wood carbonizing furnaces

TABLE 306A (Continued)
CHIMNEY SELECTION CHART

Column I	Column II	Column III	Column IV
	23. Stereotype furnaces 24. Sulphur furnaces 25. Tripoli kilns (clay, coke and gypsum) 26. Type foundry furnaces 27. Unit heaters (oil-fired) 28. Wood drying furnaces 29. Wood impregnating furnaces 30. Zinc amalgamating furnaces		

*Nonresidential type building heating appliances for heating a total volume of space not to exceed 25,000 cu ft may be connected to chimneys for residential type appliances.

NOTES:

1. Appliances otherwise classed as high heat appliances may be considered as medium heat appliances if not larger than 100 cu ft in size.
2. When such appliances are larger than 100 cu ft in size, and other furnaces classified as high heat appliances in accordance with nationally recognized good practice.
3. Continuous operating equipment of the counter current type may not require the type of flue indicated by general types of appliances.
4. For construction and other provisions for masonry chimney installation see the Standard Building Code.
5. For construction and other provisions for metal chimney installation see 306.10 through 306.14.
6. Factory-built chimneys for use with closed combustion wood burning appliances shall comply with the Type HT requirements of UL 103.

TABLE 306B
VENTING SYSTEM SELECTION CHART

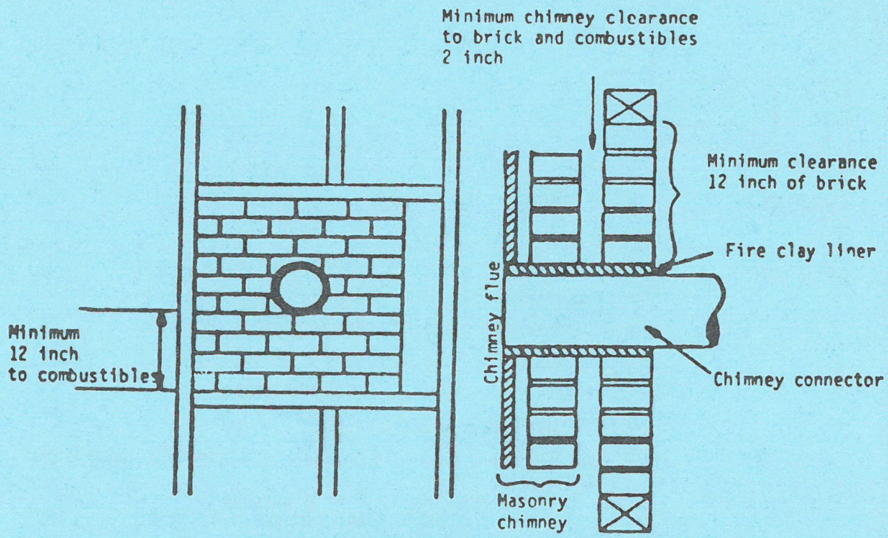
TYPE OF VENTING SYSTEM

Type B– Gas	Type BW– Gas	Type L–Oil	Metal Pipe
(Round or Oval) All listed gas appliances/ draft hoods such as: 1. Central furnaces 2. Duct furnaces 3. Floor furnaces 4. Heating boilers 5. Ranges 6. Built-in ovens 7. Vented wall furnaces listed for use with Type B vents 8. Room heaters 9. Water heaters 10. Horizontal furnaces 11. Unit heaters	1. Vertical wall furnaces for use with Type BW vents only	1. Low temperatures flue appliance listed for use with Type L venting systems 2. Gas appliances shown in Column I	1. Incinerators used outdoors, such as in open sheds, breezeways or carports as provided in 305.14A. 2. Gas appliances shown in Column I 3. Listed residential and low heat gas appliances without draft hoods and unlisted residential and low heat gas appliances with or without draft hoods

TABLE 306C
CHIMNEY CONNECTOR SYSTEMS AND CLEARANCES FROM ROOM WALL COMBUSTIBLES FOR RESIDENTIAL HEATING APPLIANCES

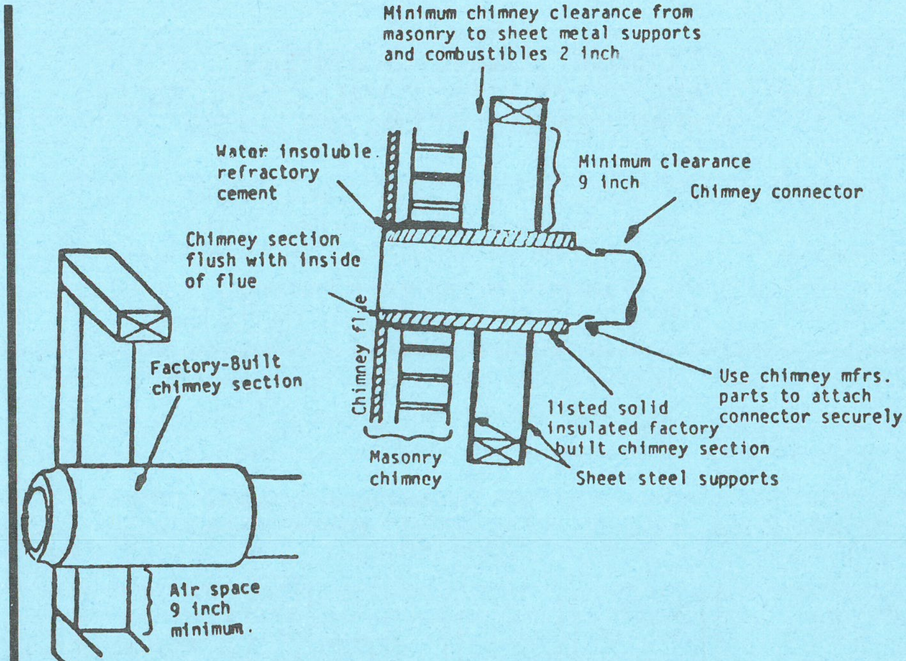
System A
(12 inch Clearance)

A 3.5 inch thick brick wall shall be framed into the combustible wall. A 5/8 inch thick fire clay liner (ASTM C 315 or equivalent) shall be firmly cemented in the center of the brick wall maintaining a 12 inch clearance to combustibles. The clay liner shall run from the outer surface of the bricks to the inner surface of the chimney liner but it shall not protrude into the chimney liner.



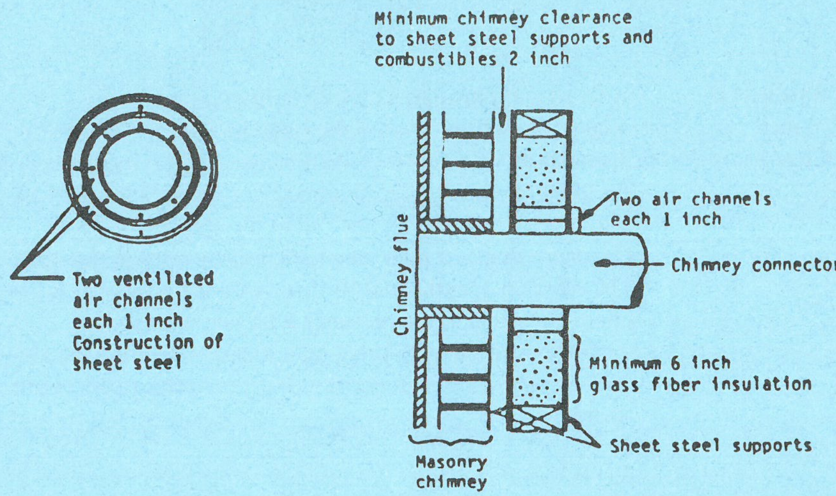
System B
(9 inch Clearance)

A listed solid insulated factory built chimney section (1 inch insulation) the same inside diameter as the connector shall be used. Sheet metal supports cut to maintain a 9 inch clearance to combustibles shall be fastened to the wall surface and to the chimney section. Fasteners shall not penetrate the chimney section flue liner. The chimney length shall be flush with the masonry chimney liner and sealed to the masonry with water insoluble refractory cement. Chimney manufacturer's parts shall be used to securely fasten the chimney connector to the chimney section.



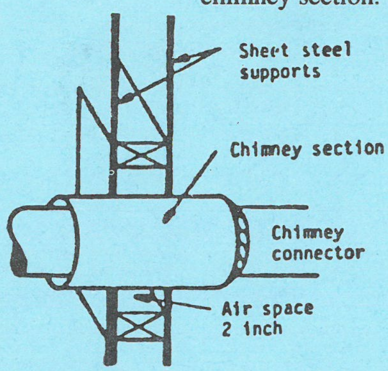
System C
(6 inch
Clearance)

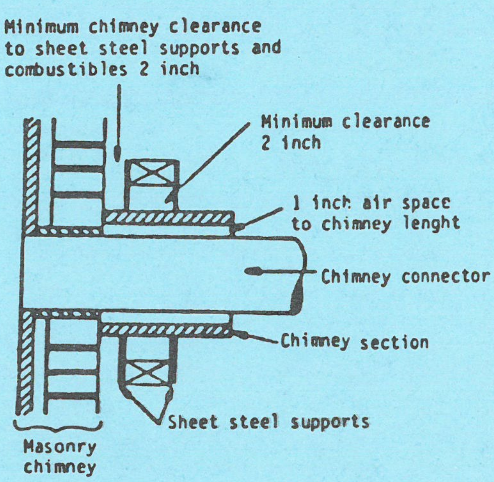
A sheet metal (min. 24 gage) ventilated thimble having two 1 inch air channels shall be used with a sheet steel chimney connector (min. 24 gage). Sheet steel supports (min. 24 gage) shall be cut to maintain a 6 inch clearance between the thimble and combustibles. The supports shall be fastened to the wall on all sides. Glass fiber insulation shall fill the 6 inch space between the thimble and the supports. The thimble shall be secured to the support.



System D (2 inch Clearance)

A listed solid insulated factory-built chimney section (1 inch insulation) with an inside diameter 2 inches larger than the chimney connector shall be used with a sheet steel chimney conector (minimum 24 gage). Sheet metal supports shall be positioned to maintain a 2 inch clearance to combustibles and to hold the chimney connector to assure that a 1 inch air space surrounds it as it passes through the chimney section. The sheet metal support shall be fastened to the wall on all sides and the chimney section shall be fastened to the supports. Fasteners used shall not penetrate the liner of the chimney section.





Requirements for systems in Table 306C:

1. Insulation material used as a part of a wall pass-through shall be noncombustible and shall have a thermal conductivity of 1.0 Btu-in./sq ft°F or less.
2. All clearances and thicknesses are minimums.
3. Materials used to close up openings for the connector shall be noncombustible.
4. Connectors for all systems except System B shall extend through the wall pass-through system to the inner face of the flue liner.

307 VENTILATION SYSTEMS

307.1 Required Systems

A separate and individual system, which shall not be part of any other system, shall be provided for ventilating each room containing any of the following materials: flammable vapors, corrosive vapors, noxious gases, or flammable dusts. For commercial food heat-processing equipment see 308. Any ventilation required involving materials incompatible with each other shall have separate ventilation systems for each of the incompatible materials. Vestibule ventilation for smokeproof enclosures shall be in accordance with the Standard Building Code. The requirements of 303.2, 303.3, 303.4 and 303.5 shall apply to ventilation equipment.

307.2 Reserved For Future Use

307.3 Ducts - General

307.3.1 Every duct and plenum used in a ventilation system shall be constructed of approved material and construction as set forth in Chapter 5.

307.3.2 Ducts shall be substantially airtight throughout and have no openings other than those required for proper operation and maintenance of the system.

307.3.3 The type of metal duct bracing, the distance of duct joints on center, the type of duct transverse joint connections, and the type of duct lateral seams, shall comply with Chapter 5.

307.3.4 Every duct shall be securely attached to the building as set forth in Chapter 5. No nails or screws shall be driven through the duct walls into the building construction and ducts shall be supported on noncombustible straps or hangers without penetration of the duct walls.

307.3.5 Every duct or plenum which is a portion of a ventilation system used for exhausting any solid particles shall be constructed so as to permit thorough cleaning of the entire duct system. Any such duct or plenum, having any section or sections inaccessible from the duct entry or discharge, shall be provided with cleanout openings. All cleanout openings shall be equipped with tight-fitting sliding or hinged doors constructed of metal equal or greater in thickness than the ducts. Such doors shall be equipped with a substantial method of latching, sufficient to hold the door tightly closed. These doors shall be so designed that they can be opened easily without the use of a tool.

307.4 Motors, Fans And Filters

307.4.1 Motors and fans shall be of sufficient capacity to provide the required air movement as specified in the Standard Building Code. Every motor and fan shall be so installed as to afford access for servicing or maintenance.

307.4.2 Fan motors, except NEMA Class I explosion proof motors, shall not be installed inside the ducts or under hoods in any ventilation system conveying flammable vapors or combustible dusts, nor shall any belt or chain driven apparatus be inside any such duct or under any such hood unless the belt or chain driven apparatus be inside any such duct or under any such hood unless the belt or chain and any pulley connection therewith is entirely enclosed and grounded except motors and receptacles listed for the class, group and division of flammable vapors or combustible dusts as indicated in Article 500, NFiPA 70.

307.4.2.1 Every fan blade located in any duct shall be of rigid noncombustible construction. In any ventilation system conveying flammable vapors or combustible dust, the fan blade, shaft and casing shall be of a nonsparking material. Bearings for fans shall be self-lubricating or shall be lubricated from outside the duct.

307.4.3 Air filters, other than grease hood filters regulated by 308, shall be of a type that, in a clean state, will not burn freely. Liquid adhesive coatings used on filters shall have a flash point of 350° F, Cleveland open cup tester, or higher. Filters qualifying as Class 1 or Class 2 shall be accepted as meeting these requirements. Evaporative coolers containing a combustible evaporation medium, such as excelsior, shall not be used.

307.4.4 Rotary fans without fan blade protection shall provide for not less than 8 ft of clearance from the finished floor level to the bottom side of the unprotected fan blades.

EXCEPTION: Fan blades of low speed residential type ceiling fans installed within dwelling units shall be located at least 6 ft 8 inches from the finished floor.

307.5 Safety Devices

Whenever a fire damper is installed it shall be installed and constructed to comply with Chapter 5. Ducts discharging combustible material directly into any combustion chamber shall conform to the requirements of NFiPA 82.

307.6 Dry Cleaning Plants

Type I and Type II Systems. The ventilation system shall provide a complete and continuous air change at least once every 3 minutes in dry cleaning and dry dyeing rooms. The system shall be provided with means for remote control and shall operate automatically when any dry cleaning or dry dyeing equipment is in use.

308 EXHAUST SYSTEMS

308.1 Systems Required

308.1.1 Exhaust system shall be provided, maintained and operated for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders, and any other equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas, or smoke, in such quantities as to be irritating or injurious to health or safety, and shall mechanically discharge such exhaust to the outdoor atmosphere. The total outdoor air supplied shall be equal in volume to that removed.

308.1.2 All equipment and system service rooms, which house sources of

308.1.2 All equipment and system service rooms, which house sources of odors, fumes, noxious gases, smoke, steam, dust, spray, or other contamination shall be such as to prevent spreading of any such contamination to any other occupied parts of the building.

308.1.3 Air exhausted from bath, toilet, urinal, lavatory, locker, coat room or similar rooms shall not be recirculated unless treated by a listed or approved air treatment system.

308.2 General Provisions

308.2.1 If a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical exhaust system for a room, adequate means shall be provided for the natural exit of the excess air supplied. If a mechanical exhaust system only is installed for a room or if a greater quantity of air is removed by a mechanical exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate means shall be provided for the natural supply of the deficiency in the air supplied.

308.2.2 The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a nuisance and from which it cannot again be readily drawn in by a ventilating system. Exhausting air into an attic or crawl space shall be prohibited. Air which is to be used for recirculation may be discharged to a supply system.

EXCEPTION: Attic fans may be permitted to discharge into attic space of residences having private attics.

308.2.3 Mechanical exhaust from bath, toilet, urinal, locker, service sink, closets and similar rooms shall be an independent system and shall not be recirculated unless treated by a listed or approved air treatment system. When exhaust systems are used, they may be combined with similar exhaust except kitchen exhaust shall be on an independent system.

308.2.4 Where natural ventilation is not provided from lavatories, toilets, bathrooms and restrooms, the requirements of the North Carolina State Plumbing Code shall be provided.

308.3 Ducts - General

The materials used in every mechanical exhaust system shall be of sheet metal or other approved materials in accordance with Chapter 5. Materials shall be of non-absorbent and moisture and corrosion resisting character. The design and construction of all equipment and the weight and bracing of all duct work shall be such that will operate under normal conditions without excessive vibrations. (See Chapter 5.) Ducts shall be substantially air-tight. Linings, if used, shall be securely anchored.

308.4 Grease Hood Duct Systems

308.4.1 Duct systems serving exhaust hoods removing smoke and grease laden vapors shall be constructed of and supported by steel 0.0598-inch (16 ga) minimum thickness or stainless steel 0.0478-inch (18 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official. Ducts constructed of materials that are subject to corrosion shall be suitably protected when installed outdoors.

308.4.1.1 All seams and joints shall be made liquid-tight with a continuous external weld. In lieu of a welded connection, the duct may be flanged to the hood in accordance with Figure 308.4, or other equivalent method.

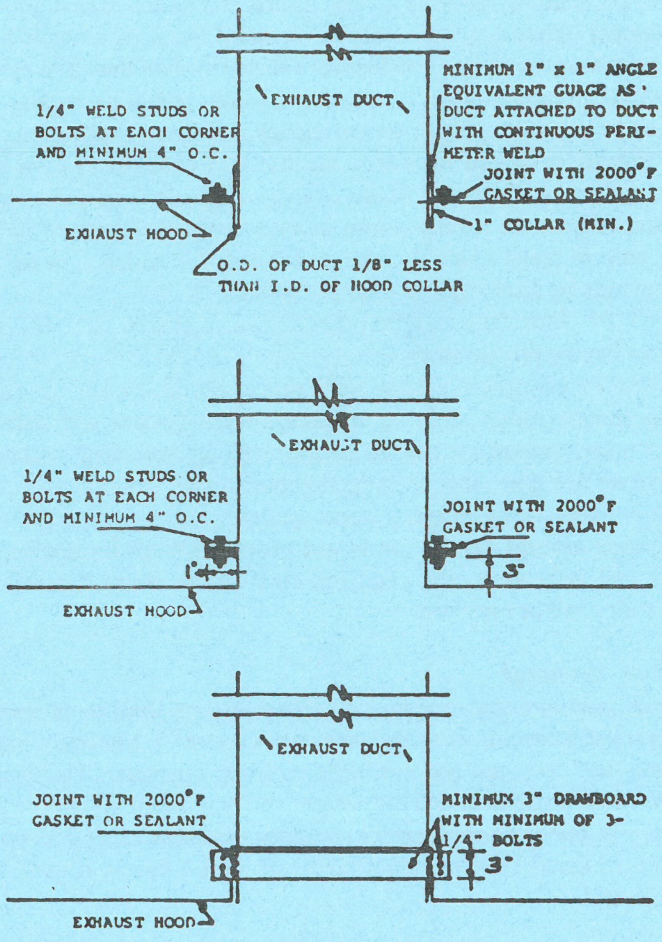


FIGURE 308.4

308.4.1.2 All duct systems furnished as a part of a grease extractor listed by a nationally recognized testing agency are considered as complying with these requirements when installed in accordance with the terms of their listing.

308.4.2 All sections of the duct system shall be constructed and installed without forming dips and traps and shall slope not less than 1 inch per foot toward either the hood or an approved residue trap.

308.4.3 The duct system shall have only those openings required for the proper operation and maintenance of the system. For cleaning purposes, cleanout openings shall be provided at each change in direction of the duct and at any other portion of the system not accessible from the duct inlet or discharge. All cleanout openings shall be located on the sides of the duct and shall be of sufficient size to permit a thorough cleaning of the entire system. Cleanout openings shall be equipped with tight-fitting doors and covers, constructed of metal which is equal to or greater in thickness than that of the ducts. Such doors or covers shall be equipped with a substantial method of latching, sufficient to make them grease-tight. Doors or covers shall be so designed that they can be opened or removed without the use of a tool.

308.4.4 Duct systems shall be properly supported and securely fastened in place at every change in direction and as required in Chapter 5. Supports or fasteners shall not penetrate any duct or plenum.

308.4.5 Duct systems shall be designed and installed in a manner to provide an air velocity within the duct system of not less than 1500 ft per minute.

308.4.6 A separate system and individual duct system shall be provided exclusively for each grease hood, except as provided herein. A single duct system may serve more than one grease hood located in the same story of the building provided that, in addition to other requirements of this Code, the installation also complies with the following:

1. All hoods served by the system shall be located in the same room or adjacent rooms.
2. No portion of the interconnecting duct shall pass through any construction which would require the openings to be fire protected as specified in the Standard Building Code.
3. Grease exhaust duct systems shall not be interconnected with any other building ventilating or exhaust system.

308.4.7 Vertical ducts located within a building of two stories or more shall be enclosed in a continuous enclosure extending from the ceiling above the hood to or through the roof. A minimum clearance of 6 inches shall be maintained between the duct and interior surface of the enclosure. The fire resistance rating of the enclosure shall be a minimum of 1 hour for buildings two through three stories in height and a minimum of 2 hours for buildings four stories or more in height. The enclosure shall be used exclusively to enclose a single grease exhaust system and shall be used for no other purposes.

308.4.8 Openings required in vertical enclosures for access to cleanout openings shall be equipped with approved sliding or hinged doors equal in fire resistance to that of the enclosure.

308.4.9 No damper shall be installed in any portion of the duct system unless specifically listed for such use. This does not prohibit the use of dampers which are part of a listed grease extractor, an approved extinguishing system or an approved fan by-pass system.

308.4.10 Every duct system shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the duct side. Ducts shall not pass through interior walls or partitions having a fire resistance rating of 2 hours or more.

308.4.11 Motors, fans and exhaust outlets for grease hood duct systems shall comply with all applicable requirements as specified in 307.4 and 308.5.

308.4.12 Fume incinerators, thermal recovery units, air pollution control devices, or other devices, may be installed in ducts or hoods or located in the path of travel of exhaust products when specifically approved for such use and shall not increase the fire hazard.

308.5 Exhaust Outlets

308.5.1 Exhaust outlets for ducts conveying noxious gases, flammable vapors, corrosive vapors, and ducts serving commercial food cooking and processing equipment, shall terminate outside the building and shall be located 10 ft from any adjacent building, parking area, adjacent property line, window, door, or air intake opening and shall be located at least 10 ft above the adjoining grade level. Every exhaust outlet which is located above the roof shall terminate at least 40 inches above the roof surface. The airflow from exhaust outlets conveying grease-laden vapors shall be in a vertical direction away from the roof surface. Where this is not possible, a metal pan at least 1 inch deep shall be provided on the roof surface to catch grease residue.

308.5.2 The exhaust from hoods serving commercial food heat-processing equipment may terminate in an approved engineered air recovery system for recirculation to the room in which the hood is located.

308.5.3 An exhaust duct may terminate through an exterior wall under the following conditions:

1. The wall is of noncombustible construction.
2. The discharge shall have a minimum clearance of 15 ft from adjoining buildings, property lines, air intakes, windows or doors. The lowest edge of the outlet shall be not less than 7 ft above any adjoining grade level parking areas, driveways or walks that are within 10 ft of the outlet.
3. The discharge of exhaust air is away from the building wall in which it is installed.
4. Clearance to any combustible elements of the building shall be not less than 40 inches from the discharge.
5. If the termination is a louver installed in the wall, the cooking devices shall be exhausted through a water-wash type exhaust system.

CHAPTER 5
DUCTS AND DUCT SYSTEMS

501 SCOPE

501.1 General

All duct systems used for the movement of air or material in air conditioning, heating, ventilating, environmental exhaust and conveying systems shall conform with the provisions of this chapter. See 307 and 308 for ventilating and exhaust systems for the removal of dust, smoke, fumes, gases, vapors, odors or other hazardous, noxious or injurious impurities.

501.2 Limitations

When referred to in this section, commercial duct applies to all systems serving spaces of over 25,000 cu ft and residential duct applies to all systems serving one and two family dwellings and spaces 25,000 cu ft and less.

502 STANDARDS

Ducts shall be constructed, braced, reinforced and installed to provide structural strength and durability. Ducts and duct systems complying with the requirements of the following standards shall be deemed as meeting the intent of this Code:

1. SMACNA HVAC Duct Construction Standards, Metal and Flexible and SMACNA Fibrous Glass Duct Construction Standard.
2. The Equipment Volume of the Handbook published by the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
3. UL 181.

503 DUCT MATERIALS

503.1 Allowable Materials

All ducts shall be constructed of iron, steel, aluminum or other approved material.

503.2 Commercial Duct Systems

503.2.1 Flexible and rigid Class 0 and Class 1 duct materials may be used when installed in accordance with the conditions of their listing, provided they are not used for vertical risers serving more than two stories and they are used on duct systems having a maximum air temperature of 250°F. Listed air duct material is not limited in length.

503.2.2 When approved by the Mechanical Official, part of the building structure may be used as a duct when installed in accordance with one of the following:

1. Ductwall construction consisting of not less than 3/4-inch cement or gypsum plaster on metal lath applied to suitable supports.
2. Duct walls of masonry construction of proper strength and design.
3. Properly constructed and lined passages of gypsum wallboard may be used for ductwalls for return air and heating ducts in which no condensation is to be encountered.

503.3 Residential Duct Systems

503.3.1 All ducts shall be constructed of metal having a minimum thickness as shown in the following table:

	Diam. or Width (in)	Nominal Thickness (in)	Equiv. Galvanized Sheet Gage No.	Aluminum Thickness (in)
Round Ducts:				
	14 or less	.0127	30	.0183
	Over 14	.0157	28	.023
Exposed Rectangular Ducts:				
	14 or less	.0157	28	.023
	Over 14	.0187	26	.032

503.3.2 Nonmetallic ducts and duct materials may be used for duct systems serving listed automatic-fired heating equipment having a 250°F temperature limit control when installed in accordance with the conditions of their listing and the following:

1. The entire system including plenums may be Class 0 or Class 1 materials.
2. Class 2 materials may be used in single-family dwellings only and shall not be used for ducts located within the first 3 ft of the bonnet, plenum or casing of the heating unit.

503.3.3 Return ducts, except those portions directly above the heating surface or closer than 2 ft from the heating unit casing, may be constructed of materials having a flame spread rating not higher than 200.

504 DUCT CONSTRUCTION AND INSTALLATION

504.1 Joints, Seams And Connections

504.1.1 Joints and seams shall be securely fastened and made substantially air tight. Where tape is used for sealing joints, it shall not be more combustible than flameproof fabric. All slip joints shall have at least a 1-inch lap which is mechanically fastened.

504.1.2 Vibration isolation connectors between ducts and mechanical systems shall be of an approved flame retardant fabric, and shall be 10 inches or less in length. On commercial systems, a sleeve joint packed with an approved material having a maximum flamespread rating of 25 and maximum smoke developed rating of 50 may be used.

504.1.3 Branches of the duct system shall be connected by one of the following:

1. factory take-off fittings, or
2. dovetail fittings constructed using alternating 3/4 x 3/4 inch tabs with joints sealed with caulking and tape.

504.1.4 Joints in all round pipe shall be secured with three or more sheet metal screws.

504.2 Protection

Ducts shall be suitably protected when placed in locations where they may be subject to damage, rupture or corrosion.

504.3 Support

Metal ducts shall be securely supported, hung or suspended by metal hangers,

installed in accordance with the manufacturer's recommendations.

507.1.2 All ducts shall slope to an accessible plenum for drainage of condensate.

507.1.3 Ducts shall be properly sealed and secured prior to pouring the concrete encasement.

508 DUCT CLEARANCES

508.1 Commercial Systems

508.1.1 Metal ducts serving heating equipment shall have a clearance from combustible construction of not less than 1/2 inch. In concealed ceiling, wall and partition spaces where the 1/2 inch clearance cannot be maintained, the interior surfaces of the concealed space shall be protected with 1/4-inch approved insulating material.

508.2 Residential

508.2.1 Supply ducts serving automatically-fired heating equipment equipped with 250°F temperature limit control shall have a clearance from combustible construction as follows:

1. When the heating unit is listed, not less than 2 inches for ducts within 3 ft of the plenum.
2. When the heating unit is unlisted, not less than 6 inches for ducts within 6 ft of the plenum.
3. Beyond the distances specified in (1) and (2) above, no clearance is required.

508.2.2 Clearances from combustible construction to vertical ducts, risers, boots and register boxes which connect to ducts within the distances from the plenum specified in 508.2.1 shall be not less than that specified for the duct.

509 PLENUMS

509.1 Plenum Chambers

509.1.1 General

A room, attic, void, hollow or concealed space shall not be used as an integral part of a duct system or plenum unless the component parts of such space are constructed entirely of noncombustible material, properly protected by means of fire dampers and/or fan cut-off controls so as to restrict the spread of fire, and arranged so as to protect the fire resistance of the assembly. For exception see 509.2. Such chambers shall not be used for storage or occupational purposes. Public exit corridors in hotels, hospitals, institutions and similar occupancies and in multi-family dwellings shall not be used as plenums for adjoining areas other than toilet rooms, bathrooms, shower rooms, sink closets, and similar auxiliary spaces opening directly on the corridor. Stairway enclosures connecting two or more stories shall not be used as plenums.

EXCEPTIONS:

1. This requirement shall not prohibit the use of mechanical ventilation for the corridors or incidental exfiltration because of pressure differential in institutional occupancies.

2. In multifamily dwellings, hotels and similar occupancies, this requirement shall not prohibit the use of a corridor as a source of make-up air through normal leakage around doors for interior exhaust fans in kitchen, appliances, bathrooms and toilets.

3. Return plenum chambers for residential duct systems as defined in 501: Nothing in 509.1 shall restrict the use of wood louvered doors, wood frame mechanical equipment supports, approved plastic type condensate drain lines, approved plastic fire sprinkler piping, water heater pans and drain line approved by the plumbing code, and piping insulation installed in mechanical equipment closets, provided all mechanical equipment meets requirements of 301.2.

4. Fuel gas lines may be installed in accessible above-ceiling spaces and crawl spaces, whether or not such spaces are used as a plenum. Gas valves and plumbing waste cleanouts shall not be located within the plenum space.

509.1.2 Material

Combustible material shall not be used in plenums unless it is properly protected or meets all standards of Class I Duct Material as defined by UL 181. Single and multi-conductor low voltage and power limited electrical wire and cables tested in accordance with UL 910 and having a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flamespread of 5 ft or less and classified as having adequate fire resistance and low smoke producing characteristics shall be permitted in concealed spaces such as spaces over suspended ceiling, plenums, ducts and other spaces used for environmental air handling purposes. Wiring meeting these requirements shall be listed and labeled as plenum cable. Piping insulation materials shall comply with the requirements of 610.1.2 in order for their use to be permitted in plenums.

509.2 Plenum Floor Systems

509.2.1 General

509.2.1.1 The use of a crawl space as a plenum shall be restricted as provided herein. Such spaces shall have not less than 3-inch clearance between the bottom of the floor joists and girders and the vapor barrier membrane. Such spaces shall be cleaned of all excess combustible material and shall not be used as a storage area.

509.2.1.2 The enclosing material of the underfloor space, including the side wall insulation, shall have a flamespread classification of not more than 200.

509.2.1.3 Access, if provided to such spaces, shall be through an opening in the floor and shall not be greater than 24 x 24 inches.

509.2.1.4 The furnace supplying such space shall be equipped with an automatic control having a maximum setting of 150°F designed to start the furnace fan when the bonnet temperature reaches the setpoint of the control and an approved temperature limit control designed to limit the outlet temperature to 200°F.

509.2.1.5 Furnaces, boilers or other heat-producing appliances shall not be installed inside the plenum.

509.2.2 Construction Practices

509.2.2.1 Framing shall comply with the requirements of the Standard Building Code.

509.2.2.2 Where required, preservatives for decay and termite protection shall be of approved water borne type.

509.2.2.3 Chemical soil treatment shall be applied to both sides of the foundation wall from the footing to the grade level. Approved chemicals shall be used. All excavations for plumbing and other services shall be completed at the time of the chemical soil treatment, or retreatment shall be necessary.

509.2.2.4 After the soil has been treated, a vapor barrier shall be provided within the foundation perimeter, from wall to wall, with joints lapped 4 inches but not sealed. The vapor barrier membrane shall be carefully fitted around pipes and drains and turned up at the foundation wall. The vapor barrier membrane shall be equal to or greater than polyethylene film of 4 mil thickness and a flamespread classification of 200 or less.

509.2.2.5 A noncombustible receptacle shall be placed below each floor register into the air chamber. Such receptacle shall conform to the following:

1. The receptacle shall be securely suspended from the floor members and shall not be more than 18 inches below the opening.
2. The size of the horizontal projected area of the receptacle shall extend 3 inches beyond the opening.
3. The perimeter of the receptacle shall have a vertical lip at least 1 inch high at the open sides if it is at the level of the bottom of the joints or 3 inches high if the receptacle is suspended.

509.2.2.6 The foundation wall shall be insulated along its inner face from the sill vertically to the underfloor plenum grade level and horizontally over the vapor barrier, a distance of 2 ft. The plenum system shall be insulated to provide a thermal resistance, excluding film resistance, of:

$R = (\Delta t\ hr/15)\ (°\ F)(ft^2/Btu)$

Where Δt = the design temperature between the air in the plenum floor system and the minimum outdoor design temperature.

509.2.2.7 Outlets from the plenum shall be provided by one of the following methods:

1. Approved air slots, floor registers or wall registers shall be provided.
2. Floor registers shall be designed for easy removal in order to give access for cleaning.
3. Wall registers shall be connected to the plenum space with a duct or boot complying with the requirements of this chapter.

510 FIRE PROTECTION OF DUCTS

510.1 Fire Door

Duct penetrations of fire walls having a fire resistance rating of 3 hours or more shall be protected by installing a listed fire door satisfactory for Class A openings on both sides of the walls.

510.2 Fire Dampers

510.2.1 Listed fire dampers shall be installed in accordance with the manufacturer's installation instructions in the following locations:

1. Ducts penetrating walls or partitions enclosing exits, boilers, and furnaces having a fire resistance rating of 1 or more hours.
2. Ducts penetrating shaft walls having a fire resistance rating of 1 or more hours.
3. Ducts penetrating floors of buildings requiring the protection of vertical openings when the duct is not protected by shafts described in 510.5.

510.2.2 Fire Dampers are not required under the following conditions:

1. In buildings which do not require protected floor openings.
2. In duct systems serving only one floor and used only for exhaust of air to the outside and not penetrating a wall or partition having a required fire resistance rating of 2 hours or more or passing entirely through the enclosure for a vertical shaft.
3. Where branch ducts connect to return risers in which the air flow is upward and subducts at least 22 inches long are carried up inside the riser at each inlet.
4. ☆ In openings in shaft walls in fully sprinklered buildings which are supervised.
5. Protection of the openings in a 1-hour wall by having not less than 1/2-inch clearance of the duct from combustible material retained, and the duct secured in the opening, by steel collars of a gage equivalent to that of the duct and fastened to both the duct and the enclosure, or other approved method affording equivalent protection.

510.3 Ceiling Penetration

Ducts penetrating the ceiling of a fire resistant roof/floor and ceiling assembly shall be protected by methods complying with the design of the assembly or by ceiling dampers specifically designed and listed for this type service.

510.4 Smoke Dampers

Unless the air system is designed to provide smoke control or pressurization functions during a fire emergency, smoke dampers with listed operators shall be installed at all duct penetrations of required smoke partitions.

TABLE 604 (Continued)
PIPE SPECIFICATIONS

Materials	Standards	Type	Max. Pressure	Max. Temp.	Max. Size	Type Joint
PB (SDR 11)	ASTM D3309 including Appendix	II	100 psi	@ 180°F	2"	Insert, Mechanical or Fusion
PB (SDR 15)	ASTM D2662 including Appendix	II	125 psi	@ 73°F	6"	Insert or Mechanical
(SDR 11.5)			160 psi	@ 73°F		
(SDR 9)			200 psi	@ 73°F		
(SDR 7)			250 psi	@ 73°F		
PB (SDR 13.5)	ASTM D2666 including Appendix	II	160 psi	@ 73°F	2"	Mechanical or Fusion
(SDR 9)			250 psi	@ 73°F		
PB (SDR 17)	ASTM D3000 including Appendix	II	125 psi	@ 73°F	6"	Mechanical Fusion or Flange
(SDR 13.5)			160 psi	@ 73°F		
(SDR 11)			200 psi	@ 73°F		
(SDR 9)			250 psi	@ 73°F		

607 FUEL OIL PIPING AND STORAGE

607.1 Gas Piping

607.1.1 Natural Gas Piping

All natural gas fuel piping shall be sized, installed, tested, and placed in operation in accordance with the requirements of the Standard Gas Code.

607.1.2 Liquefied Petroleum Gas (LPG) Piping

All LPG fuel piping shall be sized, installed, tested, and placed in operation in accordance with the requirements of the Standard Gas Code.

607.2 Flammable Liquid Storage

Flammable liquids shall be stored in accordance with the North Carolina State Fire Prevention Code and the appropriate NFiPA standards.

607.3 Liquid Fuel Piping

607.3.1 Piping materials and design.

607.3.1.1 All piping shall be wrought iron, steel or brass pipe, or brass or copper tubing except piping may be of materials other than these if used underground. Such piping shall be designed to specifications embodying priciples recognized as good engineering design for the material used and shall be approved by the authority having jurisdiction.

607.3.1.2 Wall thicknesses of wrought iron and steel pipe shall be in accordance with design methods outlined in ANSI B36.10. Listed flexible metal hose may be used to reduce the effect of jarring and vibration or where rigid connections are impracticable and shall be installed in full compliance with its listing.

607.3.1.3 Piping used in the installation of oil burners and appliances other than conversion range oil burners shall be not smaller than 3/8-inch iron pipe size or 3/8-inch OD tubing except that 1/4-inch pipe or 5/16-inch OD tubing may be used in the suction line of systems where the top of the tank is below the level of the oil pump. Copper tubing shall have 0.035-inch nominal and 0.032-inch minimum wall thickness.

607.3.1.4 Pipe shall be connected with standard fittings and tubing with fittings of listed type. Pipe connectors made of combustible materials or depending upon the frictional characteristics of combustible materials shall not be used inside of buildings or above ground outside of buildings. If used below ground outside of buildings, connectors shall be of listed type and installed in accordance with their listing. All threaded joints and connections shall be made tight with suitable lubricant or pipe compound. Unions requiring gaskets or packings, right or left couplings, and sweat fittings employing solder having a melting point of less than 1000°F shall not be used in oil lines. Cast iron fittings shall not be used.

607.3.1.5 Piping shall be substantially supported and protected against physical damage and where necessary protected against corrosion. All buried piping shall be protected against corrosion. Drop pipes from shop piping mains to burners are subject to physical damage and it may be necessary to enclose them in heavier pipe or the equivalent means to safeguard against breakage.

607.3.1.6 Proper allowance shall be made for expansion, contraction, jarring and vibration. Pipe lines other than tubing, connected to underground tanks, except straight fill lines and test wells, shall be provided with double swing joints, flexible connectors, or otherwise arranged to permit the tanks to settle without impairing the tightness of the pipe connections.

CHAPTER 9
REFERENCE STANDARDS

901 REFERENCED STANDARDS

STANDARD DESIGNATION	SECTION
ACCA Manual J: Load Calculation for Residential Winter and Summer Air Conditioning, 1981	B102
ACCA Manual N: Load Calculation for Commercial Summer and Winter Air Conditioning, 1982	B102
ANSI B 2.1-1960, Pipe Threads	602.12.1
ANSI B 9.1-1971, Safety Code for Mechanical Refrigeration	302.4, 405, 406.2.2
ANSI B 36.10-1975, Welded and Seamless Wrought Steel Pipe	606.1 607.3.1.2
ANSI B 50.11-1965, Synchronous Motors	302.6.2
ANSI B 72.1-1967	Table 604
ANSI B 72.2-1967	Table 604
ANSI B 23.1-1971, Centrifugal Pump for Process Use	302.6.1
ANSI Z21.13, Gas Fired Low-Pressure Steam and Hot Water Heating Boilers	304.2
ANSI Z21.59, Gas Fire High Pressure Steam and Hot Water Boilers	304.2
ASHRAE Applications Handbook, Chapter 57, Solar Energy Utilization for Heating and Cooling, 1982	309.1.6
ASHRAE Handbook of Fundamentals, 1981	608.1.1, B102
ASHRAE Handbook & Product Directory Equipment, 1980	302.4, 502
ASHRAE Handbook & Product Directory-Systems 1980	302.4
ASME Boiler and Pressure Vessel Code: Section I, Power Boilers Section IV, Heating Boilers Section IX, Welding and Brazing Qualifications	304.2, 304.4.2, Table 602.1
ASTM A 53-87b, Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless	Table 602.1 Table 604
ASTM A 120-84, Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses	Table 602.1, Table 604
ASTM B 42-88, Specification for Seamless Copper Pipe, Standard Sizes	Table 602.1, 608.2.3

ASTM B 43-88, Specification for Seamless Red Brass Pipe, Standard Sizes	Table 602.1 608.2.3
ASTM B 88-88a, Specification for Seamless Copper Water Tube	Table 602.1, Table 604, 608.2.4
ASTM B 280-88, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service	608.2.5
ASTM C 411-82(1987), Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation	309.6.5, 506.1.2
ASTM D 1785-86, Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120	Table 604
ASTM D 2104-85, Specification for Polyethylene (PE) Plastic Pipe, Schedule 40	Table 604
ASTM D 2239-85, Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter	Table 604
ASTM D 2662-83, Specification for Polybutylene (PB) Plastic Tubing	Table 604
ASTM D 2666-83, Specification for Polybutylene (PB) Plastic Tubing	Table 604
ASTM D 3000-73(1981), Specification for Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter	Table 604
ASTM D 3309-85b, Specification for Polybutylene (PB) Plastic Hot-Water Distribution Systems	Table 602.1, Table 604
ASTM D 3667-85, Specification for Rubber Seals Used in Flat-Plate Solar Collectors	309.5.2
ASTM D 3771-85, Specification for Rubber Seals Used in Concentrating Solar Collectors	309.5.2
ASTM D 3832-79(1987), Specification for Rubber Seals Contacting Liquids in Solar Energy Systems	309.5.2
ASTM E 84-87, Test Method for Surface Burning Characteristics of Building Materials	202, 309.6.4, 309.7.3, 610.1
ASTM E 136-1982, Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C	202
CABO Model Energy Code, 1989 Edition	B101
HYDI C 30-1973, Cooling Load Calculation Guide	B102
HYDI H 21-1984, Heat Loss Calculation Guide	B102
Incinerators Institute of America Standards	703

ASME	American Society of Mechanical Engineers United Engineering Center 345 East 47th Street New York, New York 10017
ASSE	American Society of Sanitary Engineering 228 Northern Ohio Bank Bldg. 1370 Ontario Street Cleveland, Ohio 44113
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, Pennsylvania 19103
CABO	Council of American Building Officials 5203 Leesburg Pike, Suite 708 Falls Church, Virginia 22041
CDA	Copper Development Association, Inc. 405 Lexington Avenue New York, New York 10017
CISPI	Cast Iron Soil Pipe Institute 1499 Chain Bridge Road, Suite 203 McLean, Virginia 22101
CS	Commercial Standards Superintendent of Documents Government Printing Office Washington, D.C. 20402
CSPP	Committee of Steel Pipe Producers American Iron and Steel Institute 1000 16th St. NW Washington, D.C. 20036
FMED	Factory Mutual Engineering Division Standards-Laboratories Department 1151 Boston-Providence Turnpike Norwood, Massachusetts 02060
FS	Federal Specifications Superintendent of Documents Government Printing Office Washington, D.C. 20234
HYDI	The Hydronics Institute 35 Russo Place Berkeley Heights, New Jersey 07922

IIA	Incinerator Institute of America 60 East 42nd Street New York, New York 10017
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry 420 Lexington Avenue New York, New York 10017
NBS	National Bureau of Standards (Department of Commerce) Superintendent of Documents Government Printing Office Washington, D.C. 20402
NFiPA	National Fire Protection Association Batterymarch Park Quincy, Massachusetts 02269
NIMA	National Insulation Manufacturers Association 7 Kirby Plaza Mount Kisco, New York 10549
NPGA	National Propane Gas Association 1301 West 22nd Street Oak Brook, Illinois 60521
NOFI	National Oil Fuel Institute, Inc. 60 East 42nd Street New York, New York 10017
NSF	National Sanitation Foundation NSF Building 3475 Plymouth Road Ann Arbor, Michigan 48106
PPI	Plastics Pipe Institute A Division of The Society of the Plastic Industry, Inc. 250 Park Avenue New York, New York 10017
SGA	Southern Gas Association 924 Life Building Dallas, Texas 75202

APPENDIX A

Reserved for Future Use.

APPENDIX C

Reserved for Future Use.

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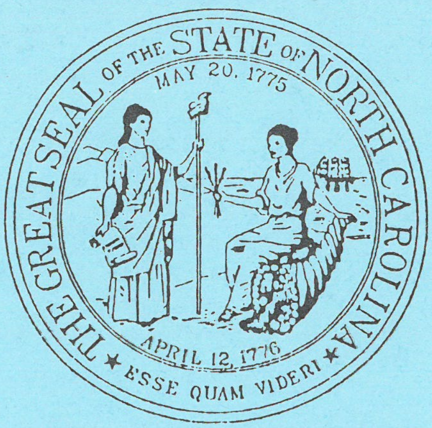
North Carolina
State Building Code



1992 Revisions

Volume III – MECHANICAL

1988 Standard Mechanical Code with North Carolina Amendments

**(Revisions Adopted Through
September 10, 1991
Effective January 1, 1992)**

**North Carolina Building Code Council
and
North Carolina Department of Insurance
Post Office Box 26387
Raleigh, North Carolina 27611**

INFORMATION SHEET
1992 AMENDMENTS

The 1988 Standard Mechanical Code has been amended by the North Carolina Building Code Council as follows:

1. Standard Mechanical Code changes adopted by the Council:
301.3, 303.3, 303.4, 303.7, 303.8, 306.3, 306.15.7.3, 306.15.7.4, 306.17.3.6, Table 306A, Table 306C, 307.1, 509.1, 509.2, and Chapter 9.

2. Additional changes adopted by the Council:
Chapter 1, 202 Definitions (Boiler Room, Furnace Room, and Mechanical Room), 301.3.2.2, 301.4, 302.2, 303.4, 303.5, 303.6, 304, 307.2, 308.2.4, 308.4.1.1, 308.5.3, 308.6.2, 308.8, 308.9, 504.1.3, 504.1.4, 510.2, 515, 517, 603.4, 607, 801.2, Chapter 9 (NFiPA 72E), and Appendix A and C.

REVISION MARKS NOTATIONS

Broken vertical bars in the margin indicate September 1990 Revisions.

Open stars in the margin indicate September 1990 Deletions. ☆

Solid vertical bars in the margin indicate 1991 Edition.

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Volume I–GENERAL CONSTRUCTION
Volume IA–ADMINISTRATION
Volume IB–N.C. UNIFORM RESIDENTIAL BUILDING CODE
Volume IC–ACCESSIBILITY
Volume ID–N.C. REGULATIONS FOR MODULAR CONSTRUCTION
Volume II–PLUMBING
Volume III–MECHANICAL
Volume IV–ELECTRICAL
Volume V–FIRE PREVENTION
Volume VI–GAS

CHAPTER 1
ADMINISTRATION

101 TITLE AND SCOPE

Provisions of the following chapters and sections shall constitute and be known and may be cited as the "North Carolina State Building Code, Volume III, Mechanical'', hereinafter referred to as "this Code.'' For Administration requirements, refer to the "North Carolina State Building Code, Volume I-A, Administration and Enforcement Requirements.''

102 APPLICABILITY

The provisions of the Mechanical Code shall apply to the installation of mechanical systems, including alterations, repairs, replacement, equipment, appliances, fixtures, fittings and/or appurtenances, including ventilating, heating, cooling, air conditioning and refrigeration systems, incinerators, and other energy-related systems.

103 EXCEPTIONS TO APPLICABILITY

The provisions of the Code shall not apply to the following:

1. Buildings for the use of any farmer or his immediate family located outside the building regulation jurisdiction of any municipality when use of the building does not involve the health and safety of the public. If the operation of such can be considered a business endeavor, it shall meet the provisions of the technical codes.

   EXCEPTION: All buildings used for sleeping purposes shall conform to the provisions of the technical codes. All electric wiring of houses, buildings, or structures shall conform to the provisions of the North Carolina State Electrical Code.
2. The design, construction, location, installation or operation of equipment for storing, handling, and transporting liquified petroleum gases for fuel purposes up to the outlet of the first stage pressure regulator, and anhydrous ammonia or other liquid fertilizers.
3. The design, construction, location, installation or operation of equipment or facilities of a public utility, as defined in G.S. 62-3, or an electric or telephone membership corporation, including without limitation poles, towers, and other structures supporting electric or communication lines from the distribution network up to the meter location.

   NOTE: All buildings owned and operated by a public utility or an electric or telephone membership corporation shall meet the provisions of the Code.
4. The Storage and Handling of Hazardous Chemicals Right to Know Act, North Carolina General Statute 95-173–95-218.

104 CROSS REFERENCES

For all cross references which specify the Standard Building, Plumbing, Fire Prevention, or Gas Codes or NFiPA 70, the North Carolina editions shall be the Code indicated. ★

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CHAPTER 2 DEFINITIONS

CHAPTER 3 AIR CONDITIONING, HEATING AND VENTILATION EQUIPMENT

CHAPTER 4 REFRIGERATION

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CHAPTER 8 ELECTRICAL REQUIREMENTS

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CHAPTER 3
AIR CONDITIONING, HEATING AND VENTILATION EQUIPMENT

301 GENERAL

301.1 Scope
This chapter is intended to insure the safe design, construction, installation, and repair of equipment used in systems pertaining to air conditioning (space cooling), heating, and ventilation.

301.2 Approval
All listed equipment shall be installed in accordance with its listing and the equipment shall be labeled accordingly, including the seal or mark of the testing agency which certifies the listing. All unlisted equipment shall be installed in accordance with this Code. Equipment installed outside shall be supported on pre-cast or poured concrete, masonry units, approved prefabricated inorganic materials, structural steel or pressure treated wood.

301.3 Structural Safety
301.3.1 General In the process of installing or repairing any air conditioning, heating, and ventilation equipment, the finished floors, walls, ceilings, tile work or any other part of the building or premises which must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the Standard Building Code.

301.3.2 Cutting, Notching And Bored Holes
301.3.2.1 Notches on the ends of joists shall not exceed one-fourth the depth. Holes bored for pipes or cable shall not be within 2 inches of the top or bottom of the joist and the diameter of any such hole shall not exceed one-third of the depth of the joist. Notches for pipes in the top or bottom of joists shall not exceed one-sixth of the depth and shall not be located in the middle one-third of the span.
301.3.2.2 In exterior walls and bearing partitions, any wood stud may be cut or notched to a depth not exceeding 25% of its width. Cutting or notching of studs to a depth not greater than 40% of the width of the stud is permitted in nonbearing partitions supporting no loads other than the weight of the partition.

EXCEPTION: Cutting and notching of studs may be increased to 65% of the width of the stud in exterior or interior walls and bearing partitions, provided that one of the following conditions is met:

1. The wall section is reinforced with 1/2" exterior grade plywood or equivalent reinforcement on the notched side of the wall. Plywood if used, shall reach from the floor to ceiling and at least one stud further on each side of the section that has been notched or cut.

2. The exterior walls of a kitchen may be reinforced by placing 1/2" plywood or equivalent reinforcement on the notched side of the wall. Plywood, if used, shall reach from the floor to counter-top height and at least one stud further on each side of the section that has been notched or cut.

301.3.2.3 A hole not greater in diameter than 40% of the stud width may be bored in any wood stud. Bored holes not greater than 60% of the width of the stud are permitted in nonbearing partition or in any wall where each bored stud is doubled provided no more than two such successive double studs are bored.

301.3.2.4 In no case shall the edge of the bored hole be nearer than 5/8 inch to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

301.4 Firestopping

All openings around pipes, tubing, wiring, conduit, etc., shall be firestopped in accordance with Chapter 10 of Volume I.

302 AIR CONDITIONING EQUIPMENT

302.1 Scope

This section covers the location, installation, alteration, replacement, repair and maintenance of air conditioning equipment. The requirements of 303.2, 303.3, 303.4 and 303.5 of this Code shall apply to air conditioning equipment.

302.2 Labeling

302.2.1 Listing of Heating and Air Conditioning Equipment Heating and air conditioning equipment (electric, gas and oil) shall be listed by a nationally recognized testing agency and shall be installed in accordance with its listing. When test standards are not available, or when sufficient different makes of listed equipment are not reasonably available locally [three or more manufacturers], equipment constructed in accordance with applicable NEC, ASME, ARI or ANSI standards using listed component parts such as burners, heaters, safety controls, wiring and safety valves and installed in strict compliance with the manufacturer's recommendations will be acceptable. Equipment accepted and certified by FM and FIA are also acceptable.

Other equipment used in environmental comfort control systems such as humidifiers, air handling fans and power roof ventilators and fan coil units, shall be either listed or shall have motors which comply with NEMA standards, wiring complying with the National Electric Code and shall be used only for service recommended by the manufacturer.

302.2.2 Listing of appliances other than Heating & Air Conditioning & Ventilating Equipment (Such as dryers, ranges, gas logs, and similar devices) These types of appliances shall be listed by a national recognized testing agency and installed according to the listing. The authority having jurisdiction shall accept without further examination and test the listings of UL or AGA.

302.3 Instructions

Permanent factory-applied instructions for ignition, operation and shutdown shall accompany the equipment. The manufacturer's instructions shall remain attached to the appliance in a position to be easily read during the life of the appliance.

302.4 National Standards

For the purpose of assisting in obtaining the objectives of this Code, all the national standards listed in Chapter 9 are hereby adopted by reference and shall be considered a part of this Code to the extent of and with the limitations set upon therein the specific sections wherein they are applicable.

Title of Standard	Designation
Handbook & Product Directory–Equipment	ASHRAE
Handbook & Product Directory–Systems	ASHRAE
Safety Code for Mechanical Refrigeration	ANSI B9.1
Standard on Water-Cooling Towers	NFiPA 214
Standard for Installation of Warm Air Heating and Air Conditioning Systems	NFiPA 90B
Standard for Installation of Air Conditioning and Ventilating Systems	NFiPA 90A

302.5 Chilled, Steam And Hot Water Piping, Gas Piping

Piping systems in which chilled or hot water is transported for heating, air conditioning, or refrigerating shall be fabricated and installed in accordance with Chapter 6 of this Code. Gas piping shall conform to the Standard Gas Code.

302.6 Pumps And Pump Motors

302.6.1 Pumps external to listed equipment and used for circulation of water or other liquid flow in heating, ventilating, and air conditioning systems shall comply with the requirements for design and operation of ANSI B123.1.

302.6.2 Synchronous motors that are part of a heating, ventilating, or air conditioning system shall comply with the ANSI B50.11.

302.7 Water Cooling Towers And Condensers

302.7.1 The construction and supports for water cooling towers, evaporating condensers and air-cooled condensers shall comply with the requirements of the Standard Building Code.

302.7.2 Water from such units shall be discharged into an approved disposal system in accordance with the Standard Plumbing Code. All water supply, waste water and connection shall comply with the requirements of the Standard Plumbing Code.

302.8 Duct Systems

302.8.1 Design, construction and installation of air ducts shall comply with Chapter 5.

302.8.2 Clearances from warm air ducts shall conform to 303.7.

302.8.3 Subject to the approval of the Mechanical Official, no clearance is required for ducts without heating used solely for ventilation, or air cooling.

302.9 Mechanical Refrigeration

All refrigeration equipment used as a portion of air conditioning equipment shall comply with Chapter 4.

303 HEATING EQUIPMENT OTHER THAN BOILERS

303.1 General

This section covers the location and installation for heat producing appliances and their accessories. When the requirements for listed appliances and their accessories are different from the requirements of this section, such listed applian-ces may be installed in accordance with the conditions specified in their listing. Listed appliances and their accessories installed or used not according to the conditions specified in their listing and all appliances not listed shall conform to the requirements of this section.

303.2 Accessibility For Service

303.2.1 Every appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls and vent connections; the lubrication of moving parts where required; and the adjustment and cleaning of burners and pilots.

303.2.2 Appliances listed for outdoor installations may be installed without protection in accordance with the provisions of their listing and shall be accessible for servicing. Appliances listed "for outdoor installation only'' shall not be installed inside a building.

303.2.3 Where an appliance is located in an equipment room, such room shall have an opening or door and passageway thereto, which is large enough to permit removal of the largest piece of the appliance, but not less than 20 inches wide.

303.3 Prohibited Location

Central furnaces (using solid, liquid or gas fuel), except direct vent or heating coils located in air handling units, shall not be installed:

1. Under a stairway
2. In a room used as a bedroom, bathroom, or in a closet with access only through a bedroom or bathroom.

   EXCEPTION: When a closet, having a weather-stripped solid door with an approved door closing device, has been designed exclusively for the central furnace and where all air for combustion and ventilation is supplied from outdoors.

303.4 Attic Installation

Every attic or furred space in which mechanical equipment is installed shall be accessible by an opening and passageway as large as the largest piece of the equipment and in no case less than 22 x 36 inches continuous from the opening to the equipment and its controls. The opening to the passageway shall be located not more than 20 ft from the equipment measured along the center line of such passageway. Every passageway shall be unobstructed and shall have solid continuous flooring not less than 24 inches wide from the entrance opening to the equipment. On the control side and other sides where access is necessary for servicing the equipment a level working platform extending a minimum of 30 inches from the edge of the equipment with a 36-inch high clear working space shall be provided. Top or bottom service equipment shall have a full clearance above or below the unit for component removal.

303.5 Under Floor Installations

303.5.1 All mechanical equipment installed in the underfloor area of any building shall comply with the following requirements:

1. An access opening and passageway of a height and width sufficient to permit removal of the mechanical equipment and in no case less than 36 wide x 22 high inches shall be provided to the working space in front of the mechanical equipment. The access opening to any such passageway shall be through an opening in an exterior wall of the building or through a trap door within the building.
2. In a crawl space, a minimum of 4 x 8 x 16 inch block or brick supports shall be installed under equipment. All stacked masonry units shall be held in place with mortar. Below grade installations shall be provided with a natural drain or an automatic lift or sump pump. Formed concrete or approved prefabricated steel units are acceptable. Equipment may be supported from floor joists with steel supports or with wood supports when the equipment is labeled for zero clearance to combustibles.
3. The lowest portion of mechanical equipment suspended from the building shall have a clearance of at least 6 inches from the ground.
4. Whenever it is necessary to excavate to install any such mechanical equipment, the excavation shall extend to a depth of 6 inches below the mechanical equipment and 12 inches on all sides of the mechanical equipment, except the control side, which shall have a clearance of 30 inches.
5. In floodplain areas, the entire crawl space grade or height shall be such that a 12-inch clearance will exist between the bottom of the mechanical equipment and the ground.

303.6 Roof Or Exterior Wall Installation

303.6.1 Mechanical equipment installations on roofs or exterior walls of buildings shall comply with the requirements for roof and wall structures as specified in the Standard Building Code, and shall be listed and approved for such use.

303.6.2 Each appliance shall have an accessible weatherproof disconnect switch and a 110-120 volt AC grounding type convenience outlet on the roof adjacent to the appliance. The convenience outlet shall be on the supply side of the disconnect switch.

303.6.3 Every appliance located on a roof of a building shall be installed on a substantial level platform. Whenever the roof has a slope greater than 3:12, a level working platform not less than 30 inches deep shall be provided in front of the entire firebox and control sides of the appliance. Guard rails 42" high and of a type permitted in areas not accessible to the public or a 36" high parapet shall be provided when any side of a working platform is facing any portion of a roof edge below the platform or when any side of an appliance faces any portion of a roof edge which is 6 feet or less from the side. Required working platforms and railings may be omitted when access to the equipment is through a required roof scuttle and all of the following provisions are met:

1. The required scuttle is located immediately adjacent to the control side of the equipment unit.
2. All controls, filters, burners, fans and motors are accessible for service and repair within 2 ft of the edge of the equipment platform on the scuttle side.
3. The equipment platform is not more than 20 inches above the high side of the scuttle opening.
4. A substantial working platform not less than 30 inches by 30 inches shall be provided directly below the scuttle at a point not less than 30 inches or more than 32 inches below the high side of the scuttle opening.
5. Scuttles located on other than the roof incline side of the equipment unit shall have their lids or trap doors hinged on the low side of the scuttle.

303.6.4 Every appliance in or on an exterior wall of a building, which is so designed that the components are serviceable only from outside the building, shall be accessible. Every appliance located on the roof of any building shall be accessible.

EXCEPTION: When the roof is less than 20 ft above grade the use of portable means of access is acceptable.

303.7 Mounting

Heat producing appliances listed for mountings on combustible floors shall be installed strictly according to their listings, subject to the approval of the Mechanical Official.

303.8 Clearances To Combustible Materials

303.8.1 General

Clearances for listed heat producing appliances and their accessories, when listed for greater or less clearances than stipulated in this Code, shall conform to heir listings, subject to the approval of the Mechanical Official.

303.8.1.1 Clearances not covered in this Code shall be subject to the approval of the Mechanical Official.

303.8.1.2 Clearances covered in this Code shall conform to Table 303.7, except if the clearances shown in the various sections of this Code differ, they shall take precedence over those shown in Table 303.7, subject to the approval of the Mechanical Official.

303.8.2 Chimney connectors or vent connectors shall not connect to a chimney in an attic. A single wall chimney shall not pass through an attic or other space normally unoccupied.

303.8.3 Factory built wood and coal burning stoves which are listed by a nationally recognized testing laboratory shall be installed in accordance with the listing.

303.8.4 Factory built wood and coal burning stoves which have not been tested and listed shall be installed with the clearances specified in Table 303.8.

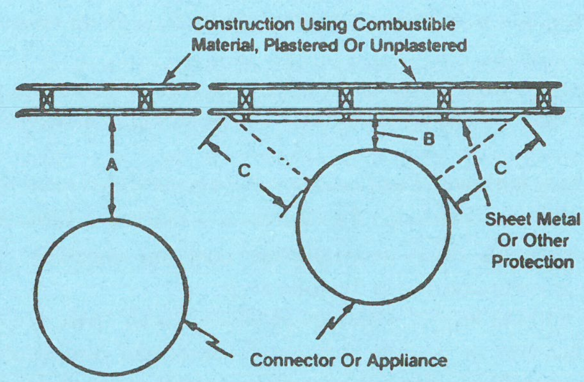
303.8.5 Combustible floors under unlisted coal and woodburning stoves shall be protected in accordance with the following:

1. Stoves without legs or with legs providing an air space less than 4 inches between ash box or bottom of firing chamber and combustible floor shall have the combustible floor protected with sheet metal or 1/8-inch asbestos, either of which shall be covered with two courses of 4-inch hollow tile or its equivalent, this in turn covered with at least 3/16-inch metal. Three courses of brick with the top course laid on edge, providing ventilating space between them, may be used in lieu of the two courses of 4-inch tile. The floor protection shall extend 12 inches beyond the sides and rear and 24 inches beyond the front of the stove.
2. Stoves equipped with legs providing an air space of 4 to 17 inches between the ash box or bottom of the firing chamber and combustible floor shall have the floor protected with sheet metal or 1/8-inch asbestos, either of which shall be covered with 4-inch hollow tile or its equivalent. The protection shall extend a minimum of 12 inches beyond the sides and rear and 24 inches beyond the front of the stove.
3. Stoves equipped with legs providing an air space of 18 inches or more between the ash box or bottom of firing chamber and combustible floor shall have the floor protected with a minimum of 28 gage metal extending 12 inches beyond the sides and 24 inches beyond the front of the stove.

303.9 Clearances With Protection

303.9.1 Appliances may be installed in rooms, but not in alcoves or closets, with clearances less than specified in Table 303.8, provided the combustible material or appliance is protected as described in Table 303.9.

FIGURE 303.9
REDUCED CLEARANCE DIAGRAM



NOTES:
A equals the required clearance with no protection, specified in Table 303.7. B equals the reduced clearance permitted in accordance with Table 303.7. The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.

303.9.2 Adequate air circulation can be provided by having all edges of the wall protector open at least 1 inch.

303.9.3 If the wall protector is mounted on a single flat wall away from corners, adequate air circulation may be provided by having only the bottom and top edges or the side and top edges open at least 1 inch.

303.9.4 Wall protectors covering two walls in a corner shall be open at the bottom and top edges at least 1 inch.

303.9.5 All clearances shall be measured from the outer surface of th combustible material to the nearest point on the surface of the solid fuel burning appliance.

303.9.6 All clearances provided between solid fuel burning appliances and combustible materials shall be large enough to maintain sufficient clearances between the combustible material and chimney connectors.

TABLE 303.8
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

These clearances apply unless otherwise shown on listed appliances. Appliances shall not be installed in alcoves or closets unless approved for such Installation. For installation on combustible floors, see note 2.

RESIDENTIAL TYPE APPLIANCE For Installation in Rooms Which are Large (See Note 3)		APPLIANCES: Above Top of Casing or Appliance	APPLIANCES: From Top and Sides of Warm-Air Bonnet or Plenum	APPLIANCES: From Front (See Note 4)	APPLIANCES: From Back	APPLIANCES: From Sides
Boilers and Water Heaters Steam Boilers–15 psi Water Boilers–250°F Water Heaters–250°F	Automatic Oil or Comb. Gas-Oil	6	–	24	6	6
	Automatic Gas	6	–	18	6	6
All Water Walled or Jacketed	Solid	6	–	48	6	6
	Electric	6	–	18	6	6
Furnaces–Central Gravity, Upflow, Downflow, Horizontal and Duct. Warm-Air–250°F Max.	Automatic Oil or Comb. Gas-Oil	6[5]	6[5]	24	6	6
	Automatic Gas	6[5]	6[5]	18	18	18
	Solid	18[6]	18[6]	48	18	18
	Electric	6[5]	6[5]	18	6	6
Furnaces–Floor For Mounting in Combustible Floors	Automatic Oil or Comb. Gas-Oil	36	–	12	12	12
	Automatic Gas	36	–	12	12	12
Heat Exchanger Steam–15 psi Max. Hot Water–250°F Max.	–	1	1	1	1	1

TABLE 303.8 (Continued)
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

RESIDENTIAL TYPE APPLIANCE For Installation in Rooms Which are Large (See Note 3)		APPLIANCES: Above Top of Casing or Appliance	From Top and Sides of Warm-Air Bonnet or Plenum	From Front See Note 6	From Back	From Sides	
Room Heaters Circulating Type Vented or Unvented	Oil or Solid	36	–	24	12	12	
	Gas	36	–	24	12	12	
Radiant or Other Type Vented or Unvented	Oil or Solid	36	–	36	36	36	
	Gas	36	–	36	18	18	
	Gas with double metal or ceramic back	36	–	36	12	18	
Radiators Steam or Hot Water	Gas	See Note 7 36	–	6	6	6	
						Firing Side	Opp Side
Ranges–Cooking Stoves Vented or Unvented	Oil	30	–	–	9	24	18
	Gas	30	–	–	6	6	
	Solid-Clay Lined Firepot	30	–	–	24	24	18
	Solid-Unlined Fiepot	30	–	–	36	36	18
	Electric	30	–	–	6	6	
Clothes Dryers Listed Types	Gas	6	–	24	6	6	
	Electric	–	–	–	–	–	
Incinerators Domestic Types	–	See Note 10 36	–	48	36	36	

TABLE 303.8 (Continued)
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

COMMERCIAL-INDUSTRIAL TYPE LOW HEAT APPLIANCES Any and All Physical Sizes Except as Noted		APPLIANCES: Above Top of Casing or Appliance See Note 8	From Top and Sides of Warm-Air Bonnet or Plenum	From Front	From Back See Note 8	From Sides See Note 8
Boilers and Water Heaters						
100 cu ft or less Any psi Steam	All Fuels	18	–	48	18	18
50 psi or Less Any size	All Fuels	18	–	48	18	18
Infra-red Heaters						
(See also "Hazardous Locations" Section 302.b)		18	–	60	18	18
Unit Heaters						
Floor Mounted or Suspended-Any Size	Steam or Hot Water	1	–	1	1	
Suspended–100 cu ft or less	Oil or Comb. Gas–Oil	6	–	24	18	18
Suspended–100 cu ft or less	Gas	6	–	18	18	18
Floor Mounted–Any Size	All Fuels	18	–	48	18	18
Ranges–Restaurant Type						
Floor Mounted	All Fuels	48	–	48	18	18
Other Low-Heat Industrial Appliances						
Floor Mounted or Suspended	All Fuels	18	18	48	18	18

TABLE 303.8 (Continued)
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

COMMERCIAL-INDUSTRIAL TYPE MEDIUM HEAT APPLIANCES		APPLIANCES: Above Top of Casing or Appliance See Note 9	From Top and Sides of Warm-Air Bonnet or Plenum	From Front	From Back See Note 9	From Sides See Note 9
Boilers and Water Heaters						
Over 50 psi						
Over 100 cu ft	All Fuels	48	–	96	36	36
Other Med-Heat Industrial Appliances						
All Sizes	All Fuels	48	36	96	36	36
Incinerators						
All Sizes	–	48	–	96	36	36
INDUSTRIAL TYPE HIGH-HEAT APPLIANCES						
High-Heat Industrial Appliances						
All Sizes	All Fuels	180	–	360	120	120

1. Standard clearances may be reduced by providing protection to combustible material in accordance with Table 303.9.
2. An appliance may be installed on a combustible floor when conforming to 303.6.
3. Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 ft the volume of a room shall be computed on the basis of a ceiling height of 8 ft.
4. The minimum dimension shall be that required for servicing the appliance including access for cleaning and normal care, tube removal, etc.
5. For a listed oil, combination gas-oil, gas, or electric furnace this dimension may be 2 inches if the furnace limit control cannot be set higher than 250°F or this dimension may be 1 inch if the limit control cannot be set higher than 250°F.

6. The dimension may be 6 inches for an automatic stoker-fired forced warm-air furnace equipped with 250°F limit control and with barometric draft control operated by draft intensity and permanently set to limit draft to a maximum intensity of 0.13-inch water gage.
7. If the underside of combustible material or metal cabinet is protected with asbestos millboard at least 1/4 inch thick covered with sheet metal of not less than No. 28 gage the distance may be not less than 24 inches.
8. If the appliance is encased in brick, the 18-inch clearance above and at sides and rear may be reduced to not less than 12 inches.
9. If the appliance is encased in brick the clearance above may be not less than 36 inches and at sides and rear may be not less than 18 inches.
10. Clearance above charging door should not be less than 48 inches.

TABLE 303.9
CLEARANCES, WITH SPECIFIED FORMS OF PROTECTION* (in)

TYPE OF PROTECTION	WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION IS:											
	36 Inches			18 Inches			12 Inch		9 Inches	6 Inches		
Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection (see Fig. 303.9). Thicknesses are minimum.	Above	Side & Rear	Chimney or Vent Connector	Above	Side & Rear	Chimney or Vent Connector	Above	Side & Rear	Chimney or Vent Connector	Above	Side & Rear	Chimney or Vent Connector
(a) 1/4 in asbestos millboard spaced out 1 in †	30	18	30	15	9	12	9	6	6	3	2	3
(b) 28 gage sheet metal on 1/4 in asbestos millboard	24	18	24	12	9	12	9	6	4	3	2	2
(c) 28 gage sheet metal spaced out 1 in †	18	12	18	9	6	9	6	4	4	2	2	2
(d) 28 gage sheet metal on 1/8 in asbestos millboard spaced out 1 in †	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1 1/2 in asbestos cement covering on heating appliance	18	12	36	9	6	18	6	4	9	2	1	6
(f) 1/4 in asbestos millboard on 1 in mineral fiber bats reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2	2
(g) 22 gage sheet metal on 1 in mineral fiber bats reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2	2	2	2
(h) 1/4 in asbestos millboard	36	36	36	18	18	18	12	12	9	4	4	4
(i) 1/4 in cellular asbestos	36	36	36	18	18	18	12	12	9	3	3	3

*Except for the protection described in (e), all clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied tothe combustible material.

† Spacers shall be of noncombustible material.

NOTES:

1. Asbestos millboard referred to above is a different material from asbestos cement board. It is not intended that asbestos cement board be used in complying with these requirements when asbestos millboard is specified.
2. The clearance from specified forms of protection shall be such as not to interfere with the requirements for accessibility in 303.2.1.
3. Where the required clearance with no protection is less than 6 inches, the required clearance for approved gas appliances may be reduced 1 inch per inch thickness of fiberglass 0.75 lb density added to protect combustible material. The insulation may be applied to the duct plenum, or combustible material to be protected.

303.10 Fuel Piping & Connections

303.10.1 Each appliance shall be designed for use with the type of fuel to which it will be connected. Such appliance shall not be converted from the fuel specified on the rating plate for use with a different fuel without securing reapproval from the Mechanical Official.

303.10.2 The tank, piping valves for appliances burning oil shall be installed in accordance with the requirements of Chapter 7 of this Code.

When 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 anti-siphon valve or other siphon breaking device shall be installed in lieu of the shutoff valve.

303.10.3 All appliances designed to burn gas shall be connected to the gas supply outlet in accordance with the Standard Gas Code.

303.11 Electric Heating Equipment

303.11.1 Electric duct heaters shall be listed and bear the seal or mark of an approved testing agency and be equipped with an approved automatic reset air outlet temperature limit control that will limit the outlet air temperature to not more than 200°F. The electric elements of the heater shall be equipped with fusible links or a manual reset temperature limit control that will prevent outlet air temperature in excess of 250°F.

303.11.2 Every electric comfort heating appliance shall bear a permanent and legible factory applied nameplate on which shall appear the following:

1. Name and trademark of the manufacturer.
2. The catalog (model) number or equivalent.
3. the electric rating in volts, ampacity and phase.
4. Btu output rating.
5. Individual marking for each electrical component in amperes or watts, volts and phase.
6. Required clearances from combustibles.
7. A seal indicating approval of the appliance by an approved testing agency.

303.11.3 Every electric comfort heating appliance shall be connected in accordance with Chapter 8 of this Code.

303.12 Panel Heating Systems

303.12.1 Panel heating is a method of radiant space heating in which heat is supplied by large heated areas of room surfaces. The heating element usually consist of warm water piping, warm air ducts, or electrical resistance elements embedded in or located behind ceiling, wall, or floor surfaces.

303.12.2 The installation of panel heating systems shall be designed and installed in strict accordance with the accepted engineering practices and the requirements of this Code.

303.12.3 All piping shall be standard weight steel pipe, type M copper tubing, or polybutyelene plastic pipe or tubing rated at 100 psi at 180°F.

303.12.4 The following joints are acceptable for piping embedded in concrete or plaster:

1. Steel pipe joints shall be welded.
2. Copper tubing shall be joined with brazing rods having a melting point of 1000°F.
3. Polybutylene pipe and tubing joints shall be installed with socket type heat fused polybutylene fittings.

303.12.5 All other piping, in all cavities or running exposed, shall be installed as permitted by this Code.

303.12.6 All embedded piping or tubing shall be tested for leaks by the hydrostatic test method by applying a pressure of not less than 100 psi water pressure or 1 1/2 times the operating pressure whichever is greater. The pressure shall be maintained for a minimum period of 4 consecutive hours, during which all joints shall be visually inspected for leaks.

303.12.7 Where piping, ducts, or electrical heating systems are used in gypsum assemblies, operating temperatures of these heating systems shall not exceed 125°F.

304 BOILERS

304.1 General

The provisions of this section shall govern the design, installation, alteration and repair of all boilers not under the jurisdiction of the North Carolina Department of Labor, Boiler and Pressure Vessel Division.

304.2 Standards

All boilers shall be designed and constructed in accordance with the requirements of one of the following standards:

1. Gas Fired Low Pressure Steam and Hot Water Boilers, ANSI Z21.13
2. Gas Fired High Pressure Steam and Hot Water Boilers, ANSI Z21.59
3. ASME Boiler and Pressure Vessel Code, Sections I, IV, and IX

304.3 Operating And Safety Controls

304.3.1 Automatic boilers shall be equipped with controls and limit devices as set forth in Table 304. Automatic boilers shall also be equipped with the following gages, as applicable: oil temperature, oil suction pressure, high and low gas pressure, stack temperature and windbox pressure. Gas-fired boilers exceeding 400,000 Btu per hour input shall conform to nationally recognized standards approved by the Mechanical Official. The Mechanical Official may approve solid fuel-fired boilers that can meet the safety requirements for automatic gas or oil-fired boilers.

304.3.2 An approved manual shutoff valve shall be installed upstream of all control devices on the main burner of a gas-fired boiler. The takeoff point for the gas supply to the pilot shall be upstream of the gas shutoff valve of the main burner and shall be valved separately. A union or other approved means of disconnect shall be provided immediately downstream of these shutoff valves.

304.3.3 Every boiler and pressure vessel shall be provided with a safety or relief valve to insure positive relief of any pressure over the pressure rating of the system. Each such valve shall be placed on the boiler side of all other valves and accessories and shall be mounted vertically on top of the boiler shell, and shall be of sufficient capacity to relieve the Btu energy that can be supplied to the boiler or as otherwise approved by the Mechanical Official. Valves so employed shall be of such nature and so constructed and arranged as to permit their being tested manually to determine their operating condition.

304.3.4 The discharge from relief valves shall be piped to within 18 inches of the floor or to an open receptacle, and when the operating temperature is in excess of 212°F, shall be equipped with a splash shield or centrifugal separator. When the discharge from safety valves would result in a hazardous discharge of steam inside the boiler room, such discharge shall be extended outside the boiler room. No valve of any description shall be placed between the safety or relief valve and the boiler, nor on the discharge pipe between the safety valve and the atmosphere. The discharge pipe shall be supported so that no undue stress is placed on the valve body.

304.4 Low Water Cutoffs

304.4.1 Each automatically fired steam boiler shall be fitted with a low water fuel cutoff so located as to automatically cut off the fuel supply when the surface of the water falls to the lowest safe water line which shall be not lower than the lowest visible part of the gage glass. If a water feeder is installed, it shall be so constructed that the water inlet valve cannot feed water into the boiler through the float chamber and so located as to supply the requisite feed water. The use of internal type low water cutoff valves is prohibited.

304.4.2 All fuel-fired water heating boilers shall be provided with an externally mounted low water cutoff or control. The use of an internal low water cutoff is permitted provided the device is of the approved type and the installation is in conformance with the ASME Boiler and Pressure Vessel Code.

304.5 Accessibility

Clearances shall be maintained around all boilers, generators, heaters, tanks and all other equipment so as to permit inspection, servicing, repair or replacement and normal visibility of all gages.

304.6 Installation

The installation of boilers shall conform to the manufacturer's instructions in addition to the requirements of this Code and operating instructions of a permanent type shall be attached to the boiler. All boiler installations upon completion shall have all controls set, adjusted and tested by the installer and a complete control diagram of a permanent legible type, together with complete boiler operating instructions shall be furnished by the installer for each installation. The manufacturer's rating data and the nameplate shall be attached to the boiler.

Remove Pages 41-44.

308.6 Hoods

308.6.1 An exhaust hood shall be installed for all commercial, industrial, institutional and other food heat-processing equipment producing smoke or grease-laden air.

EXCEPTION: Domestic equipment installed within a dwelling unit.

308.6.2 The hood shall be designed with a sufficient air volume to properly exhaust all grease and smoke vapor produced by the equipment which it serves. Unless the hood is designed and certified by a licensed architect or professional engineer or is an approved prefabricated hood tested and certified by the manufacturer the following requirements shall be met:

1. Canopy-type hoods shall be at least 2 ft deep from bottom edge to top edge of hood and shall overhang the equipment they serve at least 6 inches on all open sides.
2. The bottom edge of a canopy-type hood shall be a maximum of 7 ft above the floor.
3. Canopy hoods open on all sides shall have a minimum exhaust capacity of 150 cfm per square foot of hood area.
4. Canopy-type hoods open on three or less sides shall have a minimum exhaust capacity of 100 cfm per sq ft of hood area.
5. Backshelf-type hoods having an intake within 3 ft of vapor producing surface shall have a minimum exhaust capacity of 300 cfm per linear foot of cooking surface within a maximum distance of 1 ft from the face of the hood to the front edge of the equipment they are serving.
6. Provisions shall be made to admit air to the room where the hood is located at a rate not less than that which is exhausted by the hood. The make-up air restrictions of Section 3205.5.2 of Volume I do not apply to non-canopy type backshelf kitchen exhaust hoods.

308.6.3 All hoods shall be constructed and installed in accordance with the following:

1. Hoods shall be constructed of and supported by steel 0.0478-inch (18 ga) minimum thickness or stainless steel 0.0359-inch (20 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official.
2. Hoods shall be securely supported by noncombustible supports.
3. All seams and joints shall be made liquid-tight with a continuous external weld.
4. Hoods shall be so designed and installed to provide for thorough cleaning of the entire hood.
5. When grease troughs or gutters are provided, they shall drain to a collecting receptacle designed, fabricated and installed to be readily accessible for cleaning.

308.6.4 Every portion of the hood shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the hood side.

308.6.5 Each hood shall be equipped with a properly sized grease removal device of one of the following types:

1. Grease extractors specifically listed for this service and installed in accordance with the terms of its listing.
2. Grease filters or other grease removal devices specifically listed for use with commercial cooking equipment installed with the height of the lowest edge of the grease filter or other removal device located above the cooking or heating surface not less than the distances shown in Table 308.

308.6.6 Filters shall be tight fitting and firmly held in place, yet be easily accessible and removable without special tools. They shall be installed at a minimum angle of 45° from the horizontal. A drip tray designed and located to collect the grease from the filters and drain to an enclosed noncombustible container shall be provided beneath the lower edge of the filters. The container shall have a maximum capacity of 1 gallon unless otherwise approved by the Mechanical Official.

308.7 Fire Extinguishing Equipment

308.7.1 Duct systems, grease removal devices and exhaust hoods serving food heat processing equipment producing smoke or grease-laden air shall be protected by both an automatic fire extinguishing system and a portable extinguisher in accordance with this section. When listed grease extractors complying with 308.6.5(1) are provided for all cooking equipment, the duct fire extinguishing equipment may be omitted when approved by the Mechanical Official. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment protected by an extinguishing system or located under ventilating equipment protected by an extinguishing system.

TABLE 308
MINIMUM DISTANCE BETWEEN LOWEST EDGE OF GREASE FILTER AND COOKING OR HEATING SURFACE

	Duct System and Hood With Fire-Extinguishing System[1] (ft)
No Exposed Flame: Grills, French Fryers, etc.	1.5
Exposed Flame and Burners	2
Exposed Charcoal and Charbroil Type Fires	4

1. Fire-extinguishing system shall be of an approved type.

308.7.2 Alkaline dry chemical-type portable fire extinguishers shall be installed in the kitchen area for the protection of the cooking equipment. Extinguishers shall have a minimum rating of 40B (sodium bicarbonate or potassium bicarbonate base) and shall be conspicuously located and readily accessible along exit paths from the area. The extinguishers shall be a minimum of 100 ft and maximum of 20 ft from the cooking equipment. The top of the extinguishers shall be a maximum of 5 ft above the floor and shall be protected from physical damage.

308.7.3 Automatic systems shall be listed specifically for this type service and shall be installed in accordance with the terms of their listing. At least one manual control for activation shall be located a minimum of 10 ft and a maximum of 20 ft from the cooking equipment unless an alternate location is specifically approved by the Mechanical Official. The following types of extinguishing systems may be provided when installed in accordance with the provisions of the following applicable standards when approved by the Mechanical Official.

1. Carbon Dioxide Extinguishing System, NFiPA 12.
2. Installation of Sprinkler Systems, NFiPA 13.
3. Installation of Foam-Water Sprinkler Systems and Foam-Water Spray Systems, NFiPA 16.
4. Dry Chemical Extinguishing Systems, NFiPA 17.
5. Wet Chemical Extinguishing Systems, NFiPA 17A.
6. Fixed pipe extinguishing equipment conforming to the requirements of NFiPA 96.

308.7.4 Fat fryers, ranges, griddles, broilers, and similar cooking equipment which may be a source of ignition of grease in the exhaust system shall also be protected by approved fire extinguishing equipment.

308.7.5 Fire extinguishing equipment designed for manual operation shall have instructions posted conspiciously in the kitchen or cooking area.

308.8 Residential Range Hoods and Range Clearance

308.8.1 Residential range hoods when installed shall be vented to the outside by a Type B labeled vent or single wall pipe having a clearance of 1 inch from combustible material. Vents serving range hoods shall not terminate in an attic crawl space or any area inside the building. Listed unvented range hoods may be used when installed in accordance with the terms of their listing.

308.8.2 The vertical clearance above the cooking top of a range shall be 30 inches to combustible materials or metal cabinets except the clearance may be reduced to not less than 24 inches as follows:

1. The underside of the combustible material or metal cabinet above the cooking top is protected with not less than 1/4 inch insulating millboard covered with sheet metal not less than 0.0122 inch, or
2. A metal ventilating hood of sheet metal not less than 0.0122 inch is installed above the cooking top with a clearance of not less than 1/4 inch between the hood and the underside of the combustible material or metal cabinet, and the hood is at least as wide as the appliance is and is centered over the appliance.

308.9 Clothes Dryers

308.9.1 Dryers shall be exhausted to the outside.

308.9.2 The minimum size of a dryer exhaust shall be 4 inches in diameter.

308.9.3 Dryer exhaust ducts located within a fire rated wall, partition, floor or roof assembly shall be minimum 30 gauge galvanized steel or other non-combustible material.

308.9.4 Joints in dryer exhaust ducts shall be substantially air tight. Sheet metal screws or other fastening means shall not extend into a duct. Exhaust ducts shall have a smooth interior finish with joints running in the direction of the air flow.
308.9.5 Non-combustible flexible duct, if used, shall be installed without dips or kinks.
308.9.6 Exhaust ducts shall be terminated with a non-screened wall or roof cap equipped with a backdraft damper.
308.9.7 The outlet of the exhaust hood must be at least 12 inches from the ground and/or in accordance with the manufacturer's installation instructions.
308.9.8 Unless specified in the dryer manufacturer's installation instructions, the maximum developed length of a dryer exhaust duct shall not exceed 45' from the dryer to the exhaust termination using a 4" wall or roof cap or a louvered outlet. The maximum length shall not exceed 30' from the dryer to the exhaust termination using a 2 1/2" wall or roof cap, or a louvered outlet. There shall be a deduction of 2 1/2 feet for each 45 degree bend and 10 feet for each 90 degree bend from the maximum length permitted. For installations where this length limitation is exceeded, the minimum exhaust diameter shall be 5 inches with a minimum 4 inch exhaust termination.

308.10 Tire Rebuilding Or Recapping
308.10.1 Each room where rubber cement is used or mixed, or flammable or combustible solvents are applied, shall be ventilated in accordance with the applicable provisions of NFiPA 91.
308.10.2 Each buffing machine shall be connected to a dust collecting system which prevents the accumulation of the dust produced by the buffing process. The system shall discharge the dust to a suitable container. The system and the container shall be cleaned at frequent intervals.

309 SOLAR ENERGY UTILIZATION

309.1 General
309.1.1 This section includes provisions for minimum safe requirments for the construction, installation, alteration and repair of all equipment and systems utilizing solar energy intended to provide energy for space heating, cooling, hot water heating, swimming pool heating or process heating or cooling. Since solar systems are still in the research and development stage, this section is not intended to limit design innovations which will not constitute a hazard.
309.1.2 The purpose of the recommended requirements is to provide for reasonable protection of the public health and safety, while at the same time encouraging consumers, builders, designers, manufacturers, installers and others to utilize solar energy technologies while permitting experimentation and innovation.
309.1.3 Solar energy systems may be installed in, on, or adjacent to existing buildings or appurtenant structures without having the entire building or structure comply as required for new construction, provided the added solar energy systems and the affected portions of the existing building, mechanical, plumbing and electrical systems comply with the applicable provisions of these recommended requirements.

309.1.4 Existing solar energy systems shall be permitted to have their existing use continued provided their use and maintenance is not a hazard to life, health or property. Conditions that endanger life, limb, health or property shall be abated by repair, rehabilitation, demolition, or removal in accordance with the provisions of these recommended requirements, the building code or the reference standards set forth in the Appendices.

309.1.5 Solar energy components also serving as building components shall comply with the applicable provisions of the Standard Building Code and when connected to heating, ventilating, air conditioning and plumbing systems shall also comply with the applicable provisions of this section.

309.1.6 Solar heating systems shall be considered as supplemental or auxiliary systems unless designed to provide the total energy requirements as calculated using ASHRAE Applications Handbook Chapter 57, Solar Energy Utilization for Heating and Cooling, or other solar energy utilization data acceptable to the Mechanical Official. Solar systems and/or equipment which will not supply the total energy requirements, shall have a primary system or equipment with capacity to provide the additional energy needed in order to insure 100% capacity to satisfy the energy demand.

EXCEPTION: Experimental passive and active solar systems for the purpose of collecting technical data may be excluded from total capacity energy requirements when requested by the designer and approved by the Mechanical Official.

309.2 Maintenance And Identification

309.2.1 Solar energy systems shall be maintained in accordance with Volume I-A, Section 1.4.6, unless state or local governments' statutes or ordinances conflict with provisions contained therein.

309.2.2 Materials and equipment shall bear the manufacturer's or installer's label or otherwise be identifiable in accordance with appropriate national standards.

309.3 Design Criteria

309.3.1 The engineering design of passive and active solar systems shall be in accordance with acceptable engineering practice, and standards as listed in the applicable codes and standards adopted by the Mechanical Official. Where a primary fossil fuel or electric energy system with total capacity to satisfy the energy required is provided, and provisions are made for the protection of life, health and property, then no restrictions shall be placed on the design or capacity of the solar system.

309.3.2 When a solar energy system and an auxiliary energy system are interconnected, the maximum allowable temperature or pressure of either system shall not be exceeded in either operational or stagnant modes. The interconnections shall not compromise or by-pass the required safety devices.

510.5 Floor Penetration

In buildings more than one story in height, ducts extending through more than one floor shall be enclosed in a shaft constructed of noncombustible materials having a fire resistance rating of not less than 1 hour for buildings less than four stories in height and not less than 2 hours for buildings four stories and more in height. Ducts penetrating only one floor may be protected by installing a listed fire damper where the floor is pierced in lieu of the enclosure.

510.6 Means Of Access

An access door or other approved means of access shall be provided in ducts to permit the proper maintenance and resetting of each fire door, fire damper and smoke damper. For ducts located above the ceiling of a fire rated assembly, a service opening designed and installed so as not to reduce the fire rating of the assembly shall be provided.

510.7 Location And Installation Details

The specific location and installation details of each fire door, fire damper, ceiling damper and smoke damper shall be shown and properly identified on the building plans by the designer.

511 WEATHERPROOFING

All ducts installed outside buildings and exposed to the elements shall be properly weatherproofed in an approved manner. Ducts with internal insulation shall have all joints and seams soldered or otherwise sealed so as to be weathertight. Ducts externally insulated shall have this insulation protected with a covering of sheet metal, weatherproof membrane or a mastic coating, all of which shall be applied in an approved manner.

512 Moved to 509.1

513 AIR FILTERS

All heating and air conditioning systems of the central type shall be provided with approved type air filters. Low velocity type filters shall have a face area of not less than 1 sq in for each 2 1/2 cu ft per minute of air circulated by the unit. Filters shall be installed in the return air, upstream from any heat exchanger or coil, in an approved convenient location, and shall be easily accessible for cleaning or replacement. Filters shall be of a type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when attacked by flames. Liquid adhesive coatings used on filters shall have a flashpoint not lower than 325°F.

514 FRESH AIR INTAKES

Outdoor air intakes shall be protected against fire exposure by means of approved fire doors, dampers, or other suitable protection in accordance with the degree of exposure hazard and shall be screened with a corrosion-resistant material not larger than 1/2-inch mesh. Fresh air intakes shall not be taken from a location closer than 10 ft from any chimney or vent outlet, or sanitary sewer vent outlet, unless such vent outlet is not less than 24 inches above the fresh air inlet.

515 FAN SHUTDOWN CONTROLS

515.1 Scope

The provisions of this section shall apply to all HVAC systems except systems serving one and two family dwellings, individual apartments, condominiums, and townhouses.

515.2 Manual Controls

Each air distribution system shall be equipped with a manual control to stop supply and return fans in an emergency. The control device shall be mounted in a readily accessible location and identified.

515.3 Automatic Shutdown

Recirculating air systems serving more than one room or compartment shall be automatically shut down on detection of smoke by duct type smoke detector(s) in the return duct ahead of make-up air connection when:

1. An air handling unit serves sleeping or patient care areas in Institutional (I) or Residential (R) occupancies or required exit corridors in all occupancies regardless sof CFM capacity, or
2. An air handling unit has a rated capacity exceeding 2000 CFM.

515.4 An air handling unit serving more than one floor shall be automatically shut down on detection of smoke by a duct type detector in the return duct from each floor level located upstream from connection to the common return.

515.5 Exceptions to Sections 515.3 and 515.4.

1. Duct detectors may be omitted and air handling unit may be shut down by area smoke detector system provided full area coverage is provided as per NFiPA 72E.
2. Automatic shutdown is not required when an automatic smoke evacuation (smoke control) system, designed by a professional engineer, is installed.

515.6 An air handling unit exceeding 15,000 CFM shall automatically shut down on detection of smoke by a duct type detector located downstream of the filters. This detector is in addition to the detector required in return air of units serving more than one space as required by 515.3.

EXCEPTION: An air handling unit serving a single space with no attached duct systems.

515.7 Where a building smoke detection system is provided, each smoke or duct type detector required for control of recirculating air system shall also be connected to activate the fire alarm system.

516 STAIRWELL ENCLOSURES

Ducts serving other areas shall not be located in or pass through exit enclosures.

517 RETURN AIR INTAKE FOR RESIDENCES (Non-Engineered Systems)

517.1 If only one central return air grille is installed, it shall be of proper size. The size shall be sufficient to return a volume of air compatible with the CFM requirements and temperature rise limitations specified by the equipment manufacturer. The face velocity of return air grilles shall not exceed 450 fpm. At least one separate return shall be installed on each level of a multilevel structure. For split-level and split-foyer structures one return may serve more than one level if located near the levels served and the total area of the levels does not exceed 1600 sq ft. Return air grilles shall not be located in bathrooms or kitchens. This does not prohibit the installation of a return grille in a combination kitchen-dining room or kitchen-living room if the grille is not located within 10 ft of the cooking appliance.

517.2 In buildings with 1600 sq ft or less of conditioned area, a central return is permitted. When the building contains more than 1600 sq ft of conditioned area, additional returns shall be provided. Each return shall not serve more than 1600 sq ft of area and shall be located in the area it serves. Return air may travel through the living space to the return air intake if there are no restrictions, such as solid doors, to the air movement. When panned joists are used for return air, the structural integrity shall be maintained. Air capacity for joists, 16 inches on center shall be a maximum of 375 CFM for 8 inches joists and 525 CFM for 10 inches joists. Wiring shall not be located in spaces used for return air ducts.

602.9 Welding

Where welding is used as a means of connection or joining branch mains to the main steam piping, provisions shall be made for the expansion of the pipe at this point so that undue stresses or strains shall not be placed on the welds or piping. The bull-heading or rigid tee is prohibited on this type of connection.

602.10 Connection From Mains, Branch Mains Or Return Piping

All connections from the mains, branch mains or return piping of a steam system to radiators or to supply risers running to upper floors of a building shall be taken off at the top of the supply or return piping by use of a 45° or 90° elbow where fittings are used, or welded into the top of the piping where the welded method of connection is used.

602.11 Cold Water Supply To Hot Water Tank

The cold water supply to a hot water tank shall be discharged within 3 inches of the bottom of the tank either by direct connection at this point or by means of a pipe or tube inside the tank. There shall be installed on the cold water line close to the tank a hand shut-off valve and a vacuum relief valve. The vacuum relief valve shall be installed so that hot water cannot flow back from the tank through the cold water supply piping. (See the Standard Plumbing Code.)

602.12 Materials

602.12.1 All threads on pipe, fittings, valves, flanges and similar appurtenances shall conform to ANSI B2.1.

602.12.2 Required gaskets shall be made of material approved for the pressure and temperature to which it is to be subjected. Rubber shall not be used where pressures exceed 15 psi steam and 45 psi water or on temperatures greater than 250°F.

602.12.3 Threaded joints shall be made up with an approved thread compound or lubricant.

602.12.4 Flanges, screw type, cast iron or steel, or of the forged integral type may be used up to their working pressure and temperature ratings. All companion flanges shall have matching facing and drilling.

602.12.5 All pipe fittings and valves used on high pressure installation shall be of the type designed for the pressures and temperatures of the installation.

602.12.6 All pipe and piping used on high pressure-high temperature installations shall be of the required weight and strength suitable for the type service and pressures intended. Stress relieving may be required by the Mechanical Official for high pressure-high temperature welded installations.

603 CONDENSATE DRAIN PIPING

603.1 General

Condensation from all cooling coils or evaporators shall be carried full size from drip pan outlet and piped to a sanitary sewer drain, storm sewer drain or an approved French drain on units larger than 3 tons nominal capacity. Drains from units 3 tons and smaller capacity may terminate in gutter or roof drain, on a concrete pad or other location subject to approval of the Mechanical Official. Condensate drains from roof top units may spill on roof providing it does not drain into street or alley, or other area, of sufficient amount to be a menace.

603.2 Material

Condensate drain piping shall be galvanized steel, copper pipe, or tubing, or straight (not coiled) pipe or tubing of polybutylene, polyethylene, or PVC. The piping shall be selected for the pressure and temperature rating of the installations. Condensate waste and drain lines shall be not less than 3/4-inch size pipe or 7/8-inch tubing size. When more than one unit is manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with accepted engineering practice.

603.3 French Drain

A French drain shall consist of a pit not less than 24 inches diameter and 24 inches deep filled with coarse gravel. The drain pipe shall extend into the pit not less than 6 inches below grade and shall be securely anchored in place. The drain may be covered with sod if desired after inspection and approval of same.

603.4 Drain Pans

Auxiliary drain pans shall be installed under all evaporator coils or units containing evaporator coils, located in attic spaces, suspended ceiling spaces or furred spaces. Pans shall have a minimum depth of 1 1/2 inch and shall be not less than 3 inches larger than unit or coil dimensions in width and length and shall be constructed of not less than 0.0276-inch (24 ga) galvanized sheet steel. Pans may be constructed of combustible materials for duct mounted evaporator coils or for units containing evaporator coils which are tested and approved for zero clearance to combustibles on the casing surface adjacent to the pan. A separate drain line shall be extended from this pan terminating at a conspicious point to serve as an alarm that the regular drain is restricted. A float switch to control overflow may be used in emergency drain pan in lieu of a drain line, when approved by the Mechanical Official.

603.5 Pipe Support

The hangers or supports shall be so spaced that there shall be no undue stress or strain on the pipe, joints, fittings or valves, so that sagging will not occur in the piping between points of suspension under normal operating conditions.

604 CHILLED WATER PIPING

604.1 General

All chilled water piping and fittings shall be of steel, copper, brass, polybutylene, or polyvinyl chloride plastic (PVC) Schedule 40 type I and II high and normal impact, PVC Schedule 80 type I and II high and normal impact. Pressure rated cement-asbestos epoxy lined pipe may be used where temperature of water does not exceed 210°F. The aforementioned materials shall be installed in compliance with Table 604.

CHAPTER 8
ELECTRICAL REQUIREMENTS

801 ELECTRICAL CONNECTIONS

All electrical connections between fuel fired appliances, mechanical equipment, etc., and the building wiring shall conform to NFiPA 70. ★

802 IGNITION AND CONTROL DEVICES

Devices employing or depending upon an electrical current shall not be used to control or ignite a fuel supply if of such a character that failure of the electrical current could result in the escape of unburned fuel or in failure to reduce the supply of fuel under conditions which would normally result in its reduction unless other means are provided to prevent the development of dangerous temperatures, pressures or the escape of fuel.

803 ELECTRICAL GROUND

The fuel piping system shall not be used as a grounding electrode for an electric fuse panel, telephone circuit or lightning arrestor. Electric circuits shall not utilize fuel piping, casing of controls, panels or other metal parts in lieu of an electrical conductor. This provision shall not apply to low voltage control and ignition circuits and to electronic flame detection device circuits incorporated as part of the appliance.

804 ELECTRICAL CIRCUIT

The electrical circuit employed for operating the automatic main fuel control valve, safety shutoff device, room temperature thermostat, limit control or other electricla devices used with a fuel-burning appliance shall be in accordance with the wiring diagrams supplied with the appliance.

805 CONTINUOUS POWER

All fuel-burning appliances using electrical controls shall have the controls connected into a permanently live electrical circuit, i.e., one that is not controlled by a light switch.

NFiPA 12-1985, Carbon Dioxide Extinguishing Systems	308.7.3
NFiPA 13-1989, Installation of Sprinkler Systems	308.7.3
NFiPA 16-1986, Deluge Foam-Water Sprinkler Systems and Foam-Water Spray Systems	308.7.3
NFiPA 17-1985, Dry Chemical Extinguishing Systems	308.7.3
NFiPA 17A-1986 Wet Chemical Extinguishing Systems	308.7.3
NFiPA 31-1987, Installation of Oil Burning Equipment	306.16.2
NFiPA 70-1990, National Electrical Code/NC Amendments	307.4.2, 404.1.5, 404.1.7, 512.2, 801.1
NFiPA 72E-1987 Automatic Fire Detectors	515.5
NFiPA 82-1983, Incinerators Waste and Linen Handling Systems and Equipment	801.1, 307.5, 702
NFiPA 90A-1985, Installation of Air Conditioning and Ventilating Systems	302.4
NFiPA 90B-1984, Installation of Warm Air Heating and Air Conditioning Systems	302.4
NFiPA 91-1983, Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying	308.10.1
NFiPA 96-1987, Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment	308.7.3
NFiPA 214-1983, Water-Cooling Towers	302.4
SBCCI Standard Building Code, 1988 Edition/NC Amendments	201.2, 202, 302.7.1, 303.5.1, 306.5.2, 306.6.2, Table 306A, 307.1, 307.4.1, 308.4.6, 309.1.5, 309.4.2, 309.4.3, 404.1.1, 506.1.8, 509.2.1, 705.1, A103.7.4
SBCCI Standard Fire Prevention Code, 1988 Edition/NC Amendments	201.2

SBCCI Standard Gas Code, 1988 Edition/NC Amendments	201.2, 303.9.3, 306.15.10 306.16.1, 404.1.6, 607.1, 607.2, 709.6
SBCCI Standard Plumbing Code, 1988 Edition/NC Amendments	201.2, 302.7.2, 309.11, 309.12, 309.13.1, 404.1.4, 602.11, 606.1, 606.2
SMACNA Fibrous Glass Duct Construction Standards, 5th Ed., 1979 with 1983 Revisions	502
SMACNA HVAC Duct Construction Standards, Metal and Flexible 1st Ed., 1985	502
UL 103-89, Factory-Built Chimneys	306.3.2
UL 127-87, Factory-Built Fireplaces	306.17.1
UL 181-84, Factory-Made Air Ducts and Connectors	502, 512.2
UL 737-86, Fireplace Stoves	306.17.2
UL 910-85, Test Method for Fire and Smoke Characteristics of Cables	512.2
UL 1482-86, Room Heaters, Solid-Fuel Type	306.17.2

902 ORGANIZATIONS

The purpose of this reference index is to catalog by name and address those agencies, associations, institutions and others that are referred to in this Code by name, initials or symbols. Further there are those listed, for convenience, whose technical and other services are made available to the Mechanical Official.

ACCA	Air Conditioning Contractors of America 1228 17 Street NW Washington, D.C. 20036
AGA	American Gas Association, Inc. 8501 East Pleasant Valley Road Cleveland, Ohio 44131
ANSI	American National Standards Institute, Inc. 1430 Broadway New York, New York 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, Georgia 30329

Remove Pages 125 to 130.

STANDARD MECHANICAL CODE
1988 Edition

SBCCI®

EIGHTH PRINTING

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PREFACE

The purpose of the Standard Mechanical Code is to provide minimum requirements for safe mechanical installations, including alteration, repair, replacements, equipment, appliances, fixtures, fittings and appurtenances thereto so as to safeguard life, health and public welfare and the protection of property.

Utilized in conjunction with the Standard Building, Gas and Plumbing Codes, a community can be assured that the safety, health and welfare of the public are being provided for when the requirements as outlined in these documents are maintained.

The Standard Mechanical Code is intended to be implemented by governmental jurisdictions or other authorities having jurisdiction through the adoption by reference method. In preparing the adoption ordinance, the adopting authority should consider specifically including items such as fee schedules, local environmental factors, penalties and/or fines for code violations, etc. These will vary from locality to locality and as such cannot be effectively included in a model code document.

This Standard Mechanical Code is dedicated to the many code enforcement officials, architects, engineers and industry representatives who have given unstintingly of their time and knowledge to make this the most comprehensive and up-to-date code available.

Vertical bars in the margin indicate changes made since the 1985 edition.

Stars (★) in the margin indicate deletions from the 1985 edition.

The Standard Mechanical Code was adopted in October, 1972, at the Annual Research Conference of the Southern Building Code Congress International. The Code has been kept current through revisions and changes officially approved at Annual Research and Education Conferences held at

JACKSONVILLE, FLORIDA, October 28-November 2, 1973
BIRMINGHAM, ALABAMA, November 3-7, 1974
NASHVILLE, TENNESSEE, November 2-6, 1975
MYRTLE BEACH, SOUTH CAROLINA, November 14-18, 1976
ORLANDO, FLORIDA, October 23-27, 1977
HOUSTON, TEXAS, October 15-19, 1978
ATLANTA, GEORGIA, October 14-18, 1979
MEMPHIS, TENNESSEE, October 26-30, 1980
ORLANDO, FLORIDA, October 25-29, 1981
NASHVILLE, TENNESSEE, October 17-21, 1982
GREENSBORO, NORTH CAROLINA, October 9-13, 1983
SAVANNAH, GEORGIA, October 28-November 1, 1984
CORPUS CHRISTI, TEXAS, October 27-31, 1985
ORLANDO, FLORIDA, October 19-23, 1986
MEMPHIS, TENNESSEE, October 25-29, 1987

THE STANDARD CODES

Standard Amusement Device Code
Standard Building Code
Standard Excavation and Grading Code
Standard Existing Buildings Code
Standard Fire Prevention Code
Standard Gas Code
Standard Housing Code
Standard Mechanical Code
Standard Plumbing Code
Standard Swimming Pool Code
Standard Unsafe Building Abatement Code

CODE-RELATED PUBLICATIONS

Standard for Proscenium Curtains
Standard for the Installation of Roof Coverings
Standard for Existing High Rise Buildings
Standard for Flood Plain Management
Standard for Soil Expansion
Standard for Sound Control
Standard for Textile Wall Covering Test

EDUCATION PUBLICATIONS

Building Inspection Manual
Building Official Management Manual
Electrical Inspector Manual
Fire Prevention Inspection Manual
Gas Inspector Manual
Guide to Automatic Sprinklers
Hurricane Resistant Construction
Legal Aspects of Code Administration
Mechanical Inspector Manual
One and Two Family Dwelling Inspector Manual
Plumbing Drainage Principles
Plumbing Inspector Manual
Plumbing Venting Principles
Rehabilitation and Preservation Inspector Manual
Structural Plan Review

SAMPLE ORDINANCE TO ADOPT STANDARD CODES

ORDINANCE NO. ____________

AN ORDINANCE TO ADOPT VARIOUS STANDARD CODES RELATING TO INSPECTION ACTIVITIES OF THE (City, County, State) AND ENFORCEMENT OF BUILDING PROVISIONS AS PROVIDED IN SAID CODES.

Section 1: WHEREAS, it is the desire of, (Name of Adopting Authority) to adopt, in all respects, the various Standard Codes relating to amusement devices, building, fire prevention, gas, grading, housing, mechanical, plumbing and swimming pools and

WHEREAS, the adoption of these Codes is done to facilitate proper inspection activities by, (City County, State) relating to construction and to maintenance of buildings within the corporate limits of said town and relating to public safety, health and general welfare;

NOW, THEREFORE, BE IT ORDAINED BY (Name of Adopting Authority) that the following Codes are hereby adopted by reference as though they were copied herein fully:

Standard Amusement Device Code - 1985 Edition
Standard Building Code - 1988 Edition
Standard Excavation and Grading Code - 1975 Edition
Standard Existing Buildings Code - 1988 Edition
Standard Fire Prevention Code - 1988 Edition
Standard Gas Code - 1988 Edition
Standard Housing Code - 1988 Edition
Standard Mechanical Code - 1988 Edition
Standard Plumbing Code - 1988 Edition
Standard Swimming Pool Code - 1985 Edition
Standard Unsafe Building Abatement Code - 1985 Edition

Section 2: BE IT FURTHER ORDAINED BY (Name of Adopting Authority) that any matters in said Codes which are contrary to existing Ordinances of the City, shall prevail and that Ordinance No. ____________, entitled (*fill in here the complete title of the present building ordinance or ordinances in effect at the present time*) are hereby repealed and, to that extent any existing Ordinances to the contrary are hereby repealed in that respect only.

Section 3: BE IT FURTHER ORDAINED that within said Codes when reference is made to the duties of certain officials named therein that designated official of (City, County, State) who has duties corresponding to those of the named official in said Code shall be deemed to be the responsible official insofar as enforcing the provisions of said Code are concerned.

Section 4: BE IT FURTHER ORDAINED that this Ordinance shall take effect and be in force from and after its passage, the public welfare requiring it.

PASSED AND APPROVED BY (Name of Adopting Authority) on the day of __________.

ATTEST: ______________________
CLERK: BY:

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CHAPTER 8 ELECTRICAL REQUIREMENTS

CHAPTER 9 REFERENCE STANDARDS

APPENDIX

CHAPTER 1
ADMINISTRATION

101 TITLE AND SCOPE

101.1 Title

Provisions in the following chapters and sections shall constitute and be known and may be cited as "The Standard Mechanical Code" hereinafter referred to as "this Code".

101.2 Code Remedial

101.2.1 General. This Code is hereby declared to be remedial, and shall be construed to secure the beneficial interests and purposes thereof - which are public safety, health, and general welfare - by regulating installation and maintenance of all mechanical systems.

101.2.2 Quality Control. Quality control of materials and workmanship is not within the purview of this Code except as it relates to the purpose stated herein.

101.2.3 Permitting And Inspection. The inspection or permitting of any building or plan by any jurisdiction, under the requirements of this Code shall not be construed in any court as a warranty of the physical condition of such building or the adequacy of such plan. No jurisdiction nor any employee thereof shall be liable in tort for damages for any defect or hazardous or illegal condition or inadequacy in such building or plan, nor for any failure of any component of such building, which may occur subsequent to such inspection or permitting.

101.3 Scope

101.3.1 Applicability. The provisions of this Code shall apply to the installation of mechanical systems, including alterations, repairs, replacement, equipment, appliances, fixtures, fittings and/or appurtenances, including ventilating, heating, cooling, air conditioning and refrigeration systems, incinerators, and other energy-related systems.

101.3.2 Federal And State Authority. The provisions of this Code shall not be held to deprive any Federal or state agency, or any applicable governing body having jurisdiction, of any power or authority which it had on the effective date of the adoption of this Code or of any remedy then existing for the enforcement of its orders, nor shall it deprive any individual or corporation of its legal rights as provided by law.

101.3.3 Appendices. The appendices included in this Code are not intended for enforcement unless specifically referenced in the Code text or specifically included in the adopting ordinance.

101.3.4 Referenced Standards. Standards referenced in this Code shall be considered an integral part of this Code without separate adoption. If specific portions of a standard are denoted by Code text, only those portions of the standard shall be enforced. Where Code provisions conflict with a standard, the Code provisions shall be enforced. Permissive and advisory provisions in a standard shall not be construed as mandatory.

101.4 Mechanical Department

There is hereby established a department to be called the Mechanical Department and the person in charge shall be known as the Mechanical Official.

101.5 Existing Buildings

101.5.1 General. Alterations, repairs or replacement work may be made to any existing mechanical systems without requiring the system to comply with all the requirements of this Code provided that the alteration, repair or replacement work conforms to the requirements of this Code for new construction. The Mechanical Official shall determine the extent to which the existing system shall be made to conform to the requirements of this Code for new construction.

101.5.2 Change Of Occupancy. If the occupancy classification of an existing building is changed, the mechanical systems shall be made to conform to the intent of this Code as required by the Mechanical Official.

101.6 Special Historic Buildings

The provisions of this Code relating to the installation, alteration, repair, enlargement, restoration, replacement or relocation for mechanical systems shall not be mandatory for existing buildings or structures identified and classified by the state or local jurisdiction as Historic Buildings when such systems are judged by the Mechanical Official to be safe and in the public interest of health, safety and welfare regarding any proposed installation, alteration, repair, enlargement, restoration, relocation or replacement.

102 POWERS AND DUTIES OF THE MECHANICAL OFFICIAL

102.1 Right Of Entry

102.1.1 Whenever necessary to make an inspection to enforce any of the provisions of this Code, or whenever the Mechanical Official has reasonable cause to believe that there exists in any building or upon any premises any condition or code violation which makes such building or premises unsafe, dangerous or hazardous, the Mechanical Official may enter such building or premises at all reasonable times to inspect the same or to perform any duty imposed upon the Mechanical Official by this Code, provided that if such building or premises is occupied, he shall first present proper credentials and request entry. If such building or premises is unoccupied, he shall first make a reasonable effort to locate the owner or other persons having charge or control of the building or premises and request entry. If such entry is refused, the Mechanical Official shall have recourse to every remedy provided by law to secure entry.

102.1.2 When the Mechanical Official shall have first obtained a proper inspection warrant or other remedy provided by law to secure entry, no owner or occupant or any other persons having charge, care or control of any building or premises shall fail or neglect, after proper request is made as herein provided, to promptly permit entry therein by the Mechanical Official for the purpose of inspection and examination pursuant to this Code.

102.2 Stop Work Orders

Upon notice from the Mechanical Official, work on any system that is being done contrary to the provisions of this Code or in a dangerous or unsafe manner, shall immediately cease. Such notice shall be in writing and shall be given to the owner of the property, or to his agent, or to the person doing the work, and shall state the conditions under which work may be resumed. Where an emergency exists, the Mechanical Official shall not be required to give a written notice prior to stopping the work.

102.3 Revocation Of Permits

102.3.1 Misrepresentation Of Application. The Mechanical Official may revoke a permit or approval, issued under the provisions of this Code, in case there has been any false statement or misrepresentation as to the material fact in the application or plans on which the permit or approval was based.

102.3.2 Violation Of Code Provisions. The Mechanical Official may revoke a permit upon determination by the Mechanical Official that the installation, alteration, repair, or replacement of the mechanical system for which the permit was issued is in violation of, or not in conformity with, the provisions of this Code.

102.4 Unsafe Mechanical Systems

All mechanical systems, regardless of type, which are unsafe or which constitute a hazard to human life, health or welfare are hereby declared illegal and shall be abated by repair and rehabilitation or by demolition in accordance with the provisions of the Standard Unsafe Building Abatement Code.

102.5 Requirements Not Covered By Code

Any requirements necessary for the strength or stability of an existing or proposed mechanical system, or for the public safety, health and general welfare, not specifically covered by this Code, shall be determined by the Mechanical Official.

102.6 Alternate Materials And Alternate Methods Of Construction

The provisions of this Code are not intended to prevent the use of any material or method of construction not specifically prescribed by this Code, provided any such alternate has been approved by the Mechanical Official. The Mechanical Official shall approve any such alternate, provided he finds that the alternate for the purpose intended is at least the equivalent of that prescribed in this Code in quality, strength, effectiveness, fireresistance, durability and safety. The Mechanical Official shall require that sufficient evidence or proof be submitted to substantiate any claim made regarding the alternate.

103 PERMITS

A person, firm or corporation shall not install, enlarge, alter, repair, move, improve, remove, convert or replace any mechanical system, or cause the same to be done, without first obtaining a mechanical permit for such building or mechanical system from the Mechanical Official.

104 TESTS

The Mechanical Official may require tests or test reports as proof of compliance. Required tests are to be made at the expense of the owner, or his agent, by an approved testing laboratory or other approved agency.

105 BOARD OF ADJUSTMENTS AND APPEALS

105.1 Appointment

There is hereby established a board to be called the Board of Adjustments and Appeals, which shall consist of five members. The said Board shall be appointed by the Chief Appointing Authority.

105.2 Appeals

105.2.1 General. Whenever the Mechanical Official shall reject or refuse to approve the mode or manner of construction proposed to be followed or materials to be used in the installation or alteration of a mechanical system, or when it is claimed that the provisions of this Code do not apply, or that any equally good or more desirable form of installation can be employed in any specific case, or when it is claimed that the true intent and meaning of this Code or any of the regulations thereunder have been misconstrued or wrongly interpreted, the owner of such building or structure, or his duly authorized agent, may appeal from the decision of the Mechanical Official to the Board of Adjustments and Appeals. Notice of appeal shall be in writing and filed within 90 days after the decision is rendered by the Mechanical Official. Appeals shall be on forms provided by the Mechanical Official.

105.2.2 Unsafe Or Dangerous Mechanical Systems. In case of a mechanical system which, in the opinion of the Mechanical Official, is unsafe or dangerous, the Mechanical Official may, in his order, limit the time for such appeal to a shorter period.

105.3 Decisions

105.3.1 Variances. The Board of Adjustments and Appeals, when so appealed to and after a hearing, may vary the application of any provision of this Code to any particular case when, in its opinion, the enforcement thereof would do manifest injustice, and would be contrary to the spirit and purpose of this Code or public interest, or when, in its opinion the interpretation of the Mechanical Official should be modified or reversed.

105.3.2 Action. The Board of Adjustments and Appeals shall, in every case, reach a decision without unreasonable or unnecessary delay. Each decision of the Board of Adjustments and Appeals shall also include the reason(s) for the decision. If a decision of the Board of Adjustments and Appeals reverses or modifies a refusal, order, or disallowance of the Mechanical Official, or varies the application of any provision of this Code, the Mechanical Official shall immediately take action in accordance with such decision.

105.3.3 Decisions Are Final. Every decision of the Board of Adjustments and Appeals shall be final, subject however to such remedy as any aggrieved party might have at law or in equity.

106 VALIDITY

If any section, subsection, sentence, clause or phrase of this Code is for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this Code.

CHAPTER 2
DEFINITIONS

201 GENERAL

201.1 Tense, Gender And Number

For the purpose of this Code, certain abbreviations, terms, phrases, words, and their derivatives, shall be construed as set forth in this Section.

Words used in the present tense include the future. Words in the masculine gender include the feminine and neuter. Words in the feminine and neuter gender include the masculine. The singular number includes the plural and the plural number includes the singular.

201.2 Words Not Defined

Words not defined herein shall have the meanings stated in the Standard Building Code, Standard Plumbing Code, Standard Gas Code or Standard Fire Prevention Code. Words not defined in the Standard Codes shall have the meanings stated in the Webster's Ninth New Collegiate Dictionary, as revised.

202 DEFINITIONS

ABSORPTION SYSTEM—a refrigerating system in which the gas evolved in the evaporator is taken up by an absorber.

ACTIVE SYSTEM—a solar heating or cooling system using circulated liquid, air or other fluid to transfer energy within a structure.

ADMINISTRATIVE AUTHORITY—the individual official, board, department, or agency established and authorized by a state, county, city or other political subdivision created by law to administer and enforce the provisions of the mechanical code as adopted or amended.

AGGREGATE AMOUNT OF HEAT INPUT—the total heat input, in British thermal units per hour, of all boilers connected to one common header, except that any boiler which is permanently blanked off and discontinued from service, shall not be a factor in determining the "Aggregate Amount of Heat Input."

AIR—all air supplied to mechanical equipment for combustion, ventilation, cooling, etc. Standard air is air at standard temperature and pressure, namely 60° F and 29.92 in of mercury.

AIR CONDITIONING—the process of treating air to control its temperature, humidity, cleanliness and distribution to meet the requirements for the conditioned space.

AIR CONDITIONING SYSTEM—consists of heat exchangers, blowers, filters, supply exhaust and return ducts, and shall include any apparatus installed in connection therewith.

AIR (FOR COMBUSTION)—the amount of air required for the safe and proper combustion of fuel in fuel-fired appliances.

AIR DUCT—a conduit or passageway for conveying air to or from heating, cooling, air conditioning, or ventilating equipment but not including the plenum.

AIR DUCT MATERIAL:

1. Class 0—Air duct materials and connectors having a fire-hazard classification of zero (flame spread and smoke developed).

2. Class 1—Air-duct materials and connectors having a flamespread rating of not over 25 without evidence of continued progressive combustion and a smoke developed rating of not over 50.

3. Class 2—Air duct materials and connectors having a flamespread rating of not over 50 without evidence of continued progressive combustion and a smoke developed rating of not over 50 for the inside surface and not over 100 for the outside surface.

AIR WASHER— water spray system or device for cleaning, humidifying, or dehumidifying the air.

ALTERATION—a change in an air conditioning, heating, ventilating or refrigeration system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

AND/OR—in a choice of two code provisions, signifies that use of both provisions will satisfy the code requirement and use of either provision is acceptable also.

APPLIANCE—utilization equipment normally built in standardized sizes which is installed or connected as a unit to perform one or more functions.

APPROVED—approved by the Mechanical Official or other authority having jurisdiction.

ATTIC FAN—generally propeller type fans used during summer to draw cool night air through the structure and discharge into the attic where it escapes through louvers, soffit vents or ridge vents to the exterior of the building.

BOILER—any vessel used for generating steam or hot water for power or heating purposes to be used external to the vessel.

BOILER, HEATING (LOW PRESSURE)—hot water boilers operating at pressures not in excess of 160 psi and 250°F or steam boilers operating at pressures not in excess of 15 psi, used for heating buildings or structures. (See also High Pressure and Low Pressure).

BRAZED JOINT—a gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at a temperature above 800° F but lower than the melting temperature of the parts to be joined.

BREECHING (FLUE CONNECTION)—a passage for conducting the products of combustion from a fuel fired appliance to the vent or chimney. (See also Chimney Connector and Vent Connector).

BRIDGE WALL—a partition wall between chambers over which pass the products of combustion.

BRINE—a liquid, used for the transmission of heat without a change in its state, having no flash point or flash point above 150°F as determined in an approved manner.

BRITISH THERMAL UNIT—the quantity of heat required to raise 1 lb of water 1° F (at or near 39.2° F and at atmospheric pressure at sea level). Usually abbreviated Btu.

BUILDING USE GROUP CLASSIFICATIONS—the arrangement of buildings in classes according to use and occupancy, as set forth in the Standard Building Code.

BURNER—a device for the final conveyance of the fuel or a mixture of fuel and air to the combustion zone.

CAPACITY—the quantity or volume as produced or delivered by an air conditioning, refrigeration, heating, air handling or exhaust system.

1. Air conditioning or refrigeration capacity expressed Btu/hour or tons of refrigeration.
2. Heating capacity expressed in Btu/hour or Boiler Evaporation Rate (lb/hour).
3. Air handling or exhaust expressed in cfm (cubic feet per minute).

CHIMNEY—a primarily vertical enclosure containing one or more passageways.

1. Chimney, residential appliance type: an approved chimney for removing products of combustion from residential type appliance producing combustion gases not in excess of 1000° F measured at the appliance flue outlet.
2. Chimney, low-heat appliance type: an approved chimney for removing the products of combustion from fuel-burning low-heat appliances producing combustion gases not in excess of 1000° F. under normal operating conditions but capable of producing combustion gases of 1400° F. during intermittent forced firing for periods up to 1 hour. All temperatures shall be measured at the appliance flue outlet.
3. Chimney, medium-heat appliance type: an approved chimney for removing the products of combustion from fuel-burning medium-heat appliance producing combustion gases not in excess of 2000° F measured at the appliance flue outlet.
4. Chimney, high-heat appliance type: an approved chimney for removing the products of combustion from fuel-burning high-heat appliances producing combustion gases in excess of 2000° F measured at the appliance flue outlet.

CHIMNEY CONNECTOR—the pipe which connects a fuel appliance to a chimney. (See Breeching).

CHIMNEY, FACTORY BUILT—a chimney that is factory-made, listed by an accredited testing agency, for venting gas appliances, incinerators, and solid or liquid-fuelburning appliances.

CHIMNEY, MASONRY—a field constructed chimney of solid masonry units, bricks, stones, listed hollow masonry units or reinforced concrete built in accordance with nationally recognized standards.

CHIMNEY, METAL—field-constructed chimney made of metal that is corrosion resistant and built in accordance with nationally recognized standards.

COLLECTOR PLATE—the component of a solar collector which transfers the heat from solar energy to a circulating fluid.

COMBUSTIBLE MATERIAL—any material not defined as noncombustible.

COMBUSTION—the rapid oxidation of fuel accompanied by the production of heat or heat and light.

COMBUSTION CHAMBER—the space in a heating appliance provided for the combustion of fuel.

COMBUSTION CHAMBER, PRIMARY (INCINERATOR)—the chamber within an incinerator where primary ignition and burning of waste occur.

COMBUSTION CHAMBER, SECONDARY (INCINERATOR)—the chamber where unburned combustible materials from the primary chamber are completely burned.

COMPRESSOR—a specific machine, with or without accessories, for compressing a given refrigerant vapor.

COMPRESSOR UNIT—a condensing unit less the condenser and liquid receiver.

CONDENSATE—the liquid which separates from a gas (including flue gases) due to a reduction in temperature.

CONDENSER—a vessel or arrangement of pipe or tubing in which vaporized refrigerant is liquefied by the removal of heat.

CONDENSING FURNACE—a furnace or boiler which condenses part of the water vapor generated by the burning of hydrogen in fuels and one in which the fraction of the total latent heat remaining in the flue gases after condensation is less than one.

CONDENSING UNIT—a specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

CONFINED SPACE—a space whose volume is less than 50 cu ft per 1000 Btu per hour of the aggregate input rating of all appliances installed in that space.

DIRECT VENT APPLIANCES—appliances which are so constructed and installed that all air for combustion is derived from and all flue gases are discharged to the outside atmosphere.

DRY CLEANING SYSTEMS—dry cleaning plants or systems are classified as follows:

Type I - those systems using Class I flammable liquid solvents having a flash point below 100° F

Type II - those systems using Class II combustible liquid solvents having a flash point at or above 100° F and below 140° F.

Type III - those systems using Class III combustible liquid solvents having a flash point at or above 140° F.

Type IV and Type V - those systems using Type IV nonflammable liquid solvents.

DRYING HEARTH—a surface within the primary chamber upon which wet waste material is deposited for drying, prior to burning.

DUCT COVERINGS—includes materials such as adhesive, insulation, banding, coating(s), film and jacket used to cover the outside surface of a duct, fan casing or duct plenum.

DUCT LINING—includes materials such as adhesive, insulation, coating and film used to line the inside surface of a duct, fan casing or duct plenum.

DUCT MATERIAL—see Air Duct Material.

DUCT SYSTEM—a continuous passageway for the transmission of air, which, in addition to ducts, may include duct fittings, dampers, plenums, fans and accessory air handling equipment.

ELECTRIC SPACE HEATERS, PORTABLE—heaters not intended for permanent connection to a structure or to electric wiring.

ELECTRIC SPACE HEATERS, STATIONARY—heaters permanently mounted in a structure (air duct system) and which are permanently connected to electric wiring.

EVAPORATOR—that part of the system in which liquid refrigerant is vaporized to produce refrigeration.

EXHAUST SYSTEM—an assembly of connected ducts, plenums, fittings, registers, grilles and hoods, through which air is conducted from the space or spaces and exhausted to the outside atmosphere.

FILTER, AIR—a device used to remove air-borne solids from heating, ventilating, or air conditioning duct systems.

FIRE DAMPER—a listed assembly arranged to restrict the passage of air flow automatically in the event of fire.

FLAME SAFEGUARD—a device which will automatically shut off the fuel supply to a main burner or group of burners when the means of ignition of such burners become inoperative.

FLAMESPREAD RATING—the numerical value assigned to a material tested in accordance with ASTM E 84.

FLUE CONNECTION (BREECHING)—a passage for conducting the products of combustion from a fuel fired appliance to the vent or chimney. (See also Chimney Connector and Vent Connector).

FURNACE—a completely self-contained unit that produces heat by utilizing electric energy or by burning fuel.

FURNACE, CENTRAL—a self-contained indirect-fired or electrically heated appliance designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.

GENERATOR—any device equipped with a heating element used in the refrigerating system to increase the pressure of refrigerant in its gas or vapor state for the purpose of liquefying the refrigerant.

HEAT EXCHANGERS—a device used for the transfer of heat from one medium to another.

HEATER, ROOM (SPACE)—a free-standing heating unit burning solid, liquid or gas fuel for direct heating of the space in and adjacent to that in which the unit is located.

HEATING SYSTEM, CENTRAL WARM AIR—a heating system consisting of an air heating appliance from which the heated air is distributed by means of ducts, pipes, or plenums including any accessory apparatus and equipment installed in connection therewith.

HIGH PRESSURE (AND TEMPERATURE):

1. Steam: any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing steam for heating, power and processing, operating at pressures of 15 psi or more.

2. Hot water: any boiler, generator, pressure vessel, system, piping, or equipment used for purposes of heating or distributing hot water for heating or processing, operating at pressures in excess of 160 psi and temperatures in excess of 250° F.

INSOLATION—the total amount of solar energy reaching a surface per unit of time.

LABELED—devices, equipment or materials to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above labeled items and by whose label the manufacturer attests to compliance with applicable nationally recognized standards.

LANGLEY—standard unit of insolation, 1 langley/minute = 221 Btu/hr/sq ft.

LISTED—equipment or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner. The means for identifying listed equipment may vary for each testing laboratory, inspection agency, or other organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

LOW PRESSURE (AND TEMPERATURE)—

1. Steam: any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing steam for heating, power and processing, operating at pressures of 15 psi or less.

2. Hot water: any boiler, generator, pressure vessel, system, piping, or equipment used for the purposes of heating or distributing hot water for heating or processing, operating at 160 psi and 250° F or less.

MECHANICAL OFFICIAL—see Administrative Authority.

MINIATURE BOILER—any power boiler which does not exceed the following limits:

1. An inside shell diameter of 16 inches.

2. A heating surface of 20 sq ft (not applicable to electric boiler).
3. A gross volume of 5 cu ft.
4. A maximum allowable working pressure of 100 psi.

NONCOMBUSTIBLE MATERIAL—a material which meets either of the following requirements:

1. Materials which pass the test procedure set forth in ASTM E 136.
2. Materials having a structural base of noncombustible material as defined above in paragraph 1, with a surfacing not more than 1/8 inch thick which in addition has a flame spread rating not greater than 50 when tested in accordance with the ASTM E 84.

The term noncombustible does not apply to the flamespread characteristics of interior finish or trim materials. No material shall be classed as a noncombustible building material which is subject to increase in combustibility or flamespread beyond the limits herein established through the effects of age, moisture or other atmospheric conditions.

PACKED BED STORAGE—heat capacity storage in a bed of packed solid material, usually rock.

PHOTOVOLTAIC CONVERSION—use of semiconductor or other photovoltaic device which converts solar radiation directly to electricity.

PLENUM—air compartment or chamber to which one or more ducts are connected and which forms part of an air distribution system.

PORTABLE BOILER—a boiler which is primarily intended for temporary location and the construction and usage of which is obviously portable.

PORTABLE COOLING UNIT—a self-contained refrigerating system, not over 3 horsepower rating, which has been factory-assembled and tested, installed without connecting any refrigerant-containing parts. This definition shall not include an absorption unit.

PORTABLE EVAPORATIVE COOLER—any evaporative cooler which discharges the conditioned area without the use of ducts and can be readily transported from place to place without dismantling any portion thereof.

PORTABLE HEATING APPLIANCE—any approved unvented air heating appliance designed for environmental heating which is not secured or attached to a building by any means other than by fuel piping or electrical wiring.

PORTABLE VENTILATING EQUIPMENT—any ventilating equipment that can be readily transported from place to place without dismantling any portion thereof and which is not connected to a duct.

READILY ACCESSIBLE—having direct access without the need of removing any panel, door or similar covering of the item described, and without requiring the use of portable ladders, chairs, etc. See Accessible.

REPAIR—the reconstruction or renewal of any part of an existing mechanical system for the purpose of its maintenance.

RETURN AIR SYSTEM—an assembly of connected ducts, plenums, fittings, registers, and grilles, through which air from the space or spaces to be heated or cooled is conducted back to the supply unit. (See also Supply Air System).

SELF-CONTAINED EQUIPMENT—complete, factory assembled and tested. Heating, air conditioning or refrigeration equipment installed as a single unit, and having all working parts, complete with motive power, in an enclosed unit of said machinery.

SMOKE DAMPER—a damper arranged to interrupt airflow automatically through part of an air duct system, so as to restrict the passage of smoke. A smoke damper may be a standard louvered damper serving other control functions, if its location lends itself to the dual purpose. A smoke damper does not need to meet all the requirements of a fire damper.

SMOKE DEVELOPED RATING—a numerical value assigned to a material tested in accordance with ASTM E 84.

SOLAR COLLECTOR—any device or assembly of components which collects solar energy and uses such energy directly or transforms it to another usable form of energy.

SOLAR CONCENTRATOR—a reflective surface or refracting lens for directing insolation onto the absorber surface.

SOLAR CONSTANT—the insolation on a surface in space at the earth's distance from the sun, 428 Btu/hr/sq ft.

SOLAR COVER PLATE—a transparent plastic, glass plate or other material placed over the absorber plate of a solar collector to avoid heat losses and weathering of the absorber plate.

SOLAR ENERGY—the radiant energy of the sun in the forms of direct, diffuse or reflected radiation.

SOLAR ENERGY SYSTEM—any system using solar energy as defined above.

SOLAR MEDIUM—the material in an assembly used for storing solar energy in its transformed state, be it thermal or electrical.

SOLDERED JOINT—a gas-tight joint obtained by the joining of metal parts with metallic mixtures of alloys which melt at temperatures between 400° F and 800° F.

SUPPLY AIR SYSTEM—an assembly of connected ducts, plenums, fittings, registers and grilles through which air, heated or cooled, is conducted from the supply unit to the space or spaces to be heated or cooled. (See also Return Air System).

UNCONFINED SPACE—a space whose volume is not less than 50 cu ft per 1000 Btu/hr of the aggregate input rating of all appliances installed in that space. Rooms communicating directly with the space in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

VENT—a passageway for conveying flue gases from fuel-burning appliances, or their vent connectors, to the outside atmosphere.

VENTS, TYPES—

1. TYPE B VENTS: factory made vents listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn only gas.

2. TYPE BW VENTS: factory made vents listed by a nationally recognized testing agency for venting listed or approved gas fired vented wall furnaces.

3. TYPE L VENTS: factory made vents listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn gas or oil.

4. SINGLE-METAL WALL VENTS: vents constructed of sheet copper not less than No. 24 Manufacturer's Standard Gage or galvanized steel of not less than 0.0396 inch (20 ga), or other approved noncombustible corrosion-resistant material.

VENT CONNECTOR—the pipe used to connect an approved fuel fired appliance to a chimney or vent. (See also Flue Connection).

VENTILATION—the process of supplying or removing air by natural or mechanical means to or from any space.

VENTILATION SYSTEM—a mechanical or gravity system installed and operated in such a manner as to secure, with normal operation, the standard of ventilation required by this Code.

WHOLE HOUSE FAN— see Attic Fan.

CHAPTER 3
AIR CONDITIONING, HEATING AND VENTILATION EQUIPMENT

301 GENERAL

301.1 Scope

This chapter is intended to insure the safe design, construction, installation, and repair of equipment used in systems pertaining to air conditioning (space cooling), heating, and ventilation.

301.2 Approval

All listed equipment shall be installed in accordance with its listing and the equipment shall be labeled accordingly, including the seal or mark of the testing agency which certifies the listing. All unlisted equipment shall be installed in accordance with this Code.

302 AIR CONDITIONING EQUIPMENT

302.1 Scope

This section covers the location, installation, alteration, replacement, repair and maintenance of air conditioning equipment. The requirements of 303.2, 303.3, 303.4 and 303.5 of this Code shall apply to air conditioning equipment.

302.2 Labeling

A permanent factory-applied nameplate(s) shall be affixed to equipment on which shall appear in legible lettering, the manufacturer's name or trademark, the model, serial number, the seal or mark of the testing agency. A label shall also include the following:

1. Electrical Equipment: Electrical rating in volts, amperes, and motorphase; identification of individual electrical components in volts, amperes or watts, motor phase, Btu output and required clearance, if clearances are specified.
2. Absorption Units: Hourly rating in Btu; minimum hourly rating for units having step or automatic modulating controls; type of fuel; type of refrigerant; cooling capacity in Btu, and required clearance, if clearances are specified.

302.3 Instructions

Permanent factory-applied instructions for ignition, operation and shutdown shall accompany the equipment. The manufacturer's instructions shall remain attached to the appliance in a position to be easily read during the life of the appliance.

302.4 National Standards

For the purpose of assisting in obtaining the objectives of this Code, all the national standards listed in Chapter 9 are hereby adopted by reference and shall be considered a part of this Code to the extent of and with the limitations set upon therein the specific sections wherein they are applicable.

Title of Standard	Designation
Handbook & Product Directory—Equipment	ASHRAE
Handbook & Product Directory—Systems	ASHRAE
Safety Code for Mechanical Refrigeration	ANSI B9.1
Standard on Water-Cooling Towers	NFiPA 214
Standard for Installation of Warm Air Heating and Air Conditioning Systems	NFiPA 90B
Standard for Installation of Air Conditioning and Ventilating Systems	NFiPA 90A

302.5 Chilled, Steam And Hot Water Piping, Gas Piping

Piping systems in which chilled or hot water is transported for heating, air conditioning, or refrigerating shall be fabricated and installed in accordance with Chapter 6 of this Code. Gas piping shall conform to the Standard Gas Code.

302.6 Pumps And Pump Motors

302.6.1 Pumps external to listed equipment and used for circulation of water or other liquid flow in heating, ventilating, and air conditioning systems shall comply with the requirements for design and operation of ANSI B123.1.

302.6.2 Synchronous motors that are part of a heating, ventilating, or air conditioning system shall comply with the ANSI B50.11.

302.7 Water Cooling Towers And Condensers

302.7.1 The construction and supports for water cooling towers, evaporating condensers and air-cooled condensers shall comply with the requirements of the Standard Building Code.

302.7.2 Water from such units shall be discharged into an approved disposal system in accordance with the Standard Plumbing Code. All water supply, waste water and connection shall comply with the requirements of the Standard Plumbing Code.

302.8 Duct Systems

302.8.1 Design, construction and installation of air ducts shall comply with Chapter 5.

302.8.2 Clearances from warm air ducts shall conform to 303.7.

302.8.3 Subject to the approval of the Mechanical Official, no clearance is required for ducts without heating used solely for ventilation, or air cooling.

302.9 Mechanical Refrigeration

All refrigeration equipment used as a portion of air conditioning equipment shall comply with Chapter 4.

303 HEATING EQUIPMENT OTHER THAN BOILERS

303.1 General

This section covers the location, and installation for heat producing appliances and their accessories. When the requirements for listed appliances and their accessories are different from the requirements of this section, such listed appliances may be installed in accordance with the conditions specified in their listing. Listed appliances and their accessories installed or used not according to the conditions specified in their listing and all appliances not listed shall conform to the requirements of this section.

303.2 Accessibility For Service

303.2.1 Every appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls and vent connections; the lubrication of moving parts where required; and the adjustment and cleaning of burners and pilots.

303.2.2 Appliances listed for outdoor installations may be installed without protection in accordance with the provisions of their listing and shall be accessible for servicing. Appliances listed "for outdoor installation only" shall not be installed inside a building.

303.2.3 Where an appliance is located in an equipment room, such room shall have an opening or door and passageway thereto, which is large enough to permit removal of the largest piece of the appliance, but not less than 20 inches wide.

303.3 Attic Installation

303.3.1 Every attic or furred space in which mechanical equipment is installed shall be accessible by an opening and passageway as large as the largest piece of the equipment and in no case less than 22 x 36 inches continuous from the opening to the equipment and its controls. The opening to the passageway shall be located not more than 20 ft from the equipment measured along the center line of such passageway. Every passageway shall be unobstructed and shall have solid continuous flooring not less than 24 inches wide from the entrance opening to the equipment. On the control side and other sides where access is necessary for servicing the equipment a level working platform extending a minimum of 30 inches from the edge of the equipment with a 36-inch high clear working space shall be provided. Top or bottom service equipment shall have a full clearance above or below the unit for component removal.

303.3.2 A permanent electric light outlet and lighting fixture, controlled by a switch located at the required passageway opening, shall be provided at, or near, the furnace.

303.4 Under Floor Installations

303.4.1 All mechanical equipment installed in the underfloor area of any building shall comply with the following requirements:

1. An access opening and passageway of a height and width sufficient to permit removal of the mechanical equipment and in no case less than 36 x 22 inches shall be provided to the working space in front of the mechanical equipment. The access opening to any such passageway shall be through an opening in an exterior wall of the building or through a trap door within the building. The distance from the passageway access to the heating equipment shall not exceed 20 ft.

2. All mechanical equipment supported from the ground shall rest on a concrete slab extending not less than 3 inches above the adjoining ground level.

3. The lowest portion of mechanical equipment suspended from the building shall have a clearance of at least 6 inches from the ground.

4. Whenever it is necessary to excavate to install any such mechanical equipment, the excavation shall extend to a depth of 6 inches below the mechanical equipment and 12 inches on all sides of the mechanical equipment, except the control side, which shall have a clearance of 30 inches.

5. Whenever the excavation for either the mechanical equipment space or for the passageway exceeds a depth of 12 inches, the walls of such excavation shall be lined with waterproof concrete or masonry, extending to a height of 4 inches above the adjoining ground level.

6. In flood plain areas wherever there is a possibility that water may overflow the 4-inch high curb, the entire crawl space grade or height shall be such that a 12-inch clearance will exist between the bottom of the mechanical equipment and the ground.

7. A permanent electric light outlet and lighting fixture, controlled by a switch located at the required passageway opening, shall be provided at, or near, the mechanical equipment.

303.5 Roof Or Exterior Wall Installation

303.5.1 Mechanical equipment installations on roofs or exterior walls of buildings shall comply with the requirements for roof and wall structures as specified in the Standard Building Code, and shall be listed and approved for such use.

303.5.2 Each appliance shall have an accessible weatherproof disconnect switch and a 110-120 volt AC grounding type convenience outlet on the roof adjacent to the appliance. The convenience outlet shall be on the supply side of the disconnect switch.

303.5.3 Every appliance located on a roof of a building shall be installed on a substantial level platform. Whenever the roof has a slope greater than 3:12, a level working platform not less than 30 inches deep shall be provided in front of the entire firebox and control sides of the appliance. All sides of any working platform facing any portion of the roof edge below the platform shall be protected by substantial railing 42 inches high with vertical rails not more than 21 inches apart, except that parapets at least 24 inches high may be utilized in lieu of rails or guards. Required working platforms and railings may be omitted when access to the equipment is through a required roof scuttle and all of the following provisions are met:

1. The required scuttle is located immediately adjacent to the control side of the equipment unit.

2. All controls, filters, burners, fans and motors are accessible for service and repair within 2 ft of the edge of the equipment platform on the scuttle side.

3. The equipment platform is not more than 20 inches above the high side of the scuttle opening.

4. A substantial working platform not less than 30 inches by 30 inches shall be provided directly below the scuttle at a point not less than 30 inches or more than 32 inches below the high side of the scuttle opening.

5. Scuttles located on other than the roof incline side of the equipment unit shall have their lids or trap doors hinged on the low side of the scuttle.

303.5.4 Every appliance in or on an exterior wall of a building, which is so designed that the components are serviceable only from outside the building, shall be accessible. Every appliance located on the roof of any building shall be accessible.

EXCEPTION: When the roof is less than 20 ft above grade the use of portable means of access is acceptable.

303.6 Mounting

Heat producing appliances listed for mountings on combustible floors shall be installed strictly according to their listings, subject to the approval of the Mechanical Official.

303.7 Clearances To Combustible Materials

303.7.1 General

Clearances for listed heat producing appliances and their accessories, when listed for greater or less clearances than stipulated in this Code, shall conform to their listings, subject to the approval of the Mechanical Official.

303.7.1.1 Clearances not covered in this Code shall be subject to the approval of the Mechanical Official.

303.7.1.2 Clearances covered in this Code shall conform to Table 303.7, except if the clearances shown in the various sections of this Code differ, they shall take precedence over those shown in Table 303.7, subject to the approval of the Mechanical Official.

303.7.2 Factory built wood and coal burning stoves which are listed by a nationally recognized testing laboratory shall be installed in accordance with the listing.

303.7.3 Factory built wood and coal burning stoves which have not been tested and listed shall be installed with the clearances specified in Table 303.7.

303.7.4 Vent connectors shall not connect to a chimney in an attic. A single wall chimney shall not pass through an attic or other space normally unoccupied.

303.7.5 Combustible floors under unlisted coal and woodburning stoves shall be protected in accordance with the following:

1. Stoves without legs or with legs providing an air space less than 4 inches between ash box or bottom of firing chamber and combustible floor shall have the combustible floor protected with sheet metal or 1/8-inch asbestos, either of which shall be covered with two courses of 4-inch hollow tile or its equivalent, this in turn covered with at least 3/16-inch metal. Three courses of brick with the top course laid on edge, providing ventilating space between them, may be used in lieu of the two courses of 4-inch tile. The floor protection shall extend 12 inches beyond the sides and rear and 24 inches beyond the front of the stove.

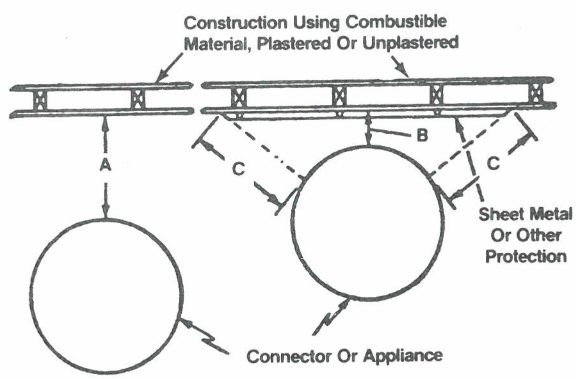
2. Stoves equipped with legs providing an air space of 4 to 17 inches between the ash box or bottom of the firing chamber and combustible floor shall have the floor protected with sheet metal or 1/8-inch asbestos, either of which shall be covered with 4-inch hollow tile or its equivalent. The protection shall extend a minimum of 12 inches beyond the sides and rear and 24 inches beyond the front of the stove.

3. Stoves equipped with legs providing an air space of 18 inches or more between the ash box or bottom of firing chamber and combustible floor shall have the floor protected with a minimum of 28 gage metal extending 12 inches beyond the sides and 24 inches beyond the front of the stove.

303.8 Clearances With Protection

Appliances may be installed in rooms, but not in alcoves or closets, with clearances less than specified in Table 303.7, provided the combustible material or appliance is protected as described in Table 303.8.

FIGURE 303.8
REDUCED CLEARANCE DIAGRAM



NOTES:

A equals the required clearance with no protection, specified in Table 303.7. B equals the reduced clearance permitted in accordance with Table 303.7. The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.

TABLE 303.7
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

These clearances apply unless otherwise shown on listed appliances. Appliances shall not be installed in alcoves or closets unless approved for such installation. For installation on combustible floors, see note 2.

RESIDENTIAL TYPE APPLIANCE For Installation in Rooms Which are Large (See Note 3)		APPLIANCE Above Top of Casing or Appliance	From Top and Sides of Warm-Air Bonnet or Plenum	From Front See Note 4	From Back	From Sides
Boilers and Water Heaters Steam Boilers—15 psi Water Boilers—250°F Water Heaters—250°F	Automatic Oil or Comb. Gas-Oil	6	—	24	6	6
	Automatic Gas	6	—	18	6	6
All Water Walled or Jacketed	Solid	6	—	48	6	6
	Electric	6	—	18	6	6
Furnaces—Central	Automatic Oil or Comb. Gas-Oil	6[5]	6[5]	24	6	6
Gravity, Upflow, Downflow, Horizontal and Duct. Warm-Air—250°F Max.	Automatic Gas	6[5]	6[5]	18	18	18
	Solid	18[6]	18[6]	48	18	18
	Electric	6[5]	6[5]	18	6	6
Furnaces—Floor For Mounting in Combustible Floors	Automatic Oil or Comb. Gas-Oil	36	—	12	12	12
	Automatic Gas	36	—	12	12	12
Heat Exchanger Steam—15 psi Max. Hot Water—250°F Max.	—	1	1	1	1	1

TABLE 303.7 (Continued)
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

RESIDENTIAL TYPE APPLIANCE For Installation in Rooms Which are Large (See Note 3)		APPLIANCE: Above Top of Casing or Appliance	APPLIANCE: From Top and Sides of Warm-Air Bonnet or Plenum	APPLIANCE: From Front (See Note 6)	APPLIANCE: From Back	APPLIANCE: From Sides	
Room Heaters Circulating Type	Oil or Solid	36	—	24	12	12	
Vented or Unvented	Gas	36	—	24	12	12	
Radiant or Other Type Vented or Unvented	Oil or Solid	36	—	36	36	36	
	Gas	36	—	36	18	18	
	Gas with double metal or ceramic back	36	—	36	12	18	
Radiators Steam or Hot Water	Gas	See Note 7 36	—	6	6	6	
						Firing Side	Opp. Side
Ranges—Cooking Stoves Vented or Unvented	Oil	30	—	—	9	24	18
	Gas	30	—	—	6	6	6
	Solid-Clay Lined Firepot	30	—	—	24	24	18
	Solid-Unlined Firepot	30	—	—	36	36	18
	Electric	30	—	—	6	6	
Clothes Dryers Listed Types	Gas	6	—	24	6	6	
	Electric	—	—	—	—	—	
Incinerators Domestic Types	—	See Note 10 36	—	48	36	36	

TABLE 303.7 (Continued)
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

COMMERCIAL-INDUSTRIAL TYPE LOW HEAT APPLIANCES Any and All Physical Sizes Except as Noted		APPLIANCE				
		Above Top of Casing or Appliance See Note 8	From Top and Sides of Warm-Air Bonnet or Plenum	From Front	From Back See Note 8	From Sides See Note 8
Boilers and Water Heaters						
100 cu ft or less Any psi Steam	All Fuels	18	—	48	18	18
50 psi or Less Any size	All Fuels	18	—	48	18	18
Infra-red Heaters						
(See also "Hazardous Locations" Section 302.b)		18	—	60	18	18
Unit Heaters						
Floor Mounted or Suspended-Any Size	Steam or Hot Water	1	—	1	1	
Suspended—100 cu ft or less	Oil or Comb. Gas—Oil	6	—	24	18	18
Suspended—100 cu ft or less	Gas	6	—	18	18	18
Floor Mounted—Any Size	All Fuels	18	—	48	18	18
Ranges—Restaurant Type						
Floor Mounted	All Fuels	48	—	48	18	18
Other Low-Heat Industrial Appliances						
Floor Mounted or Suspended	All Fuels	18	18	48	18	18

TABLE 303.7 (Continued)
STANDARD INSTALLATION CLEARANCES (In) FOR HEAT PRODUCING APPLIANCES[1]

COMMERCIAL-INDUSTRIAL TYPE MEDIUM HEAT APPLIANCES		APPLIANCE				
		Above Top of Casing or Appliance See Note 9	From Top and Sides of Warm-Air Bonnet or Plenum	From Front	From Back See Note 9	From Sides See Note 9
Boilers and Water Heaters Over 50 psi Over 100 cu ft	All Fuels	48	—	96	36	36
Other Med-Heat Industrial Appliances All Sizes	All Fuels	48	36	96	36	36
Incinerators All Sizes	—	48	—	96	36	36
INDUSTRIAL TYPE HIGH-HEAT APPLIANCES						
High-Heat Industrial Appliances All Sizes	All Fuels	180	—	360	120	120

1. Standard clearances may be reduced by providing protection to combustible material in accordance with Table 303.8.
2. An appliance may be installed on a combustible floor when conforming to 303.6.
3. Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 ft the volume of a room shall be computed on the basis of a ceiling height of 8 ft.
4. The minimum dimension shall be that required for servicing the appliance including access for cleaning and normal care, tube removal, etc.
5. For a listed oil, combination gas-oil, gas, or electric furnace this dimension may be 2 inches if the furnace limit control cannot be set higher than 250°F or this dimension may be 1 inch if the limit control cannot be set higher than 200°F.

6. The dimension may be 6 inches for an automatic stoker-fired forced warm-air furnace equipped with 250°F limit control and with barometric draft control operated by draft intensity and permanently set to limit draft to a maximum intensity of 0.13-inch water gage.
7. If the underside of combustible material or metal cabinet is protected with asbestos millboard at least 1/4 inch thick covered with sheet metal of not less than No. 28 gage the distance may be not less than 24 inches.
8. If the appliance is encased in brick, the 18-inch clearance above and at sides and rear may be reduced to not less than 12 inches.
9. If the appliance is encased in brick the clearance above may be not less than 36 inches and at sides and rear may be not less than 18 inches.
10. Clearance above charging door should not be less than 48 inches.

TABLE 303.8
CLEARANCES, WITH SPECIFIED FORMS OF PROTECTION* (in)

TYPE OF PROTECTION	WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION IS:													
	36 Inches			18 Inches			12 Inches		9 Inches	6 Inches		
Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection (see Fig. 303.8). Thicknesses are minimum.	Above	Side & Rear	Chimney or Vent Connector	Above	Side & Rear	Chimney or Vent Connector	Above	Side & Rear	Chimney or Vent Connector	Above	Side & Rear	Chimney or Vent Connector
(a) ¼ in asbestos millboard spaced out 1 in †	30	18	30	15	9	12	9	6	6	3	2	3
(b) 28 gage sheet metal on ¼ in asbestos millboard	24	18	24	12	9	12	9	6	4	3	2	2
(c) 28 gage sheet metal spaced out 1 in †	18	12	18	9	6	9	6	4	4	2	2	2
(d) 28 gage sheet metal on ⅛ in asbestos millboard spaced out 1 in †	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1½ in asbestos cement covering on heating appliance	18	12	36	9	6	18	6	4	9	2	1	6
(f) ¼ in asbestos millboard on 1 in mineral fiber bats reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2	2
(g) 22 gage sheet metal on 1 in mineral fiber bats reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2	2	2	2
(h) ¼ in asbestos millboard	36	36	36	18	18	18	12	12	9	4	4	4
(i) ¼ in cellular asbestos	36	36	36	18	18	18	12	12	9	3	3	3

*Except for the protection described in (e), all clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material.
† Spacers shall be of noncombustible material.

NOTES:

1. Asbestos millboard referred to above is a different material from asbestos cement board. It is not intended that asbestos cement board be used in complying with these requirements when asbestos millboard is specified.
2. The clearance from specified forms of protection shall be such as not to interfere with the requirements for accessibility in 303.2.1.
3. Where the required clearance with no protection is less than 6 inches, the required clearance for approved gas appliances may be reduced 1 inch per inch thickness of fiberglass 0.75 lb density added to protect combustible material. The insulation may be applied to the duct plenum, or combustible material to be protected.

303.9 Fuel Piping & Connections

303.9.1 Each appliance shall be designed for use with the type of fuel to which it will be connected. Such appliance shall not be converted from the fuel specified on the rating plate for use with a different fuel without securing reapproval from the Mechanical Official.

303.9.2 The tank, piping and valves for appliances burning oil shall be installed in accordance with the requirements of Chapter 7 of this Code.

When 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 anti-siphon valve or other siphon breaking device shall be installed in lieu of the shutoff valve.

303.9.3 All appliances designed to burn gas shall be connected to the gas supply outlet in accordance with the Standard Gas Code.

303.10 Electric Heating Equipment

303.10.1 Electric duct heaters shall be listed and bear the seal or mark of an approved testing agency and be equipped with an approved automatic reset air outlet temperature limit control that will limit the outlet air temperature to not more than 200°F. The electric elements of the heater shall be equipped with fusible links or a manual reset temperature limit control that will prevent outlet air temperature in excess of 250°F.

303.10.2 Every electric comfort heating appliance shall bear a permanent and legible factory applied nameplate on which shall appear the following:

1. Name and trademark of the manufacturer.
2. The catalog (model) number or equivalent.
3. The electric rating in volts, ampacity and phase.
4. Btu output rating.
5. Individual marking for each electrical component in amperes or watts, volts and phase.
6. Required clearances from combustibles.
7. A seal indicating approval of the appliance by an approved testing agency.

303.10.3 Every electric comfort heating appliance shall be connected in accordance with Chapter 8 of this Code.

303.11 Panel Heating Systems

303.11.1 Panel heating is a method of radiant space heating in which heat is supplied by large heated areas of room surfaces. The heating element usually consist of warm water piping, warm air ducts, or electrical resistance elements embedded in or located behind ceiling, wall, or floor surfaces.

303.11.2 The installation of panel heating systems shall be designed and installed in strict accordance with the accepted engineering practices and the requirements of this Code.

303.11.3 All piping shall be standard weight steel pipe, type M copper tubing, or polybutyelene plastic pipe or tubing rated at 100 psi at 180° F.

303.11.4 The following joints are acceptable for piping embedded in concrete or plaster:

1. Steel pipe joints shall be welded.
2. Copper tubing shall be joined with brazing rods having a melting point of 1000°F.
3. Polybutylene pipe and tubing joints shall be installed with socket type heat fused polybutylene fittings.

303.11.5 All other piping, in all cavities or running exposed, shall be installed as permitted by this Code.

303.11.6 All embedded piping or tubing shall be tested for leaks by the hydrostatic test method by applying a pressure of not less than 100 psi water pressure or 1 1/2 times the operating pressure whichever is greater. The pressure shall be maintained for a minimum period of 4 consecutive hours, during which all joints shall be visually inspected for leaks.

303.11.7 Where piping, ducts, or electrical heating systems are used in gypsum assemblies, operating temperatures of these heating systems shall not exceed 125°F.

304 BOILERS

304.1 General

The provisions of this section shall govern the design, installation, alteration and repair of all boilers.

304.2 Standards

All boilers shall be designed and constructed in accordance with the requirements of one of the following standards:

1. Gas Fired Low Pressure Steam and Hot Water Boilers, ANSI Z21.13
2. Gas Fired High Pressure Steam and Hot Water Boilers, ANSI Z21.59
3. ASME Boiler and Pressure Vessel Code, Sections I, IV, and IX.

304.3 Operating And Safety Controls

304.3.1 Automatic boilers shall be equipped with controls and limit devices as set forth in Table 304. Automatic boilers shall also be equipped with the following gages, as applicable: oil temperature, oil suction pressure, high and low gas pressure, stack temperature and windbox pressure. Except as otherwise specified, gas-fired boilers exceeding 400,000 Btu per hour input shall conform to nationally recognized standards approved by the Mechanical Official. The Mechanical Official may approve solid fuel-fired boilers that can meet the safety requirements for automatic gas or oil-fired boilers.

304.3.2 An approved manual shutoff valve shall be installed upstream of all control devices on the main burner of a gas-fired boiler. The takeoff point for the gas supply to the pilot shall be upstream of the gas shutoff valve of the main burner and shall be valved separately. A union or other approved means of disconnect shall be provided immediately downstream of these shutoff valves.

304.3.3 Every boiler and pressure vessel shall be provided with a safety or relief valve to insure positive relief of any pressure over the pressure rating of the system. Each such valve shall be placed on the boiler side of all other valves and accessories and shall be mounted vertically on top of the boiler shell, and shall be of sufficient capacity to relieve the Btu energy that can be supplied to the boiler or as otherwise approved by the Mechanical Official. Valves so employed shall be of such nature and so constructed and arranged as to permit their being tested manually to determine their operating condition.

304.3.4 The discharge from relief valves shall be piped to within 18 inches of the floor or to an open receptacle, and when the operating temperature is in excess of 212°F, shall be equipped with a splash shield or centrifugal separator. When the discharge from safety valves would result in a hazardous discharge of steam inside the boiler room, such discharge shall be extended outside the boiler room. No valve of any description shall be placed between the safety or relief valve and the boiler, nor on the discharge pipe between the safety valve and the atmosphere. The discharge pipe shall be supported so that no undue stress is placed on the valve body.

304.4 Low Water Cutoffs

304.4.1 Each automatically fired steam boiler shall be fitted with a low water fuel cutoff so located as to automatically cut off the fuel supply when the surface of the water falls to the lowest safe water line which shall be not lower than the lowest visible part of the gage glass. If a water feeder is installed, it shall be so constructed that the water inlet valve cannot feed water into the boiler through the float chamber and so located as to supply the requisite feed water. The use of internal type low water cutoff valves is prohibited.

304.4.2 All fuel-fired water heating boilers shall be provided with an externally mounted low water cutoff or control. The use of an internal low water cutoff is permitted provided the device is of the approved type and the installation is in conformance with the ASME Boiler and Pressure Vessel Code.

304.5 Accessibility

Clearances shall be maintained around all boilers, generators, heaters, tanks and all other equipment so as to permit inspection, servicing, repair or replacement and normal visibility of all gages.

304.6 Installation

The installation of boilers shall conform to the manufacturer's instructions in addition to the requirements of this Code and operating instructions of a permanent type shall be attached to the boiler. All boiler installations upon completion shall have all controls set, adjusted and tested by the installer and a complete control diagram of a permanent legible type, together with complete boiler operating instructions shall be furnished by the installer for each installation. The manufacturer's rating data and the nameplate shall be attached to the boiler.

TABLE 304
CONTROLS AND LIMIT DEVICES FOR AUTOMATIC BOILERS

Boiler Group	Fuel	Fuel Input Range (Inclusive) Note 1	Type Of Pilot Note 2	SAFETY CONTROL TIMING (Nominal Maximum Time in Seconds)				Assured Fuel Supply Control Note 4	Assured Air Supply Control Note 5	Low Fire Start Up Control Note 6	Pre-Purging Control Note 7	Hot Water Temperature and Low Water Limit Controls Note 8	Steam Pressure And Low Water Limit Controls Note 9	Approved Fuel Shutoff Note 10	Control And Limit Device System Design Note 11
				Trial For Pilot	TRIAL FOR MAIN BURNER FLAME		Main Burner Flame Failure Note 3								
					Direct Electric Ignition	Flame Pilot									
A	Gas	0-400,000 Btu/hr	Any type	90	Not Required	90	90	Not Required	Required	Not Required	Not Required	Required	Required	Not Required	Required
B	Gas	400,001-2,500,000 Btu/hr	Interrupted or intermittent	15	15	15	2-4	Not Required	Required	Not Required	Not Required	Required	Required	Not Required	Required
C	Gas	2,500,001-5,000,000 Btu/hr	Interrupted or intermit-	15	15	15	2-4	Required	Required	Required	Required	Required	Required	Required	Required
D	Gas	Over 5,000,000 Btu/hr	Interrupted	15	15	15	2-4	Required	Required	Required	Required	Required	Required	Required	Required
E	Oil	0-400,000 Btu/Hr.	Any type	Not Required	90	90	90	Not Required	Required	Not Required	Not Required	Required	Required	Not Required	Required
F	Oil	400,001-1,000,000 Btu/hr	Interrupted	Not Required	30	30	2-4	Required	Required	Not Required	Not Required	Required	Required	Not Required	Required
G	Oil	1,000,001-3,000,000 Btu/hr	Interrupted	Not Required	15	15	2-4	Required	Required	Not Required	Not Required	Required	Required	Not Required	Required
H	Oil	Over 3,000,000 Btu/hr	Interrupted	15	15	60	2-4	Required	Required	Required	Required	Required	Required	Required	Required
K	Electric	All	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required	Required	Required	Not Required	Required

Notes to Table 304

1. Fuel input shall be determined by one of the following:

(a) The maximum burner input as shown on the burner nameplate or as otherwise identified by the manufacturer.

(b) The nominal boiler rating, as determined by the Mechanical Official, plus 25%.

(c) 1 Boiler Horsepower = 33,475 Btuh.

2. Automatic boilers shall have one flame failure device on each burner which shall prove the presence of a suitable ignition source at the point where it will reliably ignite the main burner, except that boiler groups A, B, E, F and G which are equipped with direct electric ignition shall monitor the main burner and all boiler groups using interrupted pilots shall monitor only the main burner after the prescribed limited trial and ignition periods. Boiler Group A equipped with continuous pilot shall accomplish 100% shutoff within 90 seconds upon pilot flame failure. The use of intermittent pilots in boiler group C is limited to approved burner units.

3. In boiler groups B, C and D a 90-second main burner flame failure limit may apply if continuous pilots are provided on manufacturer assembled boiler-burner units which have been approved by an approved testing agency as complying with nationally recognized standards approved by the Mechanical Official. Boiler groups F and G equipped to re-energize their ignition system within 0.8 seconds after main burner flame will be permitted 30 seconds for Group F or 15 seconds for Group G to re-establish its main burner flame.

4. Boiler groups C and D shall have controls interlocked to accomplish a non-recycling fuel shutoff upon high or low gas pressure, and boiler groups F, G and H using steam or air for fuel atomization shall have controls interlocked to accomplish a non-recycling fuel shutoff upon low atomizing steam or air pressure. Boiler groups F, G and H equipped with a preheated oil system shall have controls interlocked to provide fuel shutoff upon low oil temperature.

5. Automatic boilers shall have controls interlocked to shut off the fuel supply in the event of draft failure if forced or induced draft fans are used or in the event of low combustion air flow if a gas power burner is used. Where a single motor directly driving both the fan and the oil pump is used, a separate control is not required.

6. Boiler groups C, D and H when firing in excess of 400,000 Btu per combustion chamber shall be provided with low fire start of its main burner system to permit smooth light off. This will normally be at a rate of approximately one-third of its maximum firing rate.

7. Boiler groups C, D and H shall not permit pilot or main burner trial for ignition operation before a purging operation of sufficient duration to permit a minimum of four complete air changes through the furnace, including combustion chamber and the boiler passes. Where this is not readily determinable, five complete air changes of the furnace, including combustion chamber up to the first pass, will be considered equivalent. An atmospheric gas burner with no mechanical means of creating air movement or an oil burner which obtains two-thirds or more of the air required for combustion without mechanical means of creating air movement shall not require purge by means of four air changes so long as its secondary air openings are not provided with means of closing. If such burners have means of closing secondary air openings, a time delay must be provided which puts these closures in a normally open position for 4 minutes before an attempt for ignition. An installation with a trapped combustion chamber shall in every case be provided with a mechanical means of creating air movement for purging.

8. Every automatic hot water supply boiler, low pressure hot water heating boiler, and power hot water boiler shall be equipped with two high temperature limit controls with a manual to shut reset on the control with the higher setting interlocked off

the main fuel supply except that manual reset on the high temperature limit control shall not be required on any automatic package boiler not exceeding 400,000 Btu per hour input and which has been approved by an approved testing agency. Every automatic hot water heating, power boiler and package hot water supply boiler shall be equipped with one low water level limit control with a manual reset interlocked to shut off the fuel supply so installed as to prevent damage to the boiler and to permit testing of the control without draining the heating system except on boilers used in a Residential Occupancy of less than six units and further except that the low water level limit control is not required on package hot water supply boilers approved by a nationally recognized testing agency. However, a low water limit control installed in the circulating water line may be used instead of the low water level limit control for the same purpose on coil type boilers.

9. Every automatic low pressure steam heating boiler, small power boiler and power steam boiler shall be equipped with two high steam pressure limit controls interlocked to shut off the fuel supply to the main burner with manual reset on the control with the higher setting, and two low water level limit controls one of which shall be provided with a manual reset device and independent of the feed water controller. Coil type flash steam boilers may use two high temperature limit controls, one of which shall be manually reset, in the hot water coil section of the boiler instead of the low water level limit control.

10. Boiler groups C, D and H shall use an approved automatic reset safety shutoff valve for the main burner fuel shutoff which shall be interlocked to the programming control devices required. On oil burners, where the safety shutoff valve will be subjected to pressures in excess of 10 psi when the burner is not operating, a second safety shutoff valve shall be provided in series with the first. Boiler groups C and D using gas in excess of 1 psi pressure or having a trapped combustion chamber or employing horizontal fire tubes shall be equipped with two approved safety shutoff valves, one of which shall be an automatic reset type, one of which may be used as an operating control, and both of which shall be interlocked to the limit control devices required. Boiler groups C and D using gas in excess of 1 psi pressure shall be provided with a permanent and ready means for making periodic tightness checks of the main fuel safety shutoff valve.

11. Control and limit device system shall be grounded with operating voltage not to exceed 150 volts, except that upon approval by the Mechanical Official existing control equipment to be re-used in an altered boiler control system may use 220 volt single phase with one side grounded provided such voltage is used for controls. Control and limit devices shall interrupt the ungrounded side of the circuit. A readily accessible means of manually disconnecting the control circuit shall be provided with controls so arranged that when they are de-energized the burner shall be inoperative.

305 COMBUSTION AND VENTILATION AIR

305.1 Combustion Air — General

305.1.1 The standards set forth in 305 define the minimum requirements of air for combustion and ventilation. The provisions of 305 are not intended to apply to direct vent systems which are constructed and installed in accordance with the manufacturers specifications so that all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere. These standards shall not be decreased, however manufacturers specifications shall be followed where their requirements exceed these standards.

305.1.2 To prevent space temperatures exceeding 120°F, additional ventilation air shall be supplied to the equipment room. Equipment rooms shall not be ventilated by any means which would reduce pressures in the space sufficiently to draw gases of combustion from the appliance into the equipment room.

305.1.3 The minimum dimension of rectangular air ducts shall be 3 inches.

305.1.4 Operations of exhaust fans, kitchen ventilating systems or fireplaces shall be installed so as to avoid unsatisfactory equipment operation.

305.2 Combustion Air — Solid Fuel Equipment

Rooms or spaces, in which an appliance or appliances arranged to burn solid fuel are installed, shall be provided with minimum unobstructed combustion air openings equal to 2 sq in for each 1000 Btu per hour fuel input of such appliances with a minimum total free area of 200 sq in as specified in 305.3.

305.3 Combustion Air—Liquid And Gas Fuel Equipment

305.3.1 Rooms or spaces in which gas or liquid-fuel burning appliances are installed shall be provided with minimum unobstructed combustion air openings in accordance with provisions of 305.3

305.3.2 Where appliances are installed in unconfined spaces in buildings of conventional frame, brick, or stone construction having air infiltration and without storm windows, air for combustion and draft hood dilution is adequately obtained normally by infiltration.

305.3.3 Where appliances are installed in a confined space within a one or two family residence, provision may be made for supplying this space with air for combustion and ventilation by eliminating the ceiling of the confined space, provided, however, that the area above this confined space has openings directly to outside air as required by 305.3.5.

305.3.4 Where appliances are installed in a confined space, provisions shall be made for supplying this space with air for combustion and ventilation. This may be accomplished through use of two permanent openings freely communicating with additional rooms of sufficient volume that the combined volume of all spaces meets the criteria for an unconfined space, or by compliance with provisions of 305.3.3 or 305.3.5. The total input of all appliances installed in the combined space shall be considered in making this determination. The two permanent openings shall each have a free area of not less than 1 sq in per 1000 Btu per hour of input rating of all appliances in the confined space, but not less than 100 sq in. One opening shall be within 12 inches of the top of the confined space and one within 12 inches of the bottom. If necessary, continuous ducts having cross-sectional areas at least equal to the free area of the opening shall be utilized to communicate with the source of air supply. The minimum dimensions of rectangular air ducts shall be not less than 3 inches. Any duct from the top opening must be horizontal or pitched upward.

305.3.5 Where appliances are installed in a confined space, and all air for combustion and ventilation is obtained from outdoors, the confined space shall be provided with two permanent openings, one within 12 inches of the top and one within 12 inches of the bottom of the enclosure, each opening having a minimum free area of 19 sq in. The openings shall communicate directly, or by ducts, with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors, subject to the following:

1. When directly communicating with the outdoors, each opening shall have a minimum free area of 1 sq in per 4000 Btu per hour of total input rating of all appliances in the enclosure.
2. When communicating with the outdoors through vertical ducts each opening shall have a mimimum free area of 1 sq in per 4000 Btu per hour of total input rating of all appliances in the enclosure.
3. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 sq in per 2000 Btu per hour of total input rating of all appliances in the enclosure.
4. When ducts are used, they shall have at least the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall not be less than 3 inches. Any duct from the top opening must be horizontal or pitched upward.
5. In calculating free area, consideration shall be given to the blocking effect of louvers, grilles or screens protecting openings.

305.3.6 Where appliances are installed in unconfined spaces, within a building of unusually tight construction, air for combustion, ventilation, and draft hood dilution must be obtained from the outdoors or from spaces freely communicating with the outdoors. Under these conditions, a permanent opening or opening having a total free area of at least 19 sq in but not less than 1 sq in per 5000 Btu per hour of total input rating of all appliances shall be provided. Where ducts are required they shall have at least the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 inches. The air from the outdoors must freely communicate with the room in which the appliance is located.

305.3.7 Alternate methods of supplying combustion air may be approved when special engineering assures an adequate supply of air for combustion, ventilation and draft hood dilution by mechanical means. Such mechanical systems shall be as approved by the Mechanical Official and shall supply outside air to the space. In no case shall exhaust fans be used which will create a negative pressure in a space where gas or liquid fuel appliances are installed.

305.4 Ducts For Combustion And Ventilation Air

Ducts required for combustion air shall be of galvanized steel complying with Chapter 5 or other corrosion-resistant material approved for this use, and terminate in a space not less than 6 inches deep in front of, or open to, the front or firebox side of the appliance. Every such space shall extend from the floor to the ceiling of the appliance enclosure. Combustion air openings shall be covered with corrosion-resistant screen of not less than 1/4-inch mesh.

306 CHIMNEYS AND VENTS

306.1 General

306.1.1 Chimneys shall be required for all heating or heat producing appliances except electrical heating and appliances listed for use with venting systems. Every chimney shall be constructed and every venting system shall be installed in accordance with the applicable requirements of 306. Every chimney, vent or venting system shall be capable of producing a draft at the appliance not less than that required for the safe operation of the appliance connected hereto.

306.1.2 A power exhauster may be used, except with incinerators, to increase low draft. When an exhauster is used, provision shall be made to shut off the fuel supply to the appliance in the event of failure of the exhauster.

306.1.3 Nothing in this Code shall prohibit the joining of two or more connectors into a combined connector, provided that all pipes are of sufficient size to serve all of the appliances thus connected, and provided that all pipes are constructed to comply with the severest requirements of any of those connected.

306.1.4 The connector of a fuel burning appliance shall not be connected into the chimney flue of an incinerator which has the rubbish chute identical with the chimney flue.

306.1.5 Approved plastic pipe may be used for venting condensing type furnaces and boilers in accordance with the appliance manufacturer's instructions.

306.2 Chimney Construction—General Requirements

306.2.1 A chimney shall not carry any load other than its own dead weight.

306.2.2 Chimney crickets of metal or other roofing materials shall be laid or installed on solid roof decking consistent with the construction of the roof.

306.2.3 All unsafe or dangerous chimneys shall be made safe or taken down.

306.2.4 Chimneys shall extend at least 3 ft above the highest point where they pass through the roof of the building and at least 2 ft higher than any portion of the roof located within 10 ft horizontally of such chimney.

306.2.5 An appliance equipped with a forced or induced draft system which may result in positive pressure in the venting system shall be connected to a pressure-tight venting system.

306.2.6 Whenever a building is hereafter erected, enlarged or raised, the owner of such building shall, at his own expense, carry up, either independently or on his own building, all chimneys, smokestacks, and smoke flues of an adjoining building which are within 10 ft of any portion of the wall extending above such chimney or flue. The construction of such chimney shall conform to all requirements of this Code. The chimney shall be carried up simultaneously with the walls.

306.2.7 It shall be the duty of the owner of the building to be erected, enlarged or raised, to notify, in writing, at least 10 days before such work is to begin, the owner of the chimney affected, of his intention to carry up such chimney.

306.3 Factory-Built Chimneys

306.3.1 Factory-built chimneys shall be listed and shall be installed in accordance with the conditions of the listing and the manufacturer's instructions.

306.3.2 Nothing contained in this Code shall be construed as prohibiting the use of insulated suspended factory-built chimneys provided such assemblies have been tested and approved by a recognized laboratory for the use intended and are installed in accordance with their approval.

306.3.3 Factory-built chimneys may be installed with zero clearance on wood structural members, such as framing, roof rafters, floor and ceiling joists and other component structural members, when it has been determined by test reports of recognized and approved testing laboratories that the unit does not transmit heat to the supporting combustible members of more than 90°F above room temperature. All chimney installations shall conform with the height requirements of this Code.

306.3.4 Supports for such chimneys attached to ceiling or floor joists shall be permitted provided the joists are of adequate size to support additional load.

306.4 Masonry Chimneys — General Requirements

306.4.1 Masonry chimneys shall be supported on properly designed foundations of masonry or reinforced concrete. Noncombustible material having a fire resistance rating of not less than 3 hours may be used to support masonry chimneys where such supports are independent of the floor construction and the load transferred to the ground.

306.4.2 Masonry chimneys shall not be corbeled from a wall more than 6 inches, nor shall a chimney be corbeled from a wall which is less than 12 inches thick unless it projects equally on each side of the wall provided that in the second story of a two story dwelling, corbeling of chimneys on the exterior of the enclosing walls may equal the wall thickness. Corbeling shall not exceed 1 inch projection for each course of brick projected. Corbeled smoke chambers shall be parged with fireclay mortar or refractory mortar.

306.4.3 A change in size or shape of a chimney flue where the chimney passes through the roof, shall not be made within a distance of 6 inches above or below the roof joists or rafters.

306.4.4 Cleanout openings provided in chimneys shall be equipped with ferrous metal doors and frames arranged to remain tightly closed when not in use. Adequate clearance between cleanout doors and combustible material shall be provided.

306.4.5 All spaces between chimneys and floors and ceilings through which chimneys may pass shall be firestopped with noncombustible material. The firestopping of spaces between chimneys and wood joists, beams, or headers shall be to a depth of 1 inch only placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

306.4.6 Masonry chimneys shall be proved tight by a smoke test after erection and before being put into use.

306.5 Masonry Chimneys For Residential Type Appliances

306.5.1 Masonry chimneys shall be constructed of solid masonry units or reinforced concrete with walls not less than 4 inches thick or rubble stone masonry not less than 12 inches thick.

306.5.2 Masonry chimneys for residential type appliances shall be lined with approved fire clay tile flue liners not less than 5/8-inch thick, or with other approved liner of material that will resist corrosion, softening or cracking from flue gases at temperatures up to 1800°F. Fire clay tile liners shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fire clay mortar or as listed in Table 1402.9 of the Standard Building Code with close fitting joints left smooth on the inside.

306.5.3 Liners shall be separate from the chimney wall and the space between the liner and masonry shall not be filled. Only enough mortar shall be used to make a good joint and hold the liners in position.

306.5.4 Flue liners shall start from a point not less than 8 inches below the intake. They shall extend as nearly vertically as possible for the entire height of the chimney, and shall extend at least 4 inches above the crown of the chimney, but not more than 6 inches.

306.5.5 Where two adjoining flues in the same chimney are separated only by flue liners the joints of the adjacent flue liners shall be staggered at least 7 inches.

306.5.6 Where more than two flues are located in the same chimney, masonry wythes (partitions) at least 4-inches wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings that there are not more than two flues in group of adjoining flues without such wythe separation.

306.5.7 Stainless steel flue liners may be used in an existing chimney. All pipe and fittings shall be constructed of stainless steel having not less than 16% chromium and having a minimum thickness of 0.018 inch. Longitudinal seams on all fittings and each pipe section shall be formed with interlocking seams and spot welded or shall be overlapped with a continuous weld. Connections between pipe and fitting sections shall overlap a minimum of 1 inch with the male end toward the appliance and shall be mechanically secure against disengaging when in service or during cleaning. A telescoping means shall be provided to prevent mechanical damage during heating and cooling cycles. The entire assembly shall be self-supporting. A cap shall be provided at the top of the liner to provide protection from the weather and any other undesirable objects entering the liner. Stainless steel flue liners shall be tested by an approved testing laboratory to resist corrosion, softening or cracking from flue gases at temperatures up to 1800° F.

306.5.8 When existing masonry chimneys are lined with a listed chimney liner system, the system shall be installed in accordance with the listing.

306.5.9 Masonry chimneys for residential type appliances shall extend at least 3 ft above the highest point where they pass through the roof of a building and at least 2 ft higher than any portion of a building within 10 ft.

306.5.10 All wood beams, joists and studs shall be trimmed away from chimneys. Headers, beams, joists and studs shall be not less than 2 inches from the outside face of a chimney or from masonry enclosing a flue. Ends of wood girders may be supported on a corbeled shelf of a masonry chimney provided there is not less than 8 inches of solid masonry between the ends and the flue liner.

306.5.11 Combustible lathing, furring or plaster grounds shall not be placed against a chimney at any point more than 1 1/2 inches from the corner of the chimney, but this shall not prevent plastering directly on the masonry or on metal lath and metal furring, nor shall it prevent placing chimneys for residential type appliances entirely on the exterior of a building against the sheathing.

306.6 Masonry Chimneys For Low Heat Appliances

306.6.1 Masonry chimneys shall be constructed of solid masonry units or reinforced concrete with walls not less than 8 inches thick, except that rubble stone masonry shall be not less than 12 inches thick.

306.6.2 Masonry chimneys for low heat appliances shall be lined with approved fire clay tile flue liners not less than 5/8 inch thick, or with other approved liner of material that will resist corrosion, softening or cracking from flue gases at temperatures up to 1800° F. Fire clay tile liners shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fire clay mortar or as listed in Table 1402.9 of the Standard Building Code with close fitting joints left smooth on the inside.

306.6.2.1 Flue liners shall start from a point not less than 8 inches below the intake. They shall extend as nearly vertically as possible for the entire height of the chimney, and shall extend at least 4 inches above the crown of the chimney, but not more than 6 inches.

306.6.2.2 Where two adjoining flues in the same chimney are separated only by flue liners, the joints of the adjacent flue liners shall be staggered at least 7 inches.

306.6.3 Where more than two flues are located in the same chimney, masonry wythes (partitions) at least 4-inches wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings that there are not more than two flues in any group of adjacent flues without such wythe separation.

306.6.4 Masonry chimneys for low-heat appliances shall extend at least 3 ft above the highest point where they pass through the roof of a building and at least 2 ft higher than any portion of a building within 10 ft.

306.6.4.1 All wood beams, joists and studs shall be trimmed away from chimneys. Headers, beams, joists, and studs shall be not less than 2 inches from the outside face of a chimney or from masonry enclosing a flue.

306.6.4.2 Combustible lathing, furring or plaster grounds shall not be placed against a chimney at any point more than 1 1/2 inches from the corner of the chimney, but this shall not prevent plastering directly on the masonry or on metal lath and metal furring, nor shall it prevent placing chimneys for low heat appliances entirely on the exterior of a building against the sheathing.

306.7 Masonry Chimneys For Medium Heat Appliances

306.7.1 Masonry chimneys for medium heat appliances shall be constructed of solid masonry units or of reinforced concrete not less than 8 inches thick, except that stone masonry shall be not less than 12 inches thick; and in addition, shall be lined with not less than 4 1/2-inch of fire brick laid on the 4 1/2 inches bed in fire clay mortar, starting not less than 2 ft below the chimney connector entrance and extending for a distance of at least 25 ft above the chimney connector entrance. Chimneys extending 25 ft or less above the chimney connector shall be lined to the top.

306.7.2 Masonry chimneys for medium heat appliances shall extend not less than 10 ft higher than any portion of any building within 25 ft and shall have a clearance of 2 inches from buildings and structures.

306.8 Masonry Chimneys For High Heat Appliances

306.8.1 Masonry chimneys for high heat appliances shall be constructed with double walls of solid masonry units or of reinforced concrete each not less than 8-inches thick, with an air space of not less than 2 inches between them. The inside of the interior walls shall be of fire brick not less than 4 1/2-inches thick laid on the 4 1/2-inches bed in fire clay.

306.8.2 Masonry chimneys for high heat appliances shall extend not less than 20 ft higher than any portion of any building within 50 ft and shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection, maintenance operations on the chimney and to avoid danger of burns to persons. Clearances shall be based on good engineering practice and acceptable to the Mechanical Official.

306.9 Masonry Chimneys For Incinerators

306.9.1 Masonry chimneys for residential type incinerators shall be constructed in accordance with 306.5.

306.9.2 The flue of fuel-fed incinerators (apartment-house type) shall serve the incinerator only and be used for no other purpose. The flue liner shall be straight and plumb and shall be smooth on the inside and the size of incinerator flues shall be in accordance with the following:

1. Where not more than one service opening is provided, the size of flue shall be not less than 14 x 14 inches or 196 sq in, inside measurements, except that in one family dwellings the size shall be not less than 12 x 12 inches or 144 sq inches.

2. Where two to six service openings are provided, the size of flue shall be not less than 18 by 18 inches or 324 sq in, inside measurements.

3. Where seven or more service openings are provided, the size of flue shall be not less than 22 x 22 inches or 484 sq inches, inside measurements.

306.9.3 A masonry chimney serving an incinerator with a combustion chamber having a horizontal combined hearth and grate area of 7 sq ft or less shall have walls of clay or shale brickwork not less than 4 inches thick with a lining of 4 1/2 inches of fire brick for a distance of not less than 10 ft above the roof of the combustion chamber. Beyond this point chimney walls shall consist of not less than 8 inches of clay or shale brickwork with a standard fire clay tile flue liner not less than 5/8 inch thick extending from the top of the fire brick lining to the top of the chimney.

306.9.4 A masonry chimney serving an incinerator with a combustion chamber having a horizontal combined hearth and grate area exceeding 7 sq ft shall have walls of clay or shale brickwork not less than 4-inches thick with a lining of 4 1/2 inches of fire brick for a distance of not less than 40 ft above the roof of the combustion chamber. Beyond this point, chimney walls shall consist of not less than 8 inches of clay or shale brickwork with a standard fire clay tile flue liner not less than 5/8 inch thick extending from the top of the fire brick lining to the top of the chimney.

306.9.5 Other constructions may be used if equivalent to the construction outlined in 306.9.1 through 306.9.4 in structural strength, insulating value and ability to withstand thermal expansion and flame impingement.

306.9.6 Fire brick shall be laid in high-temperature cement or fire clay mortar.

306.9.7 A chimney flue that is divided into two channels, one for feeding refuse and the other for the discharge of combustion gases, shall be constructed as specified in 306.9.

306.9.8 Masonry chimneys for fuel-fed incinerators shall be supported on properly designed foundations of masonry or reinforced concrete. Noncombustible material having a fire resistance rating of not less than 3 hours may be used to support masonry chimneys where such supports are independent of the floor construction and the load is transferred to the ground. They shall be so constructed as not to place excessive stress upon the roof of the combustion chamber. Masonry chimneys may be supported on incinerator walls.

306.9.9 All flues shall terminate in a substantially constructed spark arrester with openings not greater than 3/4 inch, or be provided with other suitable means of avoiding discharge of flying particles. Expansion chambers used as a secondary combustion chamber shall be constructed equivalent to that of the incinerator combustion chamber. Those used only for settling shall be of construction equivalent to that of the upper portion of the incinerator.

306.9.10 Masonry chimneys of fuel-fed incinerators shall extend at least 4 ft above sloping roofs measured from the highest point at which the chimney passes through the roof and at least 8 ft above flat roofs. In either case, the chimney shall extend at least 2 ft higher than any portion of a building within 20 ft.

306.9.10.1 A clearance of not less than 2 inches shall be provided between the exterior surface of chimneys for fuel-fed apartment house type incinerators and combustible material.

306.9.10.2 Combustible lathing, furring or plaster grounds shall not be placed against a chimney at any point more than 1 1/2 inches from the corner of the chimney but this shall not prevent plastering directly on the masonry or on metal lath and metal furring; nor shall it prevent placing chimneys entirely on the exterior of a building against the sheathing.

306.9.11 All service openings into an incinerator flue shall be provided with a hopper or other charging device constructed of metal of sufficient thickness and durability to prevent cracking, breakage, or deformation in normal usage. Such hopper or other charging device shall be firmly built into the masonry and shall be so designed and installed that no part will project into the flue and that the opening to the flue exterior will be closed off while the service opening (hopper) door is fully open. The hopper or other device shall be counterweighted or otherwise devised so that it will close automatically upon release and be so constructed as to be tight fitting when in the closed position.

306.9.12 Masonry chimneys of commercial and industrial type incinerators, except as provided in 306.9.13 and 306.9.14 shall not be less than 8 inches of clay or shale brickwork or reinforced concrete lined with fire brick not less than 4 1/2 inches thick for the full height of the chimney.

306.9.13 Subject to approval by the Mechanical Official, commercial and industrial type incinerators may be connected to chimneys constructed of 8 inches of clay or shale brickwork or reinforced concrete lined with fire clay flue liner, where the incinerator is specially constructed to produce low flue gas temperatures.

306.9.14 Other constructions may be used if equivalent to 306.9.12 and 306.9.13 in structural strength, insulating value, and ability to withstand thermal expansion and flame impingement.

306.9.15 Fire brick and other refractory lining shall be laid in high temperature cement or fire clay mortar.

306.9.16 Masonry chimneys for commercial and industrial incinerators shall be supported on properly designed foundations of masonry or reinforced concrete. Noncombustible material having a fire resistance rating of not less than 3 hours may be used to support masonry chimneys where such supports are independent of the floor construction and the load is transferred to the ground. They shall be so constructed as not to place excessive stress upon the roof of the combustion chamber. Masonry chimneys may be supported on incinerator walls.

306.9.17 Incinerators used for the burning of rubbish or other readily combustible solid waste material shall include effective means for arresting sparks and flying particles, such as an expansion chamber, baffle walls, or other effective arrangement, or the flues of such incinerators shall be provided with an approved spark arrester having openings not greater than 1/2 inch.

306.9.18 Masonry chimneys for commercial and industrial type incinerators shall extend at least 4 ft above sloping roofs measured from the highest point at which the chimney passes through the roof and at least 8 ft above flat roofs. In either case, the chimney shall extend at least 2 ft above any ridge, parapet, cornice, penthouse or other obstruction within 20 ft.

306.9.19 A clearance of not less than 4 inches shall be provided between the exterior surface of masonry chimneys for commercial and industrial type incinerators and combustible material.

306.10 Metal Chimneys (Smokestacks)

306.10.1 Metal chimneys shall be of adequate thickness based on good engineering practice, properly riveted or welded, and securely supported. When selecting the thickness of metal chimneys consideration should be given to factors such as location, maintenance, use, etc., as well as engineering design factors. As a guide the following are thicknesses of uncoated sheet steel for given cross-sectional areas:

Thickness (in)	Area (sq in)
0.0598 (16 ga)	Up to 154
0.0747 (14 ga)	154 to 201
0.105 (12 ga)	201 to 254
0.135 (10 ga)	Larger than 254

306.10.2 Metal chimneys shall not be carried up inside of ventilating ducts unless such ducts are constructed and installed as required by this Code for chimneys and the ventilating ducts are used solely for exhaust of air from the room or space in which the appliance served by the metal chimney is located.

306.10.3 Metal chimneys shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection and maintenance operations on the chimneys and to avoid danger of burns to persons.

306.11 Metal Chimneys For Low Heat Appliances

306.11.1 Metal chimneys for residential type low heat appliances without an exhauster shall extend at least 3 ft above the highest point where they pass through the roof of a building and at least 2 ft higher than any portion of a building within 10 ft. The outlet of a metal chimney for residential type and low heat appliances equipped with an exhauster may terminate at a location not less than 3 ft from an adjacent building or building opening and at least 10 ft above grade or walkways. In any case, the outlet shall be so arranged that the flue gases are not directed so as to jeopardize people, overheat combustible structures, or enter building openings in the vicinity of the outlet.

306.11.2 Exterior metal chimneys used only for residential type low heat appliances as defined in Table 306A shall have a clearance of not less than 6 inches from a wall of wood frame construction and from any combustible material.

306.11.3 Exterior metal chimneys over 18 inches in diameter shall have a clearance of not less than 4 inches, and those 18 inches or less in diameter a clearance of not less than 2 inches from a building wall of other than wood frame construction.

306.11.4 An exterior metal chimney shall not be nearer than 24 inches to any door or window or to any walkway, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

306.11.5 Where a metal chimney extends through any story above that in which the appliances connected to the chimney are located, it shall be enclosed in such upper stories with walls of noncombustible constuction having a fire resistance of not less than 1 hour.

306.11.6 The enclosure shall provide a space on all sides of the chimney sufficient to permit inspection and repair.

306.11.7 The enclosing walls shall be without openings, except doorways equipped with approved self-closing fire doors at various floor levels for inspection purposes.

306.11.8 Where a metal chimney used for residential type construction as defined in Table 306A is located in the same story of a building as that in which the appliances connected thereto are located, it shall have a clearance of not less than 18 inches from a wall of wood frame construction and from any combustible material.

306.11.9 Where a metal chimney serving only low heat appliances as defined in Table 306A passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of noncombustible material, of galvanized iron or approved corrosion resistant metal, extending not less than 9 inches below and 9 inches above the roof construction, and of a size to provide not less than 6 inches clearance on all sides of the chimney; or the combustible material in the roof construction shall be cut away so as to provide not less than 18 inches clearance on all sides of the chimney, with noncombustible material used to close up such opening entirely.

306.12 Metal Chimneys For Medium Heat Appliances

306.12.1 Metal chimneys for medium heat appliances shall extend not less than 10 ft higher than any portion of any building within 25 ft.

306.12.2 Exterior metal chimneys used for medium heat appliances as defined in Table 306A shall have a clearance of not less than 24 inches from a wall of wood frame construction and from any combustible material.

306.12.3 Exterior metal chimneys over 18 inches in diameter shall have a clearance of not less than 4 inches and those 18 inches or less in diameter a clearance of not less than 2 inches from a building wall other than wood frame construction.

306.12.4 Portions of an exterior metal chimney shall not be nearer than 24 inches to any door or window or to any walkway, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

306.12.5 Where a metal chimney extends through any story of a building above that story in which the appliances connected to the chimney are located, it shall be enclosed in such upper stories with walls which are continuous of noncombustible construction having a fire resistance rating of not less than 1 hour.

306.12.6 The enclosure shall provide a space on all sides of the chimney sufficient to permit inspection and repair.

306.12.7 The enclosing walls shall be without openings, except doorways equipped with approved self-closing fire doors at various floor levels for inspection purposes.

306.12.8 Where a metal chimney serving a medium heat appliance as defined in Table 306A passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of galvanized iron or approved corrosion resistant metal, extending not less than 9 inches below and 9 inches above the roof construction, and of a size to provide not less than 18-inch clearance on all sides of the chimney.

306.12.9 Where a metal chimney used for medium heat appliances as defined in Table 306A is located in the same story of a building as that story in which the appliances connected are located, it shall have a clearance of not less than 36 inches from a wall of wood frame construction and from any combustible material.

306.13 Metal Chimneys For High Heat Appliances

306.13.1 Metal chimneys used for high heat appliances as defined in Table 306A shall be lined with not less than 4 1/2 inches of fire brick laid in fire clay mortar extending not less than 25 ft above the chimney connector entrance. Chimneys extending 25 ft or less above the chimney connector shall be lined to the top.

306.13.2 Metal chimneys for high heat appliances shall extend not less than 20 ft higher than any portion of any building within 50 ft and shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection, for maintenance operations on the chimney and to avoid danger of burns to persons. Clearances shall be based on good engineering practice and acceptable to the Mechanical Official.

306.14 Metal Chimneys For Incinerators

306.14.1 Metal pipe made from 0.0396-inch (20 ga) minimum galvanized steel or other equivalent noncombustible corrosion resistant material may be used for residential type incinerators installed in locations such as sheds, breezeways or carports provided the metal pipe is exposed and readily examinable for its full length and clearances not less than 18 inches are maintained from combustible material. The metal pipe shall extend at least 3 ft above the highest point where it passes through the roof and at least 2 ft higher than any portion of the building within 10 ft. Where the metal pipe passes through a roof constructed of combustible material, clearances shall conform to the requirements of 306.11.4 through 306.11.9.

306.14.2 Metal chimneys of commercial and industrial type incinerators shall be lined with firebrick not less than 4 1/2-inches thick for the full height of the chimney.

306.14.3 Firebrick shall be laid in high temperature cement or fire clay mortar.

306.14.4 Subject to approval by the authority having jurisdiction, commercial and industrial type incinerators may be connected to a metal chimney without firebrick flue liner provided the incinerator is specially constructed to produce low flue gas temperatures.

306.14.5 Metal chimneys of commercial and industrial type incinerators shall extend at least 4 ft above sloping roofs measured from the highest point at which the metal chimney passes through the roof and at least 8 ft above flat roofs. In either case, the chimney shall extend at least 2 ft higher than any portion of a building within 20 ft.

306.14.6 A clearance of not less than 4 inches shall be provided between the exterior surface of metal chimneys for commercial and industrial type incinerators and combustible material.

306.15 Chimney Connectors And Vent Connectors

306.15.1 Connectors Required. Connectors shall be used to connect appliances to the vertical chimney or vent unless the chimney or vent is attached directly to the appliance.

306.15.2 Materials.

306.15.2.1 Connectors shall be made of noncombustible material capable of withstanding the flue gas temperatures produced by the appliances and of sufficient thickness to withstand physical damage. The material of connectors shall also be resistant to corrosion. Connectors for appliances installed in attics shall be of Type B or Type L vent material for listed gas appliances with draft hoods or of Type L vent material for oil appliances listed as suitable for Type L vents. For other appliances allowed in attics, a chimney shall be attached directly to the appliance.

306.15.2.2 When selecting the thickness of metal for connectors of appliances not installed in attics, considerations should be given to factors such as location, maintenance, use, etc., as well as engineering design factors. As a guide the following are thicknesses of galvanized steel for given diameter connectors:

Galvanized Thickness (in)	Diameter of Connector (in)
0.0276 (24 ga)	10 or less
0.0336 (22 ga)	10 to 12
0.0396 (20 ga)	14 to 16
0.0635 (16 ga)	16

306.15.2.3 Connectors used for gas appliances having draft hoods and for listed conversion-burner-equipped appliances having draft hoods may be constructed of materials having resistance to corrosion and heat not less than that of 0.187-inch thick (28 ga) steel, or they may be of Type B or Type L vent material. Connectors made of Type L vent material may be used with oil appliances listed as suitable for use with Type L venting system.

306.15.3 Length. A connector shall be as short and straight as possible. The appliance shall be located as close as practical to the chimney, vent, or venting system. The horizontal run of an uninsulated connector to a natural-draft chimney, or vent, shall be not more than 75% of the height of the vertical portion of the chimney or vent above the connector, unless part of an engineered venting system.

306.15.4 Size. The connector, for its entire length, shall not be smaller than the flue collar of the appliance unless otherwise recommended by the appliance, chimney, or vent manufacturer.

306.15.5 Clearance.

306.15.5.1 Clearance from combustible materials for chimney connectors shall be 18 inches for residential type appliances, and commercial-industrial type low heat appliances. The clearance for commercial-industrial type medium heat appliances shall be 36 inches.

306.15.5.2 Vent connector clearances for gas appliances not equipped with draft hoods, except clothes dryers, shall be 18 inches. This distance may be 6 inches for listed gas appliances equipped with draft hoods, and for boilers and furnaces equipped with listed conversion burners and with draft hoods. A vent connector of listed Type B or Type L venting material may be used with listed appliances and may be installed in accordance with their listing.

306.15.5.3 Vent connectors serving direct vent appliances utilizing a condensing system may be installed in accordance with the furnace manufacturer's instructions.

306.15.6 Location. When the connector used for a gas appliance having a draft hood must be located in or pass through a crawl space or other cold area, that portion of the connector shall be of listed Type B or Type L vent material or be provided with equivalent means of insulation.

306.15.7 Installation.

306.15.7.1 A connector to a masonry chimney shall extend through the wall to the inner face or liner but not beyond, and shall be firmly cemented to masonry. A thimble may be used to facilitate removal of the chimney connector for cleaning, in which case the thimble shall be permanently cemented in place with high-temperature cement.

306.15.7.2 A chimney connector or a vent connector shall not pass through any floor or ceiling.

306.15.7.3 Connectors for listed residential and low heat gas appliances with draft hoods except incinerators may pass through walls or partitions constructed of combustible material if:

1. Made of listed Type B or Type L material and installed with not less than listed clearances to combustible material.
2. Made of single wall metal pipe and guarded by a ventilated metal thimble not less than 4 inches larger in diameter than the vent connector.

306.15.7.4 Connectors of low heat appliances except listed residential and low heat gas appliances with draft hoods (Table 306B, Column 1) shall not pass through walls or partitions constructed of combustible material unless thay are guarded at the point of passage by:

1. Metal ventilated thimbles not less than 12 inches larger in diameter than the connector.
2. Metal or burned fire clay thimbles built in brickwork or other approved fireproofing materials extending not less than 8 inches beyond all sides of the thimble.

306.15.7.5 In lieu of thimbles all combustible material in the wall or partition shall be cut away from the connector a sufficient distance to provide the clearance required from such connector. Any material used to close up such openings shall be noncombustible insulating material.

306.15.7.6 A connector of any medium or high heat appliance classified in Table 306A shall not pass through any wall or partition constructed of combustible material.

306.15.7.7 Connectors shall maintain a pitch of rise of at least 1/4 inch per foot (horizontal length of pipe) from the appliance to the chimney.

306.15.7.8 Connectors shall be installed so as to avoid sharp turns or other construction features which would create excessive resistance to the flow of flue gases. A device which will obstruct the free flow of flue gases shall not be installed in a connector, chimney, or vent. This shall not be construed to prohibit the use of devices specifically listed for installation in a connector, such as heat reclaimers, draft regulators, and safety controls.

306.15.7.9 Connectors shall be securely supported and joints fastened with sheet-metal screws, rivets, or other approved means.

306.15.7.10 The entire length of a connector shall be readily accessible for inspection, cleaning, and replacement, unless listed materials are used and previous approval has been obtained from the Mechanical Official.

306.15.7.11 A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace opening is sealed or the chimney flue which vents the fireplace is permanently sealed below the connection.

306.15.8 Interconnection.

306.15.8.1 Connectors shall not be connected to a chimney, vent, or venting system served by a power exhauster unless the connection is made in the negative pressure side of the exhauster.

306.15.8.2 Two or more fuel-burning appliances may be connected to a single chimney or vent provided sufficient draft is available for safe combustion in each appliance and removal of all the products of combustion safely to the outdoors. Gas and oil appliances so connected shall be equipped with primary safety controls.

306.15.9 Dampers.

306.15.9.1 Manually operated dampers shall not be placed in chimneys, vents or connectors of stoker fired, or liquid or gas-burning appliances. Fixed baffles on the appliance side of draft hoods and draft regulators shall not be classified as dampers.

306.15.9.2 A listed automatic vent damper device may be installed on an existing appliance installation provided the appliance is listed and equipped with a draft hood and provided the device is installed by a qualified agency in accordance with the terms of its listing. The name of the installer and date of installation shall be marked on a label affixed to the damper device.

306.15.9.3 On gas appliances in excess of 800,000 Btu input having more than two draft hoods, fixed manual baffles may be used in the connectors between draft hoods and the common breeching as a means of equalizing the available draft pull.

306.15.10 Draft Hoods. For information concerning the use and installation of draft hoods, refer to the Standard Gas Code.

306.16 Draft Regulators

306.16.1 Gas appliances connected to chimneys, other than those required by the Standard Gas Code to be installed with draft hoods, may be installed with draft regulators if in accordance with the appliance manufacturer's instruction.

306.16.2 For information concerning the use and installation of draft regulators with oil-burning appliances, refer to NFiPA 31.

306.16.3 Solid fuel-burning appliances may be installed with draft regulators to reduce draft intensity. Such regulators shall be installed and set in accordance with the instructions furnished with the appliance or the draft regulator.

306.16.4 A barometric draft regulator, if used, shall be installed in the same room or enclosure as the appliance in such a manner that a difference in pressure between the air in the vicinity of the regulator and the combustion air supply will not be permitted.

306.17 Fireplaces

306.17.1 Factory-built Fireplaces. Factory-built fireplaces shall be listed and shall be installed in accordance with the conditions of the listing. Factory-built fireplaces shall also be required to be installed in accordance with 306.17.3.6 and 306.17.3.9. The factory-built fireplaces shall be tested in accordance with and meet the requirements of UL 127.

306.17.2 Factory-built Fireplace Stoves. Factory-built fireplace stoves and solid fuel type room heaters shall be listed and shall be installed in accordance with the conditions of the listing. The factory-built fireplace stoves shall be tested in accordance with and meet the requirements of UL 737. The solid fuel type room heaters shall be tested in accordance with and meet the requirements of UL 1482.

306.17.3 Masonry Fireplaces.

306.17.3.1 Fireplaces shall be constructed of solid masonry or of reinforced concrete with back and sides of the thickness specified in this paragraph, except as provided in 306.17.1. Where a lining of firebrick at least 2 inches thick or other approved lining is provided, the total thickness of back and sides, including the lining, shall be not less than 8 inches of solid masonry or reinforced concrete. Where no such lining is provided, the thickness of back and sides shall be not less than 12 inches of solid masonry or reinforced concrete.

306.17.3.2 Steel fireplace units incorporating a firebox liner of not less than 1/4 inch thick steel and an air chamber may be installed with masonry to provide a total thickness at the back and sides of not less than 8 inches, not less than 4 inches of which shall be solid masonry.

306.17.3.3 Warm air ducts employed with steel fireplace units of circulating air type shall be constructed of metal or masonry.

306.17.3.4 Fireplace hearth extensions shall be provided of approved noncombustible material for all fireplaces. Where the fireplace opening is less than 6 sq ft, the hearth extension shall extend at least 16 inches to the front of, and at least 8 inches beyond each side of the fireplace opening. Where the fireplace opening is 6 sq ft or larger, the hearth extension shall extend at least 20 inches to the front of and at least 12 inches beyond each side of the fireplace opening. Where a fireplace is elevated above or overhangs a floor, the hearth extension shall also extend over the area under the fireplace.

306.17.3.5 Fireplaces constructed of masonry or reinforced concrete shall have hearth extensions of brick, concrete, stone, tile or other approved noncombustible material properly supported and with no combustible material against the underside thereof. Wooden forms or centers used during the construction of hearth and hearth extension shall be removed when the construction is completed.

306.17.3.6 Hearth extensions of approved factory-built fireplaces and fireplace stoves shall be not less than 3/8-inch thick asbestos, concrete, hollow metal, stone, tile or other approved noncombustible material. Such hearth extensions may be placed on the sub or finish flooring whether the flooring is combustible or not. The hearth extension shall be readily distinguishable from the surrounding floor.

306.17.3.7 All wood beams, joists and studs shall be trimmed away from fireplaces. Headers supporting trimmer arches at fireplaces shall not be less than 20 inches from the face of the chimney breast. Trimmers shall not be less than 6 inches from the inside face of the nearest flue lining.

306.17.3.8 Woodwork shall not be placed within 4 inches of the back of a fireplace but this shall not prevent plastering directly on the masonry or on metal lath and metal furring.

306.17.3.9 Woodwork shall not be placed within 6 inches of a fireplace opening. Woodwork above and projecting more than 1 1/2 inches from a fireplace opening shall not be placed less than 12 inches from the top of a fireplace opening.

306.17.4 False Fireplaces False fireplaces may be used in connection with listed gas or electric heaters, provided such fireplaces are constructed of noncombustible materials.

TABLE 306A
CHIMNEY SELECTION CHART

Chimneys for RESIDENTIAL TYPE Appliances	Chimneys for LOW HEAT Appliances	Chimneys for MEDIUM HEAT Appliances	Chimneys for HIGH HEAT Appliances
1. Factory built (residential) 2. Masonry (residential)[4]	1. Factory built (low heat) 2. Masonry (low heat type)[4] 3. Metal (smokestack)[5]	1. Factory built (medium heat type) 2. Masonry (med. heat type)[4] 3. Metal (smokestack)[5]	1. Masonry (high heat type) 2. Metal (smokestack)[5]

TYPES OF APPLIANCES TO BE USED WITH EACH TYPE CHIMNEY

Column I	Column II	Column III	Column IV
A. Residential appliances such as: 1. Ranges 2. Warm air furnaces 3. Water heaters 4. Hot water heating boilers 5. Low pressure steam heating boilers (not over 15 psig) 6. Domestic incinerators 7. Floor furnaces 8. Wall furnaces 9. Room heaters 10. Fireplace stoves	A. All appliances shown in Column I B. Nonresidential type building heating appliances for heating a total volume of space exceeding 25,000 cu ft* C. Appliances such as: 1. Annealing baths for hard glass (fats, paraffin, salts, or metals) 2. Bake ovens (in bakeries)	All appliances shown in Columns I and II, and appliances such as: 1. Alabaster gypsum kilns 2. Annealing furnaces (glass or metal) 3. Charcoal furnaces 4. Cold stirring furnaces 5. Feed driers (direct fire heated) 6. Fertilizer driers (direct fire heated) 7. Galvanizing furnaces 8. Gas producers	All appliances shown in Columns I, II and III, and appliances[2] such as: 1. Bessemer retorts 2. Billet and bloom furnaces 3. Blast furnaces 4. Bone calcining furnaces 5. Brass furnaces 6. Carbon point furnaces 7. Cement brick and tile kilns 8. Ceramic kilns 9. Coal and water

TABLE 306A (Continued)
CHIMNEY SELECTION CHART

Column I	Column II	Column III	Column IV
B. Fireplaces	3. Boiling vats, for wood fibre, straw, lignin, etc. 4. Candy furnace 5. Coffee roasting 6. Core ovens 7. Cruller furnaces 8. Feed drying ovens 9. Fertilizer drying 10. Fireplaces, other than residential type 11. Forge furnaces (solid fuel) 12. Gypsum kilns 13. Hardening furnaces (below dark red) 14. Hot air engine furnaces 15. Ladle drying furnaces 16. Lead melting furnaces 17. Nickel plate (drying) furnaces 18. Paraffin furnaces 19. Recuperative furnaces (spent materials) 20. Rendering furnaces 21. Rosin melting furnaces 22. Steam boilers operating at not over 50 psi; pressing machine boilers	9. Hardening furnaces (cherry to pale red) 10. Incinerators commercial and industrial type 11. Lehrs and glory holes 12. Lime kilns 13. Linseed oil boiling furnaces 14. Porcelain bircuit kilns 15. Pulp driers (direct fire heated) 16. Steam boilers operating at over 50 lb. per sq. in. gage pressure except pressing machine boilers 17. Water-glass kiln 18. Wood-distilling furnaces 19. Wood-gas retorts	10 Cupolas 11. Earthenware kilns 12. Glass blow furnaces 13. Glass furnaces (smelting) 14. Glass kilns 15. Open hearth furnaces 16. Ore roasting furnaces 17. Porcelain baking and glazing kilns 18. Pot-arches 19. Puddling furnaces 20. Regenerative furnaces 21. Reverberatory furnaces 22. Stack, carburetor or superheating furnaces (in water gas works) 23. Vitreous enameling ovens (ferrous metals) 24. Wood carbonizing furnaces

TABLE 306A (Continued)
CHIMNEY SELECTION CHART

Column I	Column II	Column III	Column IV
	23. Stereotype furnaces 24. Sulphur furnaces 25. Tripoli kilns (clay, coke and gypsum) 26. Type foundry furnaces 27. Unit heaters (oil-fired) 28. Wood drying furnaces 29. Wood impregnating furnaces 30. Zinc amalgamating furnaces		

*Nonresidential type building heating appliances for heating a total volume of space not to exceed 25,000 cu ft may be connected to chimneys for residential type appliances.

NOTES:

1. Appliances otherwise classed as high heat appliances may be considered as medium heat appliances if not larger than 100 cu ft in size.
2. When such appliances are larger than 100 cu ft in size, and other furnaces classified as high heat appliances in accordance with nationally recognized good practice.
3. Continuous operating equipment of the counter current type may not require the type of flue indicated by general types of appliances.
4. For construction and other provisions for masonry chimney installation see the Standard Building Code.
5. For construction and other provisions for metal chimney installation see 306.10 through 306.14.

TABLE 306B
VENTING SYSTEM SELECTION CHART

TYPE OF VENTING SYSTEM

Type B — Gas	Type BW — Gas	Type L — Oil	Metal Pipe
(Round or Oval) All listed gas appliances/ draft hoods such as: 1. Central furnaces 2. Duct furnaces 3. Floor furnaces 4. Heating boilers 5. Ranges 6. Built-in ovens 7. Vented wall furnaces listed for use with Type B vents 8. Room heaters 9. Water heaters 10. Horizontal furnaces 11. Unit heaters	1. Vertical wall furnaces for use with Type BW vents only	1. Low temperatures flue appliance listed for use with Type L venting systems 2. Gas appliances shown in Column I	1. Incinerators used outdoors, such as in open sheds, breezeways or carports as provided in 305.14A. 2. Gas appliances shown in Column I 3. Listed residential and low heat gas appliances without draft hoods and unlisted residential and low heat gas appliances with or without draft hoods.

307 VENTILATION SYSTEMS

307.1 Required Systems

A separate and individual system, which shall not be part of any other system, shall be provided for ventilating each room containing any of the following materials; flammable vapors, corrosive vapors, noxious gases, or flammable dusts. For commercial food heat-processing equipment see 308. Any ventilation required involving materials incompatible with each other shall have separate ventilation systems for each of the incompatible materials. Vestibule ventilation for smokeproof enclosures shall be in accordance with the Standard Building Code.

307.2 Elevated Duct Temperatures

Where ventilation duct temperatures exceed 250°F, special protective measures may be required by the Mechanical Official.

307.3 Ducts — General

307.3.1 Every duct and plenum used in a ventilation system shall be constructed of approved material and construction as set forth in Chapter 5.

307.3.2 Ducts shall be substantially airtight throughout and have no openings other than those required for proper operation and maintenance of the system.

307.3.3 The type of metal duct bracing, the distance of duct joints on center, the type of duct transverse joint connections, and the type of duct lateral seams, shall comply with Chapter 5.

307.3.4 Every duct shall be securely attached to the building as set forth in Chapter 5. No nails or screws shall be driven through the duct walls into the building construction and ducts shall be supported on noncombustible straps or hangers without penetration of the duct walls.

307.3.5 Every duct or plenum which is a portion of a ventilation system used for exhausting any solid particles shall be constructed so as to permit thorough cleaning of the entire duct system. Any such duct or plenum, having any section or sections inaccessible from the duct entry or discharge, shall be provided with cleanout openings. All cleanout openings shall be equipped with tight-fitting sliding or hinged doors constructed of metal equal or greater in thickness than the ducts. Such doors shall be equipped with a substantial method of latching, sufficient to hold the door tightly closed. These doors shall be so designed that they can be opened easily without the use of a tool.

307.4 Motors, Fans And Filters

307.4.1 Motors and fans shall be of sufficient capacity to provide the required air movement as specified in the Standard Building Code. Every motor and fan shall be so installed as to afford access for servicing or maintenance.

307.4.2 Fan motors, except NEMA Class I explosion proof motors, shall not be installed inside the ducts or under hoods in any ventilation system conveying flammable vapors or combustible dusts, nor shall any belt or chain driven apparatus be inside any such duct or under any such hood unless the belt or chain and any pulley connection therewith is entirely enclosed and grounded except motors and receptacles listed for the class, group and division of flammable vapors or combustible dusts as indicated in Article 500, NFiPA 70.

307.4.2.1 Every fan blade located in any duct shall be of rigid noncombustible construction. In any ventilation system conveying flammable vapors or combustible dust, the fan blade, shaft and casing shall be of a nonsparking material. Bearings for fans shall be self-lubricating or shall be lubricated from outside the duct.

307.4.3 Air filters, other than grease hood filters regulated by 308, shall be of a type that, in a clean state, will not burn freely. Liquid adhesive coatings used on filters shall have a flash point of 350° F, Cleveland open cup tester, or higher. Filters qualifying as Class 1 or Class 2 shall be accepted as meeting these requirements. Evaporative coolers containing a combustible evaporation medium, such as excelsior, shall not be used.

307.4.4 Rotary fans without fan blade protection shall provide for not less than 8 ft of clearance from the finished floor level to the bottom side of the unprotected fan blades.

> EXCEPTION: Fan blades of low speed residential type ceiling fans installed within dwelling units shall be located at least 6 ft 8 inches from the finished floor.

307.5 Safety Devices

Whenever a fire damper is installed it shall be installed and constructed to comply with Chapter 5. Ducts discharging combustible material directly into any combustion chamber shall conform to the requirements of NFiPA 82.

307.6 Dry Cleaning Plants

Type I and Type II Systems. The ventilation system shall provide a complete and continuous air change at least once every 3 minutes in dry cleaning and dry dyeing rooms. The system shall be provided with means for remote control and shall operate automatically when any dry cleaning or dry dyeing equipment is in use.

308 EXHAUST SYSTEMS

308.1 Systems Required

308.1.1 Exhaust system shall be provided, maintained and operated for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders, and any other equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas, or smoke, in such quantities as to be irritating or injurious to health or safety, and shall mechanically discharge such exhaust to the outdoor atmosphere. The total outdoor air supplied shall be equal in volume to that removed.

308.1.2 All equipment and system service rooms, which house sources of

odors, fumes, noxious gases, smoke, steam, dust, spray, or other contamination shall be such as to prevent spreading of any such contamination to any other occupied parts of the building.

308.1.3 Air exhausted from bath, toilet, urinal, lavatory, locker, coat room or similar rooms shall not be recirculated unless treated by a listed or approved air treatment system.

308.2 General Provisions

308.2.1 If a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical exhaust system for a room, adequate means shall be provided for the natural exit of the excess air supplied. If a mechanical exhaust system only is installed for a room or if a greater quantity of air is removed by a mechanical exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate means shall be provided for the natural supply of the deficiency in the air supplied.

308.2.2 The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a nuisance and from which it cannot again be readily drawn in by a ventilating system. Exhausting air into an attic or crawl space shall be prohibited. Air which is to be used for recirculation may be discharged to a supply system.

EXCEPTION: Attic fans may be permitted to discharge into attic space of residences having private attics.

308.2.3 Mechanical exhaust from bath, toilet, urinal, locker, service sink, closets and similar rooms shall be an independent system and shall not be recirculated unless treated by a listed or approved air treatment system. When exhaust systems are used, they may be combined with similar exhaust except kitchen exhaust shall be on an independent system.

308.2.4 Where natural ventilation or approved air treatment system is not provided, 2 cu ft of air per minute per sq ft of floor area shall be exhausted from lavatories, toilets, bathrooms and restrooms.

EXCEPTIONS:

1. For lavatories, toilets, bathrooms, and restrooms in one and two family dwellings, exhaust air may be reduced to a minimum of 1 cu ft per minute per sq ft of floor area.
2. For private toilet rooms with not more than one water closet and one lavatory, exhaust air may be reduced to a minimum of 1 cu ft per minute per sq ft of floor area.

308.3 Ducts — General

The materials used in every mechanical exhaust system shall be of sheet metal or other approved materials in accordance with Chapter 5. Materials shall be of non-absorbent and moisture and corrosion resisting character. The design and construction of all equipment and the weight and bracing of all duct work shall be such that will operate under normal conditions without excessive vibrations. (See Chapter 5). Ducts shall be substantially air-tight. Linings, if used, shall be securely anchored.

308.4 Grease Hood Duct Systems

308.4.1 Duct systems serving exhaust hoods removing smoke and grease laden vapors shall be constructed of and supported by steel 0.0598-inch (16 ga) minimum thickness or stainless steel 0.0478-inch (18 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official. Ducts constructed of materials that are subject to corrosion shall be suitably protected when installed outdoors.

308.4.1.1 All seams and joints shall be made liquid-tight with a continuous external weld.

308.4.1.2 All duct systems furnished as a part of a grease extractor listed by a nationally recognized testing agency are considered as complying with these requirements when installed in accordance with the terms of their listing.

308.4.2 All sections of the duct system shall be constructed and installed without forming dips and traps and shall slope not less than 1 inch per foot toward either the hood or an approved residue trap.

308.4.3 The duct system shall have only those openings required for the proper operation and maintenance of the system. For cleaning purposes, cleanout openings shall be provided at each change in direction of the duct and at any other portion of the system not accessible from the duct inlet or discharge. All cleanout openings shall be located on the sides of the duct and shall be of sufficient size to permit a thorough cleaning of the entire system. Cleanout openings shall be equipped with tight-fitting doors and covers, constructed of metal which is equal to or greater in thickness than that of the ducts. Such doors or covers shall be equipped with a substantial method of latching, sufficient to make them grease-tight. Doors or covers shall be so designed that they can be opened or removed without the use of a tool.

308.4.4 Duct systems shall be properly supported and securely fastened in place at every change in direction and as required in Chapter 5. Supports or fasteners shall not penetrate any duct or plenum.

308.4.5 Duct systems shall be designed and installed in a manner to provide an air velocity within the duct system of not less than 1500 ft per minute.

308.4.6 A separate system and individual duct system shall be provided exclusively for each grease hood, except as provided herein. A single duct system may serve more than one grease hood located in the same story of the building provided that, in addition to other requirements of this Code, the installation also complies with the following:

1. All hoods served by the system shall be located in the same room or adjacent rooms.
2. No portion of the interconnecting duct shall pass through any construction which would require the openings to be fire protected as specified in the Standard Building Code.
3. Grease exhaust duct systems shall not be interconnected with any other building ventilating or exhaust system.

308.4.7 Vertical ducts located within a building of two stories or more shall be enclosed in a continuous enclosure extending from the ceiling above the hood to or through the roof. A minimum clearance of 6 inches shall be maintained between the duct and interior surface of the enclosure. The fire resistance rating of the enclosure shall be a minimum of 1 hour for buildings two through three stories in height and a minimum of 2 hours for buildings four stories or more in height. The enclosure shall be used exclusively to enclose a single grease exhaust system and shall be used for no other purposes.

308.4.8 Openings required in vertical enclosures for access to cleanout openings shall be equipped with approved sliding or hinged doors equal in fire resistance to that of the enclosure.

308.4.9 No damper shall be installed in any portion of the duct system unless specifically listed for such use. This does not prohibit the use of dampers which are part of a listed grease extractor, an approved extinguishing system or an approved fan by-pass system.

308.4.10 Every duct system shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the duct side. Ducts shall not pass through interior walls or partitions having a fire resistance rating of 2 hours or more.

308.4.11 Motors, fans and exhaust outlets for grease hood duct systems shall comply with all applicable requirements as specified in 307.4 and 308.5.

308.4.12 Fume incinerators, thermal recovery units, air pollution control devices, or other devices, may be installed in ducts or hoods or located in the path of travel of exhaust products when specifically approved for such use and shall not increase the fire hazard.

308.5 Exhaust Outlets

308.5.1 Exhaust outlets for ducts conveying noxious gases, flammable vapors, corrosive vapors, and ducts serving commercial food cooking and processing equipment, shall terminate outside the building and shall be located 10 ft from any adjacent building, parking area, adjacent property line, window, door, or air intake opening and shall be located at least 10 ft above the adjoining grade level. Every exhaust outlet which is located above the roof shall terminate at least 40 inches above the roof surface. The airflow from exhaust outlets conveying grease-laden vapors shall be in a vertical direction away from the roof surface. Where this is not possible, a metal pan at least 1 inch deep shall be provided on the roof surface to catch grease residue.

308.5.2 The exhaust from hoods serving commercial food heat-processing equipment may terminate in an approved engineered air recovery system for recirculation to the room in which the hood is located.

308.6 Hoods

308.6.1 An exhaust hood shall be installed for all commercial, industrial, institutional and other food heat-processing equipment producing smoke or grease-laden air.

EXCEPTION: Domestic equipment installed within a dwelling unit.

308.6.2 The hood shall be designed with a sufficient air volume to properly exhaust all grease and smoke vapor produced by the equipment which it serves. Unless the hood is designed and certified by a licensed architect or professional engineer or is an approved prefabricated hood tested and certified by the manufacturer the following requirements shall be met:

1. Canopy-type hoods shall be at least 2 ft deep from bottom edge to top edge of hood and shall overhang the equipment they serve at least 6 inches on all open sides.

2. The bottom edge of a canopy-type hood shall be a maximum of 7 ft above the floor.

3. Canopy hoods open on all sides shall have a minimum exhaust capacity of 150 cfm per square foot of hood area.

4. Canopy-type hoods open on three or less sides shall have a minimum exhaust capacity of 100 cfm per sq ft of hood area.

5. Backshelf-type hoods having an intake within 3 ft of vapor producing surface shall have a minimum exhaust capacity of 300 cfm per linear foot of cooking surface within a maximum distance of 1 ft from the face of the hood to the front edge of the equipment they are serving.

6. Provisions shall be made to admit air to the room where the hood is located at a rate not less than that which is exhausted by the hood.

308.6.3 All hoods shall be constructed and installed in accordance with the following:

1. Hoods shall be constructed of and supported by steel 0.0478-inch (18 ga) minimum thickness or stainless steel 0.0359-inch (20 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official.

2. Hoods shall be securely supported by noncombustible supports.

3. All seams and joints shall be made liquid-tight with a continuous external weld.

4. Hoods shall be so designed and installed to provide for thorough cleaning of the entire hood.

5. When grease troughs or gutters are provided, they shall drain to a collecting receptacle designed, fabricated and installed to be readily accessible for cleaning.

308.6.4 Every portion of the hood shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the hood side.

308.6.5 Each hood shall be equipped with a properly sized grease removal device of one of the following types:

1. Grease extractors specifically listed for this service and installed in accordance with the terms of its listing.

2. Grease filters or other grease removal devices specifically listed for use with commercial cooking equipment installed with the height of the lowest edge of the grease filter or other removal device located above the cooking or heating surface not less than the distances shown in Table 308.

308.6.6 Filters shall be tight fitting and firmly held in place, yet be easily accessible and removable without special tools. They shall be installed at a minimum angle of 45° from the horizontal. A drip tray designed and located to collect the grease from the filters and drain to an enclosed noncombustible container shall be provided beneath the lower edge of the filters. The container shall have a maximum capacity of 1 gallon unless otherwise approved by the Mechanical Official.

308.7 Fire Extinguishing Equipment

308.7.1 Duct systems, grease removal devices and exhaust hoods serving food heat processing equipment producing smoke or grease-laden air shall be protected by both an automatic fire extinguishing system and a portable extinguisher in accordance with this section. When listed grease extractors complying with 308.6.5(1) are provided for all cooking equipment, the duct fire extinguishing equipment may be omitted when approved by the Mechanical Official. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment protected by an extinguishing system or located under ventilating equipment protected by an extinguishing system.

TABLE 308
MINIMUM DISTANCE BETWEEN LOWEST EDGE OF GREASE FILTER AND COOKING OR HEATING SURFACE

	Duct System and Hood With Fire-Extinguishing System[1] (ft)
No Exposed Flame: Grills, French Fryers, etc	1.5
Exposed Flame and Burners	2
Exposed Charcoal and Charbroil Type Fires	4

1. Fire-extinguishing system shall be of an approved type.

308.7.2 Alkaline dry chemical-type portable fire extinguishers shall be installed in the kitchen area for the protection of the cooking equipment. Extinguishers shall have a minimum rating of 40B (sodium bicarbonate or potassium bicarbonate base) and shall be conspicuously located and readily accessible along exit paths from the area. The extinguishers shall be a minimum of 10 ft and maximum of 20 ft from the cooking equipment. The top of the extinguishers shall be a maximum of 5 ft above the floor and shall be protected from physical damage.

308.7.3 Automatic systems shall be listed specifically for this type service and shall be installed in accordance with the terms of their listing. At least one manual control for activation shall be located a minimum of 10 ft and a maximum of 20 ft from the cooking equipment unless an alternate location is specifically approved by the Mechanical Official. The following types of extinguishing systems may be provided when installed in accordance with the provisions of the following applicable standards when approved by the Mechanical Official.

1. Carbon Dioxide Extinguishing System, NFiPA 12.
2. Installation of Sprinkler Systems, NFiPA 13.
3. Installation of Foam-Water Sprinkler Systems and Foam-Water Spray Systems, NFiPA 16.
4. Dry Chemical Extinguishing Systems, NFiPA 17.
5. Wet Chemical Extinguishing Systems, NFiPA 17A.
6. Fixed pipe extinguishing equipment conforming to the requirements of NFiPA 96.

308.7.4 Fat fryers, ranges, griddles, broilers, and similar cooking equipment which may be a source of ignition of grease in the exhaust system shall also be protected by approved fire extinguishing equipment.

308.7.5 Fire extinguishing equipment designed for manual operation shall have instructions posted conspicuously in the kitchen or cooking area.

308.8 Residential Range Hoods

308.8.1 Residential range hoods when installed shall be vented to the outside by a Type B labeled vent or single wall pipe having a clearance of 1 inch from combustible material. Vents serving range hoods shall not terminate in an attic crawl space or any area inside the building. Listed unvented range hoods may be used when installed in accordance with the terms of their listing.

308.8.2 Residential range hood shall have a vertical clearance above the cooking top of not less than 30 inches to combustible material or metal cabinets, except the clearance may be reduced to not less than 24 inches as follows:

1. The underside of the combustible material or metal cabinet above the cooking top is protected with not less than 1/4 inch insulating millboard covered with sheet metal not less than 0.0122 inch, or
2. A metal ventilating hood of sheet metal not less than 0.0122 inch is installed above the cooking top with a clearance of not less than 1/4 inch between the hood and the underside of the combustible material or metal cabinet, and the hood is at least as wide as the appliance is and is centered over the appliance.

308.9 Clothes Dryers

308.9.1 Exhaust ducts serving clothes dryers shall comply with the following:

1. Ducts shall not be connected to a vent connector, gas vent, chimney crawl space, attic or other similar concealed space.
2. Duct joints shall not be assembled with sheet metal screws or other fastening means which extend into the duct.
3. Each joint shall be reasonably sealed with noncombustible material.

4. The size and limitations to the length of the exhaust duct shall conform to the manufacturer's installation instructions.

308.9.2 Exhaust ducts serving residential type clothes dryers shall be of a material designed constructed and recommended by the manufacturer for this service.

308.9.3 Residential dryer vents when specific dryers are not being installed shall be constructed of minimum 0.0157-inch (30 ga) galvanized steel or other noncombustible material of equivalent strength and corrosion resistance. The vents shall have smooth interior finish with joints running in the direction of the air flow. Minimum size of the exhaust duct shall be 4 inches ID. The maximum length shall not exceed 25 ft from dryer location to wall or roof cap. There shall be a deduction of 2 1/2 ft for each 45° bend and 5 ft for each 90° bend.

308.9.3.1 The wall or roof cap shall be nonscreened with back draft damper and minimum size of 4 inches. The entire exhaust system shall be insulated from all combustible materials and shall be properly secured in place.

308.9.4 Exhaust ducts serving commercial type clothes dryers shall be constructed of a material equivalent in strength and corrosion resistance to minimum 0.0217-inch (26 ga) galvanized steel. Ducts shall have a minimum clearance of 6 inches to combustible materials. Clearance to combustible materials may be reduced provided the combustible material is protected in accordance with Table 303.8.

308.10 Tire Rebuilding Or Recapping

308.10.1 Each room where rubber cement is used or mixed, or flammable or combustible solvents are applied, shall be ventilated in accordance with the applicable provisions of NFiPA 91.

308.10.2 Each buffing machine shall be connected to a dust collecting system which prevents the accumulation of the dust produced by the buffing process. The system shall discharge the dust to a suitable container. The system and the container shall be cleaned at frequent intervals.

309 SOLAR ENERGY UTILIZATION

309.1 General

309.1.1 This section includes provisions for minimum safe requirements for the construction, installation, alteration and repair of all equipment and systems utilizing solar energy intended to provide energy for space heating, cooling, hot water heating, swimming pool heating or process heating or cooling. Since solar systems are still in the research and development stage, this section is not intended to limit design innovations which will not constitute a hazard.

309.1.2 The purpose of the recommended requirements is to provide for reasonable protection of the public health and safety, while at the same time encouraging consumers, builders, designers, manufacturers, installers and others to utilize solar energy technologies while permitting experimentation and innovation.

309.1.3 Solar energy systems may be installed in, on, or adjacent to existing buildings or appurtenant structures without having the entire building or structure comply as required for new construction, provided the added solar energy systems and the affected portions of the existing building, mechanical, plumbing and electrical systems comply with the applicable provisions of these recommended requirements.

309.1.4 Existing solar energy systems shall be permitted to have their existing use continued provided their use and maintenance is not a hazard to life, health or property. Conditions that endanger life, limb, health or property shall be abated by repair, rehabilitation, demolition, or removal in accordance with the provisions of these recommended requirements, the building code or the reference standards set forth in the Appendices.

309.1.5 Solar energy components also serving as building components shall comply with the applicable provisions of the Standard Building Code and when connected to heating, ventilating, air conditioning and plumbing systems shall also comply with the applicable provisions of this section.

309.1.6 Solar heating systems shall be considered as supplemental or auxiliary systems unless designed to provide the total energy requirements as calculated using ASHRAE Applications Handbook Chapter 57, Solar Energy Utilization for Heating and Cooling, or other solar energy utilization data acceptable to the Mechanical Official. Solar systems and/or equipment which will not supply the total energy requirements, shall have a primary system or equipment with capacity to provide the additional energy needed in order to insure 100% capacity to satisfy the energy demand.

> EXCEPTION: Experimental passive and active solar systems for the purpose of collecting technical data may be excluded from total capacity energy requirements when requested by the designer and approved by the Mechanical Official.

309.2 Maintenance And Identification

309.2.1 Solar energy systems shall be maintained in accordance with A101.3.4, unless state or local governments statutes or ordinances conflict with provisions contained therein.

309.2.2 Materials and equipment shall bear the manufacturer's or installer's label or otherwise be identifiable in accordance with appropriate national standards.

309.3 Design Criteria

309.3.1 The engineering design of passive and active solar systems shall be in accordance with acceptable engineering practice, and standards as listed in the applicable codes and standards adopted by the Mechanical Official. Where a primary fossil fuel or electric energy system with total capacity to satisfy the energy required is provided, and provisions are made for the protection of life, health and property, then no restrictions shall be placed on the design or capacity of the solar system.

309.3.2 When a solar energy system and an auxiliary energy system are interconnected, the maximum allowable temperature or pressure of either system shall not be exceeded in either operational or stagnant modes. The interconnections shall not compromise or by-pass the required safety devices.

309.3.3 Liquid solar energy systems shall be capable of being drained and vented and of being filled without air entrapment.

309.3.4 Solar energy systems and components which are subject to contact by unauthorized personnel and which are maintained at elevated temperatures shall be protected with proper safeguards.

309.3.5 Adequately sized, listed or approved pressure relief devices shall be provided in pressurized solar energy systems and subsystems. Where a pressurized system or portion thereof can be isolated by valving, each such isolated system or portion thereof shall have a listed or approved pressure relief valve. The devices shall be set to relieve the pressure at or below the maximum allowable pressure. Such devices shall drain to approved locations and when connected to the drainage systems shall be connected in accordance with 304.3.3.

309.3.6 Solar energy systems shall be designed to prevent damage by vacuum conditions or shall be provided with listed or approved vacuum relief valves.

309.3.7 Those portions of a solar energy system connected to potable water supply shall be protected with listed or approved temperature relief devices in accordance with applicable provisions of 304.3.3.

309.3.8 Provisions shall be made for thermal expansion at both operating and stagnation temperatures.

309.3.9 Provisions shall be made to prevent damage from freezing of the heat transfer or storage fluids.

309.4 Access And Location

309.4.1 Solar energy collectors, controls, dampers, fans, blowers and pumps shall be accessible for inspection, maintenance, repair and replacement.

309.4.2 No solar energy system shall be installed in a location whch obstructs means of egress, or accessibility to the building or structure for the fire fighting apparatus as required by the Standard Building Code.

309.4.3 Solar energy systems, equipment or components shall not be installed in violation of existing zoning, fire, or nuisance regulations which govern general construction of structures and buildings as provided in the Standard Building Code or by the Mechanical Official. No solar installation shall be made which would create a hazard to the general public, as determined by the Mechanical Official.

309.5 Materials, Specifications And Tests

309.5.1 Materials shall be listed or approved and be of an approved type, and shall be designated for the fluids they are to handle and for their intended use. Materials that may be adversely affected by environmental factors shall be protected in an approved manner.

309.5.2 Sealants and gasket materials used in pressurized systems shall be suitable for the combined system pressure and temperature and for the fluids contained. Seals used in solar systems shall comply with ASTM D 3667, ASTM D 3832 and ASTM D 3771.

309.5.3 Heat transfer fluids which are hazardous shall not be used in solar systems except when approved by the Mechanical Official. The flash point of heat transfer liquids shall be:

1. Vented inside: At least 50° F above the design maximum operating temperature and as high as the maximum stagnation temperature of the liquid in the system.

2. Vented outside: At least 50° F above the design maximum operating temperature and greater than the maximum stagnation temperature minus 200° F of the liquid in the system provided the collector, collector manifold and manifold relief valve discharge neither directly nor indirectly into the building and away from open flames and ignition sources.

309.5.4 A flammable gas or liquid shall not be used as a heat transfer fluid unless approved by the Mechanical Official. The flash point of fluid used in factory or high-hazard occupancies may be lower, subject to the approval of the Mechanical Official.

309.6 Collector

309.6.1 Manufactured collectors shall be labeled with the manufacturers name, address and types of transfer fluids compatible with the collector design. Listed collectors shall also include the markings required under the terms of the listing. All collectors, including shop and site-built collectors, shall be labeled to indicate the operating fluid, the maximum allowable temperature and pressure and the direction of fluid flow.

309.6.2 All materials provided in the fluid passages of a collector assembly shall be capable of withstanding the maximum allowable pressure and temperature.

309.6.3 Where leakage can cause an unsafe electrical condition, the construction of the collector shall provide protection against both external leakage of the contained fluid from the collector and internal leakage into the collector from environmental conditions or cleaning operations as performed during intended user maintenance as specified in the installer instructions.

309.6.4 The collector components which are exposed to air circulated to occupied spaces shall be noncombustible or shall have a flamespread rating not exceeding 25 and a smoke developed rating not exceeding 50 when tested in accordance with ASTM E 84.

> EXCEPTION: When approved smoke detectors are installed in the duct system from the collector which, when activated, stop all air flow through the collector and sounds an alarm, materials which meet the requirements of 309.6.5 may be used. Minimum sensitivity of approved smoke devices shall be set to operate when smoke reduces the intensity of a 1-ft long beam of white light by 4% or the equivalent.

309.6.5 Insulating material shall not flame, smolder, glow or smoke when tested in accordance with ASTM C 411 at the temperature to which it is exposed in service. In no case shall the test temperature be below 250° F. Higher outlet air temperatures may be used when connected to duct materials approved or listed and installed for higher temperature use.

309.6.6 The sustained design outlet temperature of collectors handling air circulated to occupied spaces shall not exceed 250° F.

309.7 Thermal Storage — Air Systems

309.7.1 Heat storage media and thermal storage tank materials including any interior protection coatings, shall not impart toxic elements to air distributed to areas of human occupancy.

309.7.2 Rocks and pebbles used as sensible heat storage shall be washed free of fines and organic materials prior to placement in the rock storage bins.

309.7.3 Materials exposed to the air passage shall be noncombustible or shall have a flame spread rating not exceeding 25 and have a smoke developed rating not exceeding 50 when tested in accordance with ASTM E 84.

> EXCEPTION: In one and two family dwellings, materials not meeting the criteria of 309.7.3 may be used when smoke detectors approved for duct installation are installed which, when actuated, stop all air flow through the storage device and sound an alarm. Minimum sensitivity of approved smoke devices shall be set to operate when smoke reduces the intensity of a 1-ft long beam of white light by 4% or the equivalent.

309.7.4 Where storage units are located outside or underground, they shall be adequately protected against the intrustion of water.

309.8 Thermal Storage — Liquid Systems

309.8.1 Pressurized tanks shall be leak tested after installation except when the tank contains markings to indicate prior testing has been accomplished. If testing is required, the test pressure shall be one and one-half times the maximum allowable pressure. Nonpressurized tanks shall be tested visually for leaks by filling.

309.8.2 Potable water systems shall be protected from make-up water cross connections to the solar energy storage system in accordance with the requirements of the locally adopted plumbing code.

309.8.3 All openings into tanks, except vents, shall be tightly covered and secured in place. Vents shall be screened with corrosion-resistant materials having not less than twenty openings per linear inch, or otherwise protected.

309.8.4 Nonpressurized tanks connected to a make-up water system shall have overflows directed to an approved point of disposal. Make-up water piping from the potable water systems shall be connected as required in 606.

309.8.5 The liquid solar energy storage system shall be capable of being emptied.

309.8.6 Shutoff valves shall be provided between the supply system and cold and hot water storage tanks.

309.9 Thermal Storage Units And Tanks

309.9.1 Storage units shall be designed to contain the storage media without structural failure from temperature, pressure or weight.

309.9.2 Storage tanks shall be designed for the application, whether for above ground or below ground installation.

309.9.3 Dissimilar piping materials which are not compatible and are to be joined together shall be electrically isolated to prevent electrolytic and/or galvanic destruction.

309.10 Controls

309.10.1 In solar energy systems the following conditions must be prevented either by inherent design features or by equipping the system with the necessary controls:

1. The addition of energy to the storage media when the temperature of the storage media has reached its maximum allowable temperature.
2. Thermosiphoning which will allow components to be damaged by freezing.
3. Heat transfer fluids reaching the maximum allowable temperature of the system in liquid systems. The pressure and temperature relief devices required in 309.3.5 through 309.3.7 shall not be considered as controls to satisfy this condition.
4. Damage from thermal shock.

EXCEPTION: Provisions of 309.10.1 shall not apply where adequate data is submitted to demonstrate that these conditions will not occur due to the design and location of the system.

309.10.2 The solar energy system shall revert to a safe mode in the event of manual shutdown or power failure.

309.10.3 All switches and controls shall be clearly identified as to function. All warning lights, when provided, shall indicate the abnormal condition. If manual control adjustments are required during normal operation of the solar system, the control system shall be designed to assure that the safety of the system and the building in which it is installed are not compromised by failure to make those adjustments.

309.11 Distribution

309.11.1 Piping materials shall conform to the manufacturer's recommendations and 602.1.

309.11.2 Piping shall be sized to limit the sustained fluid velocity to levels recommended by the pipe manufacturer considering the type of fluid.

309.11.3 Joints shall be of a type approved for the piping material being used and the intended use and shall conform to the manufacturer's recommendations and 602.3.

309.11.4 Joints between dissimilar materials shall conform to the manufacturer's recommendations and the Standard Plumbing Code.

309.11.5 Pipes embedded in structural concrete shall conform to 602.5.

309.11.6 Changes in direction of piping shall conform to the manufacturer's recommendations and the Standard Plumbing Code.

309.11.7 Where different sizes of pipe and fittings are to be connected, such connections shall conform to the manufacturer's recommendations and the Standard Plumbing Code.

309.11.8 Piping shall be supported in conformance with the manufacturer's recommendations and 602.4.

309.11.9 Pipe openings in walls, floors or ceilings shall be closed an protected in accordance with 602.5.

309.11.10 Trenching adjacent to footing and trenching, bedding, tunneling and backfilling shall be in conformance with the Standard Plumbing Code.

309.11.11 All piping embedded in structural concrete or masonry shall be tested in accordance with the Standard Plumbing Code. All other piping shall be tested as follows:

1. Prior to piping tests, and after all equipment has been installed, the liquid system shall be flushed to remove sediment, dirt, loose scale, etc., as prescribed by the manufacturer. Strainers shall be cleaned or replaced. During flushing of the system, the collectors may be disconnected or by-passed to prevent the passage of debris through the collector.
2. Closed solar heating system piping using liquid heat transfer fluids not directly connected to the potable water supply shall be tested for pressures not less than one and one-half times the maximum design operating pressure for a minimum of 15 minutes.
3. The portion of the system connected to the domestic water system shall be tested in the following manner: Upon completion of a section or of the entire water supply system, it shall be tested and proved tight under a water pressure not less than the maximum working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply. Except for plastic pipe systems, the water test may be substituted by an air test of 50 psi. Test pressures shall be maintained for a minimum period of 15 minutes without the system leaking. The piping being tested shall remain exposed for inspection and shall not leak during the test.
4. Open systems shall be tested by filling to overflow.
5. Final leak testing shall be at the maximum allowable pressure with the fluid to be used in the system.
6. Testing may be waived by the Mechanical Official.

309.12 Drainage

309.12.1 Solar energy system piping shall be provided with a method for drainage. If the system is drained through the building drainage system, it shall be through an air gap in accordance with the Standard Plumbing Code.

309.12.2 Drains serving heat transfer fluids over 140°F or which are toxic or corrosive shall be protected in accordance with the requirements of the Standard Plumbing Code.

309.12.3 Drains in solar systems where high temperature, high pressure, or hazardous fluids are discharged shall have a warning label. For hazardous fluids, the label shall describe the hazardous properties of the fluid and emergency first aid procedures. Valves regulating such a discharge shall not be readily accessible to unauthorized personnel.

309.13 Health

309.13.1 Potable water systems shall be protected against contamination in accordance with the Standard Plumbing Code.

309.13.2 Heat exchangers used in domestic water heating systems shall be approved for the use intended. The system shall have adequate protection to assure that the potability of the supply and distribution water is properly safeguarded as approved by the Mechanical Official.

309.13.3 Food, drink, or other products manufactured or processed for human or animal consumption shall not be stored, prepared or displayed beneath overhead distribution piping unless such pipes are protected against leakage or condensation reaching such products as required in 610.2.4.

309.14 Air Distribution System

Duct systems shall be constructed and installed in accordance with the requirements of Chapter 5.

CHAPTER 4
REFRIGERATION

401 CLASSIFICATION OF REFRIGERATION SYSTEMS

401.1 Direct System

One in which the evaporator is in direct contact with the material or space refrigerated or is located in air-circulating passages communicating with such spaces.

401.2 Indirect System

One in which a liquid such as brine or water, cooled by the refrigerant, is circulated to the material or space refrigerated or is used to cool air so circulated. Indirect systems which are distinguished by the type or method of application are given in the following paragraphs:

1. Indirect Open-Spray System is one in which a liquid such as a brine or water, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to such cooling chamber and is sprayed therein.
2. Indirect Closed-Surface System is one in which a liquid such as brine or water, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to and through such a cooling chamber in pipes or other closed circuits.
3. Indirect Vented Closed-Surface System is one in which a liquid such as brine or water, cooled by an evaporator located in a vented enclosure external to a cooling chamber, is circulated to and through such cooling chamber in pipes or other closed circuits.
4. Double Indirect Vented Open-Spray System is one in which a liquid such as brine or water, cooled by an evaporator located in a vented enclosure external to a cooling chamber, is circulated to a second enclosure where it cools another supply of a liquid such as brine or water, and this liquid in turn is circulated to a cooling chamber and is sprayed therein.

401.3 Double (Secondary) System

One in which an evaporative refrigerant is used in a secondary circuit. For the purpose of this Code, each system enclosing a separate body of an evaporative refrigerant shall be considered as a separate direct system.

402 REFRIGERANT CLASSIFICATION

Refrigerants are, for the purpose of this Code, divided into groups as follows:

Group 1

Carbon Dioxide (Refrigerant 744) .... CO_2
Dichlorodifluoromethane (Refrigerant 12) .... CCl_2F_2
Dichlorodifluoromethane, 73.8% .... CCl_2F_2
and Ethylident Fluoride, 26.2% .... CH_3CHF_2
(Refrigerant 500)

Dichloromethane (Methylene Chloride) .... CH_2Cl_2
(Refrigerant 30)
Dichloromonofluoromethane (Refrigerant 21) .... $CHCl_2F$
Dichlorotetrafluoroethane (Refrigerant 114) .... $C_2Cl_2F_4$
Monobromotrifluoromethane (Refrigerant 13B1) .... $CBrF_3$
Monochlorodifluoromethane (Refrigerant 22) .... $CHClF_2$
Monochlorodifluoromethane, 48% .... $CHClF_2$
and Monochloropenta-fluoroethane, 51.2% .... $CClF_2CF_3$
(Refrigerant 502)
Monochlorotrifluoromethane (Refrigerant 13) .... $CClF_3$
Octafluorocyclobutane (Refrigerant C318) .... C_4F_8
Trichloromonofluoromethane (Refrigerant 11) .... CCl_3F
Trichlorotrifluoroethane (Refrigerant 113) .... $C_2Cl_3F_3$

Group 2

Ammonia (Refrigerant 717) .... NH_3
Dichloroethylene .... $C_2H_2Cl_2$
Ethyl chloride .... C_2H_2Cl
Methyl Chloride (Refrigerant 40) .... CH_3Cl
Methyl formate (Refrigerant 611) .... $HCOOCH_3$
Sulphur dioxide (Refrigerant 764) .... SO_2

Group 3

Butane (Refrigerant R-600) .... C_4H_{10}
Ethane (Refrigerant 170) .... C_2H_6
Ethylene (Refrigerant 1150) .... C_2H_4
Isobutane (Refrigerant 601) .... $(CH_3)_3CH$
Propane (Refrigerant 290) .... C_3H_8

403 EQUIPMENT LOCATION

403.1 General

403.1.1 No portion of any refrigerating system shall be located in any elevator shaft, dumbwaiter shaft, or any shaft having moving objects therein.

403.1.2 Every room or space, other than a machinery room complying with the requirements of this chapter, in which any refrigerant-containing portion of a condensing unit is located, shall be provided with permanent gravity ventilation openings of not less than 2 sq ft total area, opening directly to the outside of the building, or extending to the outside of the building by continuous ducts, or by a mechanical exhaust system of ventilation arranged to provide a complete change of air in such room or space at least every 20 minutes and to discharge to the outer air.

403.1.3 A refrigerant compressor of more than 1 horsepower rating shall not be located less than 10 ft from any public aisle or exit passageway in any occupancy unless separated by partitions of a minimum 1 hour fire resistance.

403.1.4 All refrigerating piping and fittings, brine piping and fittings which during normal operation could reach a surface temperature below the dew point of the surrounding air and are located in spaces or areas where condensation could cause a safety hazard to the building occupants, structure, electrical equipment, or any other equipment, shall be protected in a manner to prevent such damage.

403.1.4.1 A compressor shall not be located in any hazardous location.

403.1.4.2 A portion of any refrigerating system shall not be installed in any location where it would be subject to damage from an external source.

404 INSTALLATION REQUIREMENTS

404.1 Condenser And Compressor Units

404.1.1 Foundations and supports for condensing units or compressor units shall be of substantial construction sufficient to support the load. When used, wood exposed to the weather shall be pressure treated or approved wood of natural resistance to decay in accordance with the Standard Building Code.

404.1.2 Moving machinery should be guarded in accordance with applicable safety standards, or as required by the Mechanical Official.

404.1.3 Clear space adequate for inspection and servicing of condensing units or compressor units shall be provided. Condensing units or compressor units with enclosures shall be readily accessible for servicing and inspection. Illumination adequate for inspection and servicing of condensing units or compressor units shall be provided. A minimum of 100 watt source within 10 ft of equipment shall be provided.

404.1.4 Water supply and discharge connections shall be made in accordance with the Standard Plumbing Code.

404.1.5 Electrical equipment and wiring shall be installed in accordance with NFiPA 70, and provided that the person doing such work, as provided for in this Code, is authorized to remove and replace electrical control devices, remove and replace fuses, and disconnect and reconnect motors, all of which shall be integral parts, or incident to the operation of refrigeration equipment or apparatus as herein defined when incident to the repair or maintenance of such equipment or apparatus.

404.1.6 Gas fuel devices and equipment used with refrigerating systems shall be installed in accordance with the Standard Gas Code.

404.1.7 When the quantity of flammable refrigerant in any one refrigerating system exceeds the amount given in Table 404 for each 1000 cu ft of room volume in which the system or any part thereof is installed, no flame-producing device or hot surface above 800°F shall be permitted in such room and all electrical equipment in the room shall conform to the requirements of Hazardous Locations Class I of NFiPA 70. Flammable refrigerant as listed in Table 404 shall not be used in a refrigerating system in excess of 1000 lb, unless approved by the Mechanical Official.

405 REQUIREMENTS NOT COVERED

All requirements of installations for refrigerant piping design and construction of refrigeration equipment including pressure vessels relief devices for use in systems and on pressure vessels, and other requirements not covered by Chapter 4, shall conform to ANSI B9.1, subject to the approval of the Mechanical Official.

TABLE 404
MAXIMUM PERMISSIBLE QUANTITIES OF FLAMMABLE REFRIGERANTS

Name	Chemical formula	Maximum quantity (lb) per 1000 cu ft of room volume
Butane	C_4H_{10}	2 1/2
Ethane	C_2H_6	2 1/2
Ethyl chloride	C_2H_5Cl	6
Ethylene	C_2H_4	2
Isobutane	$(CH_3)_3CH$	2 1/2
Methyl chloride	CH_3Cl	10
Methyl formate	$HCOOCH_3$	7
Propane	C_3H_8	2 1/2

406 FIELD TESTS

406.1 General

Every refrigerant-containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, and control mechanisms that are factory tested, shall be tested and proved tight after complete installation, and before operation, at not less than the minimum refrigerant leak field test pressures shown in Table 406 or in accordance with 406.2.2 and 406.2.3

406.2 Testing

406.2.1 Leak test pressure requirements of Table 406 are not intended to apply to gas bulk storage tanks that are not permanently connected to a refrigeration system. (See Table 406).

406.2.2 Systems erected on the premises using Group I refrigerant and with copper tubing not exceeding 5/8-inch OD, with wall thickness as required by ANSI B9.1, may be tested by means of refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 70° F or higher.

406.2.3 Limited charged systems equipped with a pressure relief device, erected on the premises, shall be tested at a pressure not less than 1 1/2 times the pressure setting of the relief device.

406.2.4 Oxygen or any combustible gas or combustible mixture of gases shall not be used within the system for testing. Any inert, nontoxic gas similar to carbon dioxide or nitrogen will be acceptable.

406.2.5 The means used to build up the test pressure shall have either a pressure limiting device or a pressure reducing device and a gage on the outlet side.

406.2.6 A dated declaration of test shall be provided for all systems containing 50 lb or more of refrigerant, where tests are required by 406.1. The declaration shall be mounted in a frame, protected by glass, and posted in the machinery room and shall give the name of the refrigerant and the field test pressure applied to the high side and the low side of the system. The declaration of test shall be signed by the installer and, if an inspector is present at the tests, he shall also sign the declaration. When requested, copies of this declaration shall be furnished to the enforcing authority. This posting does not apply to Group 1 refrigerants.

TABLE 406
MINIMUM FIELD TEST PRESSURES FOR REFRIGERANT LEAKS

Refrigerant Name and Number	Chemical formula	Minimum test pressure (psi) High Side	Minimum test pressure (psi) Low Side
Ammonia (R-71)	NH_3	300	150
Butane (R-600)	C_4H_{10}	95	50
Carbon dioxide (R-744)	CO_2	1500	1000
Dichlorodifluoromethane (R-12)	CCl_2F_2	235	140
Dichlorodifluoromethane 73.8% and Ethylidene fluoride 26.2% (R-500)	CCl_2F_2 / $CH_3\text{-}CHF_2$	285	150
Dichloroethylene (1130)	$C_2H_2Cl_2$	30	30
Dichloromethane (Methylene Chloride) (R-30)	CH_2Cl_2	30	30
Dichloromonofluoromethane (R-21)	$CHCl_2F$	70	40
Dichlorotetrafluoroethane (R-114)	$C_2Cl_2F_4$	50	50
Ethane (R-170)	C_2H_6	1200	700
Ethyl chloride (R-160)	C_2H_5Cl	60	50
Ethylene (R-1150)	C_2H_4	1600	1200
Isobutane (R-601)	$(CH_3)_3CH$	130	70
Methyl chloride (R-40)	CH_3Cl	210	120
Methyl formate (R-611)	$HCOOCH_3$	50	50
Monobromotrifluoromethane (R-31B1)	$CBrF_3$	435	245
Monochlorodifluoromethane (R-22)	$CHClF_2$	300	150
Monochlorodifluoromethane 48.8% and Monochloropentafluoroethane 51.2% (R-502)	$CHClF_2$ / $CClF_2CF_3$	300	150
Monochlorotrifluoromethane (R-13)	$CClF_3$	685**	685**
Octafluorocyclobutane (R-C318)	C_4F_8	130	70
Propane (R-290)	C_3H_8	300	150
Sulphur dioxide (R-764)	SO_2	170	85
Trichloromonofluoromethane (R-11)	CCl_3F	20	20
Trichlorotrifluoroethane (R-113)	$C_2Cl_3F_3$	20	20

TABLE 406 (Continued)
MINIMUM FIELD TEST PRESSURES FOR REFRIGERANT LEAKS

NOTES:

1. For refrigerants not listed in Table 406 the test pressure for the high pressure side shall not be less than the saturated vapor pressure of the refrigerant at 150°F. The test pressure for the low pressure side shall not be less than the saturated vapor pressure of the refrigerant at 110°F. However, the test pressure for either the high or low side need not exceed 125% of the critical pressure of the refrigerant. In no case shall the test pressure be less than 30 psi.

2. When a compressor is used as a booster to obtain a low pressure and discharges into the suction side of another system, the booster compressor is considered a part of the low side, and values listed under the low side column in Table 406 shall be used for both high and low side of the booster compressor provided that a low pressure stage compressor of the positive displacement type is protected by a pressure-relief device.

3. In field testing systems using nonpositive displacement compressors, the entire system shall be considered as the low side pressure for field test purposes.

**Critical pressure is 561 psi at critical temperature of 83.9°F. (See Note 1)

CHAPTER 5
DUCTS AND DUCT SYSTEMS

501 SCOPE

501.1 General

All duct systems used for the movement of air or material in air conditioning, heating, ventilating, environmental exhaust and conveying systems shall conform with the provisions of this chapter. See 307 and 308 for ventilating and exhaust systems for the removal of dust, smoke, fumes, gases, vapors, odors or other hazardous, noxious or injurious impurities.

501.2 Limitations

When referred to in this section, commercial duct applies to all systems serving spaces of over 25,000 cu ft and residential duct applies to all systems serving one and two family dwellings and spaces 25,000 cu ft and less.

502 STANDARDS

Ducts shall be constructed, braced, reinforced and installed to provide structural strength and durability. Ducts and duct systems complying with the requirements of the following standards shall be deemed as meeting the intent of this Code:

1. SMACNA HVAC Duct Construction Standards, Metal and Flexible and SMACNA Fibrous Glass Duct Construction Standard.
2. The Equipment Volume of the Handbook published by the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
3. UL 181.

503 DUCT MATERIALS

503.1 Allowable Materials

All ducts shall be constructed of iron, steel, aluminum or other approved material.

503.2 Commercial Duct Systems

503.2.1 Flexible and rigid Class 0 and Class 1 duct materials may be used when installed in accordance with the conditions of their listing, provided they are not used for vertical risers serving more than two stories and they are used on duct systems having a maximum air temperature of 250° F. Listed air duct material is not limited in length.

503.2.2 When approved by the Mechanical Official, part of the building structure may be used as a duct when installed in accordance with one of the following:

1. Ductwall construction consisting of not less than 3/4-inch cement or gypsum plaster on metal lath applied to suitable supports.
2. Duct walls of masonry construction of proper strength and design.
3. Properly constructed and lined passages of gypsum wallboard may

be used for ductwalls for return air and heating ducts in which no condensation is to be encountered.

503.3 Residential Duct Systems

503.3.1 All ducts shall be constructed of metal having a minimum thickness as shown in the following table:

Diam. or Width, (in)	Nominal Thickness (in)	Equiv. Galvanized Sheet Gage No.	Aluminum Thickness (in)
Round Ducts:			
14 or less	.0127	30	.0183
Over 14	.0157	28	.023
Exposed Rectangular Ducts:			
14 or less	.0157	28	.023
Over 14	.0187	26	.032

503.3.2 Nonmetallic ducts and duct materials may be used for duct systems serving listed automatic-fired heating equipment having a 250° F temperature limit control when installed in accordance with the conditions of their listing and the following:

1. The entire system including plenums may be Class 0 or Class 1 materials.
2. Class 2 materials may be used in single-family dwellings only and shall not be used for ducts located within the first 3 ft of the bonnet, plenum or casing of the heating unit.

503.3.3 Return ducts, except those portions directly above the heating surface or closer than 2 ft from the heating unit casing, may be constructed of materials having a flame spread rating not higher than 200.

504 DUCT CONSTRUCTION AND INSTALLATION

504.1 Joints, Seams And Connections

504.1.1 Joints and seams shall be securely fastened and made substantially air tight. Where tape is used for sealing joints, it shall not be more combustible than flameproof fabric. All slip joints shall have at least a 1-inch lap which is mechanically fastened.

504.1.2 Vibration isolation connectors between ducts and mechanical systems shall be of an approved flame retardant fabric, and shall be 10 inches or less in length. On commercial systems, a sleeve joint packed with an approved material having a maximum flamespread rating of 25 and maximum smoke developed rating of 50 may be used.

504.2 Protection

Ducts shall be suitably protected when placed in locations where they may be subject to damage, rupture or corrosion.

504.3 Support

Metal ducts shall be securely supported, hung or suspended by metal hangers, straps, rods, lugs or brackets complying with the duct construction standards referenced in 502. Approved nonmetallic ducts and approved duct systems shall be installed and supported in accordance with the terms of their listing. When approved by the Mechanical Official, heavy gage galvanized wire may be used for supports. When duct static pressure exceeds 2-inch water gage, any piercing of the duct wall to attach the duct to a supporting structure shall be sealed.

504.4 Location

Ducts shall not be installed in or within 4 inches of the ground unless the provisions of 507 are met.

504.5 Exposed Ducts

Vertical supply ducts in residential systems which are exposed in closets or rooms shall be covered or lined with a minimum of 1/4-inch thick approved fire resistant material.

504.6 Protection Of Openings

Exposed openings in fan housing shall be protected with screens or gratings to prevent accidents or the entry of foreign material.

504.7 Safety

All mechanical equipment shall be provided with guards or protectors over rotating parts to prevent accidents.

504.8 Lighting

Lights or lighting installed within the enclosure of any duct system shall be enclosed fixtures of the marine (vapor-tight) type. Germicidal lamps are not included.

504.9 Weather Protection

All ducts including linings, coverings and vibration isolation connectors installed on the exterior of the building shall be adequately protected against the elements.

505 FLEXIBLE CONNECTORS

505.1 General

Flexible air duct connectors for use between ducts and air outlets or air outlet units which do not pass through floors of buildings need not conform to the requirements of 503 for ducts if they conform to the following provisions:

1. Air duct connectors up to 8-inch diameter shall be minimum Class 2 materials.
2. Air duct connectors exceeding 8-inch diameter shall be minimum Class 1 materials.
3. Flexible air duct connectors shall not exceed 14 ft in length.
4. Flexible air duct connectors shall not pass through a fire wall or partition having a required fire resistance rating of 2 hours or more.

506 INSULATION

506.1 Materials

506.1.1 Coverings and linings, including adhesives when used, shall have a flamespread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating not over 50.

506.1.2 Duct coverings and linings shall not flame, flow, smolder, or smoke when tested in accordance with ASTM C 411 at the temperature to which it is exposed in service. In no case shall the test temperature be below 250° F.

506.1.3 Linings shall be interrupted at the area of operation of a fire damper or fire door.

506.1.4 Linings shall be interrupted for a minimum of 18 inches upstream and 30 inches downstream from electric resistance and fuel burning heaters in a duct system. (See 506.2.)

506.1.5 Listed equipment internally lined shall be considered as meeting the requirements of 506.1.

506.1.6 Duct coverings shall not penetrate a wall or floor required to have a fire resistance rating or required to be firestopped.

506.1.7 Service openings shall not be concealed by duct coverings unless the exact location of the opening is properly labeled.

506.1.8 Foam plastic shall conform to 717 of the Standard Building Code.

506.1.9 External duct work insulation and factory insulated flexible duct work shall be legibly printed or labeled at intervals not greater than 36 inches with the name of the manufacturer, the nominal thickness and density of the insulation or R-value and the flamespread and smoke developed ratings of the composite materials.

506.2 Installation

506.2.1 All ductwork installed in an attic shall be insulated. All metal supply ductwork installed in a ventilated crawl space or other nonconditioned area shall be insulated. Insulation shall be a minimum 2 inches thick, 3/4 pound density blanket or 1 inch thick, 1 1/2 lb density liner. When ducts used for cooling are externally insulated, the insulation shall be covered with a vapor barrier having a maximum permeance of 0.05 perms or aluminum foil having a minimum thickness of 2 mils. When nonmetallic ducts or other approved insulating or lining materials are used, the maximum thermal conductance value of the material shall be 0.23 at 75° F. All exterior ducts insulated shall be properly protected with an approved weatherproof vapor barrier.

506.2.2 Where duct liner has been interrupted, a duct covering of equal thermal performance shall be installed.

506.2.3 All ducts which operate at temperatures in excess of 120° F shall have sufficient thermal insulation to limit the exposed surface temperature to 120° F (vapor barrier not required).

507 DUCTS IN CONCRETE SLABS

507.1 General

507.1.1 Ducts located in or under concrete shall be of metal of sufficient strength encased on all sides with not less than 2 inches of concrete or shall be of other approved material specifically designed for this service installed in accordance with the manufacturer's recommendations.

507.1.2 All ducts shall slope to an accessible plenum for drainage of condensate.

507.1.3 Ducts shall be properly sealed and secured prior to pouring the concrete encasement.

508 DUCT CLEARANCES

508.1 Commercial Systems

508.1.1 Metal ducts serving heating equipment shall have a clearance from combustible construction of not less than 1/2 inch. In concealed ceiling, wall and partition spaces where the 1/2 inch clearance cannot be maintained, the interior surfaces of the concealed space shall be protected with 1/4-inch approved insulating material.

508.2 Residential

508.2.1 Supply ducts serving automatically-fired heating equipment equipped with 250°F temperature limit control shall have a clearance from combustible construction as follows:

1. When the heating unit is listed, not less than 2 inches for ducts within 3 ft of the plenum.
2. When the heating unit is unlisted, not less than 6 inches for ducts within 6 ft of the plenum.
3. Beyond the distances specified in (1) and (2) above, no clearance is required.

508.2.2 Clearances from combustible construction to vertical ducts, risers, boots and register boxes which connect to ducts within the distances from the plenum specified in 508.2.1 shall be not less than that specified for the duct.

509 PLENUM FLOOR SYSTEMS

509.1 General

509.1.1 The use of a crawl space as a plenum shall be restricted as provided herein. Such spaces shall have not less than 3-inch clearance between the bottom of the floor joists and girders and the vapor barrier membrane. Such spaces shall be cleaned of all excess combustible material and shall not be used as a storage area.

509.1.2 The enclosing material of the underfloor space, including the side wall insulation, shall have a flamespread classification of not more than 200.

509.1.3 Access, if provided to such spaces, shall be through an opening in the floor and shall not be greater than 24 x 24 inches.

509.1.4 The furnace supplying such space shall be equipped with an automatic control having a maximum setting of 150°F designed to start the furnace fan when the bonnet temperature reaches the setpoint of the control and an approved temperature limit control designed to limit the outlet temperature to 200°F.

509.1.5 Furnaces, boilers or other heat-producing appliances shall not be installed inside the plenum.

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509.2 Construction Practices

509.2.1 Framing shall comply with the requirements of the Standard Building Code.

509.2.2 Where required, preservatives for decay and termite protection shall be of approved water borne type.

509.2.3 Chemical soil treatment shall be applied to both sides of the foundation wall from the footing to the grade level. Approved chemicals shall be used. All excavations for plumbing and other services shall be completed at the time of the chemical soil treatment, or retreatment shall be necessary.

509.2.4 After the soil has been treated, a vapor barrier shall be provided within the foundation perimeter, from wall to wall, with joints lapped 4 inches but not sealed. The vapor barrier membrane shall be carefully fitted around pipes and drains and turned up at the foundation wall. The vapor barrier membrane shall be equal to or greater than polyethylene film of 4 mil thickness and a flamespread classification of 200 or less.

509.2.5 A noncombustible receptacle shall be placed below each floor register into the air chamber. Such receptacle shall conform to the following:

1. The receptacle shall securely suspended from the floor members and shall not be more than 18 inches below the opening.
2. The size of the horizontal projected area of the receptacle shall extend 3 inches beyond the opening.
3. The perimeter of the receptacle shall have a vertical lip at least 1 inch high at the open sides if it is at the level of the bottom of the joints or 3 inches high if the receptacle is suspended.

509.2.6 The foundation wall shall be insulated along its inner face from the sill vertically to the underfloor plenum grade level and horizontally over the vapor barrier, a distance of 2 ft. The plenum system shall be insulated to provide a thermal resistance, excluding film resistance, of:

$R = (\Delta t \text{ hr}/15)\ (^\circ \text{ F})(\text{ft}^2/\text{Btu})$

Where Δt = the design temperature between the air in the plenum floor system and the minimum outdoor design temperature.

509.2.7 Outlets from the plenum shall be provided by one of the following methods:

1. Approved air slots, floor registers or wall registers shall be provided.
2. Floor registers shall be designed for easy removal in order to give access for cleaning.
3. Wall registers shall be connected to the plenum space with a duct or boot complying with the requirements of this Chapter.

510 FIRE PROTECTION OF DUCTS

510.1 Fire Door

Duct penetrations of fire walls having a fire resistance rating of 3 hours or more shall be protected by installing a listed fire door satisfactory for Class A openings on both sides of the walls.

510.2 Fire Dampers

510.2.1 Listed fire dampers shall be installed in accordance with the manufacturer's installation instructions in the following locations:

1. Ducts penetrating walls or partitions having a fire resistance rating of 1 or more hours.

2. Ducts penetrating shaft walls having a fire resistance rating of 1 or more hours.

3. Ducts penetrating floors of buildings requiring the protection of vertical openings when the duct is not protected by shafts described in 510.5.

510.2.2 Fire Dampers are not required under the following conditions:

1. In buildings which do not require protected floor openings.

2. In duct systems serving only one floor and used only for exhaust of air to the outside and not penetrating a wall or partition having a required fire resistance rating of 2 hours or more or passing entirely through the enclosure for a vertical shaft.

3. Where branch ducts connect to return risers in which the air flow is upward and subducts at least 22 inches long are carried up inside the riser at each inlet.

4. In steel duct systems penetrating 1-hour walls or partitions where the duct penetrating the rated partition does not exceed 100 sq in, and meeting the following minimum requirements: the entire system shall be of 0.0217-inch (26 ga) minimum steel duct, the duct shall continue for not less than 5 ft from the rated wall. When wall registers occur at the rated wall a fire damper shall be provided.

5. In openings in shaft walls in fully sprinklered buildings which are supervised

510.3 Ceiling Penetration

Ducts penetrating the ceiling of a fire resistant roof/floor and ceiling assembly shall be protected by methods complying with the design of the assembly or by ceiling dampers specifically designed and listed for this type service.

510.4 Smoke Dampers

Unless the air system is designed to provide smoke control or pressurization functions during a fire emergency, smoke dampers with listed operators shall be installed at all duct penetrations of required smoke partitions.

510.5 Floor Penetration

In buildings more than one story in height, ducts extending through more than one floor shall be enclosed in a shaft constructed of noncombustible materials having a fire resistance rating of not less than 1 hour for buildings less than four stories in height and not less than 2 hours for buildings four stories and more in height. Ducts penetrating only one floor may be protected by installing a listed fire damper where the floor is pierced in lieu of the enclosure.

510.6 Means Of Access

An access door or other approved means of access shall be provided in ducts to permit the proper maintenance and resetting of each fire door, fire damper and smoke damper. For ducts located above the ceiling of a fire rated assembly, a service opening designed and installed so as not to reduce the fire rating of the assembly shall be provided.

510.7 Location And Installation Details

The specific location and installation details of each fire door, fire damper, ceiling damper and smoke damper shall be shown and properly identified on the building plans by the designer.

511 WEATHERPROOFING

All ducts installed outside buildings and exposed to the elements shall be properly weatherproofed in an approved manner. Ducts with internal insulation shall have all joints and seams soldered or otherwise sealed so as to be weathertight. Ducts externally insulated shall have this insulation protected with a covering of sheet metal, weatherproof membrane or a mastic coating, all of which shall be applied in an approved manner.

512 PLENUM CHAMBERS

512.1 General

A room, attic, void, hollow or concealed space shall not be used as an integral part of a duct system or plenum unless the component parts of such space are constructed entirely of noncombustible material, properly protected by means of fire dampers and/or fan cut-off controls so as to restrict the spread of fire, and arranged so as to protect the fire resistance of the assembly. For exception see 509. Such chambers shall not be used for storage or occupational purposes. Public exit corridors in hotels, hospitals, institutions and similar occupancies and in multi-family dwellings shall not be used as plenums for adjoining areas other than toilet rooms, bathrooms, shower rooms, sink closets, and similar auxiliary spaces opening directly on the corridor. Stairway enclosures connecting two or more stories shall not be used as plenums.

EXCEPTIONS:

1. This requirement shall not prohibit the use of mechanical ventilation for the corridors or incidental exfiltration because of pressure differential in institutional occupancies.

2. In multifamily dwellings, hotels and similar occupancies, this requirement shall not prohibit the use of a corridor as a source of make-up air through normal leakage around doors for interior exhaust fans in kitchen, appliances, bathrooms and toilets.

3. Return plenum chambers for residential duct systems as defined in 501: Nothing in 512 shall restrict the use of wood louvered doors, wood frame mechanical equipment supports, approved plastic type condensate drain lines, water heater pans and drain line approved by the plumbing code, and piping insulation installed in mechanical equipment closets, provided all mechanical equipment meets requirements of 301.2.

4. Fuel gas lines may be installed in accessible above-ceiling spaces and crawl spaces, whether or not such spaces are used as a plenum. Gas valves and plumbing waste cleanouts shall not be located within the plenum space.

512.2 Material

Combustible material shall not be used in plenums unless it is properly protected or meets all standards of Class 1 Duct Material as defined by UL 181. Single and multi-conductor low voltage and power limited electrical wire and cables tested in accordance with UL 910 and having a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread of 5 ft or less and classified as having adequate fire resistance and low smoke producing characteristics shall be permitted in concealed spaces such as spaces over suspended ceiling, plenums, ducts and other spaces used for environmental air handling purposes. Piping insulation materials shall comply with the requirements of 610.1.2 in order for their use to be permitted in plenums.

513 AIR FILTERS

All heating and air conditioning systems of the central type shall be provided with approved type air filters. Low velocity type filters shall have a face area of not less than 1 sq in for each 2 1/2 cu ft per minute of air circulated by the unit. Filters shall be installed in the return air, upstream from any heat exchanger or coil, in an approved convenient location, and shall be easily accessible for cleaning or replacement. Filters shall be of a type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when attacked by flames. Liquid adhesive coatings used on filters shall have a flashpoint not lower than 325°F.

514 FRESH AIR INTAKES

Outdoor air intakes shall be protected against fire exposure by means of approved fire doors, dampers, or other suitable protection in accordance with the degree of exposure hazard and shall be screened with a corrosion-resistant material not larger than 1/2-inch mesh. Fresh air intakes shall not be taken from a location closer than 10 ft from any chimney or vent outlet, or sanitary sewer vent outlet, unless such vent outlet is not less than 24 inches above the fresh air inlet.

515 FAN SHUTDOWN CONTROLS

515.1 Capacity From 2000 - 15,000 CFM

Recirculating air systems with a fan capacity between 2000 cfm and 15,000 cfm shall automatically shut down when heat within the system (136°F) becomes excessive. The automatic control (firestat) shall be in the return air stream prior to any exhausting from the building or mixing with fresh air makeup. An approved smoke detector for duct installation may be used in lieu of the firestat or, upon the approval of the Mechanical Official, properly arranged heat and smoke sensors that also are connected to the fan system for automatic shutdown may be used.

515.2 Capacity Less Than 2000 CFM

Recirculating air systems with a fan capacity less than 2000 cfm, but serving an area used for egress, shall have automatic shutdown.

515.3 Capacity Greater Than 15,000 CFM

Recirculating air systems with a fan capacity greater than 15,000 cfm shall automatically shut down by means of an approved smoke detector placed in the return air duct prior to any exhausting from the building or mixing with the fresh air makeup.

EXCEPTIONS:

1. When approved smoke dampers are installed to isolate the fan unit from the remainder of the system upon activation from properly arranged heat and smoke sensors.

2. When automatic by-pass dampers are arranged at the fan unit to exhaust the air to the outside of the building upon activation from an approved heat and smoke sensor system.

515.4 Controls

All controls shall be listed. Upon activation of the safety control, the system shall not restart until the safety control is manually reset.

516 STAIRWELL ENCLOSURES

Ducts serving other areas shall not be located in or pass through exit enclosures.

CHAPTER 6
PIPING

601 GENERAL

The provisions of this chapter shall govern the construction, installation, alteration and repair of all heating, cooling and certain process piping for steam, chilled and hot water systems unless otherwise provided for in this Code.

602 STEAM AND HOT WATER PIPING

602.1 General

Steam and hot water piping shall conform to Table 602.1. The system shall be designed to operate within specified pipe or tubing working pressure and temperature rating.

TABLE 602.1
MATERIAL STANDARDS

Materials	Standards	Remarks
Steel	ASTM A 120/A 53	Schedule 40
Copper Tube	ANSI/ASTM B 88	
Copper Pipe	ANSI/ASTM B 42	
Brass Pipe	ANSI/ASTM B 43	
Polybutylene	ANSI/ASME B31.9 and ASTM D 3309	Hot water piping only

602.2 Reaming

All pipe or tubing shall be reamed after cutting to not less than full internal dimensions.

602.3 Pipe Joining

Polybutylene pipe and tubing shall be joined by fusion, insert fittings and crimp rings, or mechanical fittings. Steel piping shall be joined by welding or by the use of screw or flanged fittings, or mechanical fittings. Copper tubing shall be joined by brazing, soldering or approved compression fittings.

EXCEPTION: For joints in embedded construction, see 303.11.4.

602.4 Pipe Support

602.4.1 Pipe and piping shall be properly hung and supported to permit expansion and contraction. U-bends, swing joints or expansion joints shall be installed so as to permit free expansion and contraction of the piping. Swing joints or U-bends shall be fabricated of equivalent pipe material, and shall be suitable for the pressures and temperatures at which the installation is designed to operate. Expansion joints of either the slip sleeve or corrugated copper type may be used where such joints meet the temperature and pressure.

requirements of the installation.

602.4.2 All piping shall be securely supported on substantial noncombustible supports or hangers. Such supports or hangers shall be securely fastened to an adequate support or structural member. The hangers or supports shall be so spaced that there shall be no undue stress or strain on the pipe, joints, fittings or valves and so sagging will not occur in the pipe between points of suspension under normal operating conditions.

602.4.3 The piping shall be securely fastened to proper type anchor foundations where necessary to prevent undue stress or strain on boilers or equipment due to weight of the pipe or expansion and contraction.

602.5 Piping Through Walls, Floors, Etc.

Piping passing through walls, ceilings, floors, in or under concrete slabs, beams, or any portion of the building structure, shall be free to expand and contract and shall not be embedded in plaster, concrete or masonry. Such piping shall be provided with metal sleeves or thimbles when passing through concrete or masonry walls, ceilings, floors or beams, and such sleeves or thimbles shall be at least 3/8 inch larger than the outside diameter of the pipe or the pipe plus insulation. Openings through wooden floors, ceilings, walls and beams shall be at least 3/8 inch larger than the outside diameter of the pipe or the pipe plus insulation. Piping penetrating fire resistant assemblies shall not reduce the fire rating of the assembly. The Mechanical Official shall approve the type of sleeve and insulation to be used on piping carrying steam, water, or other fluids at temperatures in excess of 300° F.

EXCEPTION: Piping for panel heating systems may be embedded in accordance with 303.11.

602.5.1 Steam piping serving areas other than stair heating units shall not be located in or pass through exit enclosures.

602.6 Vertical Piping Secured

Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents but in no case less than at every other story height.

602.7 Branch Main Stress

Where the main steam supply or hot water supply piping or the main return piping of a system is divided into two or more branch mains or returns, such branches from the main piping shall be taken off with tees and elbows or "Y" branch fittings, so installed and connected that undue stresses or strains from pipe expansion or other causes shall not be placed on the pipe fittings or threads at the point or points of junction of the piping.

602.8 Bull-Heading Tees

The use of bull-heading tee connections is prohibited where the side opening of a tee is connected to the main piping and where the two branch connections are taken off the run of the tee thereby forming a rigid connection.

602.9 Welding

Where welding is used as a means of connection or joining branch mains to the main steam piping, provisions shall be made for the expansion of the pipe at this point so that undue stresses or strains shall not be placed on the welds or piping. The bull-heading or rigid tee is prohibited on this type of connection.

602.10 Connection From Mains, Branch Mains Or Return Piping

All connections from the mains, branch mains or return piping of a steam system to radiators or to supply risers running to upper floors of a building shall be taken off at the top of the supply or return piping by use of a 45° or 90° elbow where fittings are used, or welded into the top of the piping where the welded method of connection is used.

602.11 Cold Water Supply To Hot Water Tank

The cold water supply to a hot water tank shall be discharged within 3 inches of the bottom of the tank either by direct connection at this point or by means of a pipe or tube inside the tank. There shall be installed on the cold water line close to the tank a hand shut-off valve and a vacuum relief valve. The vacuum relief valve shall be installed so that hot water cannot flow back from the tank through the cold water supply piping. (See the Standard Plumbing Code.)

602.12 Materials

602.12.1 All threads on pipe, fittings, valves, flanges and similar appurtenances shall conform to ANSI B2.1.

602.12.2 Required gaskets shall be made of material approved for the pressure and temperature to which they are to be subjected. Rubber shall not be used where pressures exceed 15 psi steam and 45 psi water or on temperatures greater than 250° F.

602.12.3 Threaded joints shall be made up with an approved thread compound or lubricant.

602.12.4 Flanges, screw type, cast iron or steel, or of the forged integral type may be used up to their working pressure and temperature ratings. All companion flanges shall have matching facing and drilling.

602.12.5 All pipe fittings and valves used on high pressure installation shall be of the type designed for the pressures and temperatures of the installation.

602.12.6 All pipe and piping used on high pressure-high temperature installations shall be of the required weight and strength suitable for the type service and pressures intended. Stress relieving may be required by the Mechancial Official for high pressure-high temperature welded installations.

603 CONDENSATE DRAIN PIPING

603.1 General

Condensation from all cooling coils or evaporators shall be carried full size from drip pan outlet and piped to a sanitary sewer drain, storm sewer drain or an approved French drain on units larger than 3 tons nominal capacity. Drains from units 3 tons and smaller capacity may terminate in gutter or roof drain, on a concrete pad or other location subject to approval of the Mechanical Official. Condensate drains from roof top units may spill on roof providing it does not drain into street or alley, or other area, of sufficient amount to be a menace.

603.2 Material

Condensate drain piping shall be galvanized steel, copper pipe, or tubing, or straight (not coiled) pipe or tubing of polybutylene, polyethylene, or PVC. The piping shall be selected for the pressure and temperature rating of the installation. Condensate waste and drain lines shall be not less than 3/4-inch size pipe or 7/8-inch tubing size. When more than one unit is manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with accepted engineering practice.

603.3 French Drain

A French drain shall consist of a pit not less than 24 inches diameter and 24 inches deep filled with coarse gravel. The drain pipe shall extend into the pit not less than 6 inches below grade and shall be securely anchored in place. The drain may be covered with sod if desired after inspection and approval of same.

603.4 Drain Pans

Auxiliary drain pans shall be installed under all evaporator coils or units containing evaporator coils, located in attic spaces, suspended ceiling spaces or furred spaces. Pans shall have a minimum depth of 1 1/2 inch and shall be not less than 3 inches larger than unit or coil dimensions in width and length and shall be constructed of not less than 0.0276-inch (24 ga) galvanized sheet steel. A separate drain line shall be extended from this pan terminating at a conspicious point to serve as an alarm that the regular drain is restricted. A float switch to control overflow may be used in emergency drain pan in lieu of a drain line, when approved by the Mechanical Official.

603.5 Pipe Support

The hangers or supports shall be so spaced that there shall be no undue stress or strain on the pipe, joints, fittings or valves, so that sagging will not occur in the piping between points of suspension under normal operating conditions.

604 CHILLED WATER PIPING

604.1 General

All chilled water piping and fittings shall be of steel, copper, brass, polybutylene, or polyvinyl chloride plastic (PVC) Schedule 40 type I and II high and normal impact, PVC Schedule 80 type I and II high and normal impact. Pressure rated cement-asbestos epoxy lined pipe may be used where temperature of water does not exceed 210°F. The aforementioned materials shall be installed in compliance with Table 604.

604.1.1 Type K, L or M copper may be used on all underground or underslab copper lines and joined by a brazing filler metal.

604.1.2 Type 3003-0 aluminum tubing may be used for chilled water piping only.

604.1.3 All piping and fittings shall be marked to indicate type, weight, or pressure as applicable.

604.1.4 All plastic pipe shall be installed and supported in accordance with the manufacturer's recommendations and in such a manner as to give protection from physical damage to the piping and shall not be used as a connection material to heating devices, nor other equipment where temperature and/or vibration could affect the piping.

605 CONDENSER WATER PIPING

605.1 General

Condenser water piping shall be of the same quality and installed in the same manner as required in 604.

605.2 Bleed-Off

All cooling tower bleed-off lines shall be extended to a sanitary sewer drain or storm sewer drain. Such drain shall not in any case be allowed to drain into yards, street or alleys, or on the roof of a building which drains into such an area.

605.3 Installation

Cooling towers shall be provided with a direct connection to a water supply through an individual float control valve. The control valve shall terminate not less than 3 inches above the highest possible water level in the cooling tower pan. A convenient means shall be provided, either a gate valve or a capped nipple, for draining or flushing the tower.

606 MAKE-UP WATER PIPING

606.1 General

From an approved back-flow preventer installed as required by the Standard Plumbing Code, to the inlet on a boiler, chiller, or other water-using device covered by this Code, the piping shall be as hereinbefore specified for hot and chilled water piping, except on boilers operating above 250° F or 100 psi, the make-up water line shall be black iron or wrought-iron pipe conforming to Schedule 80 of ANSI B36.10 and extra-heavy malleable iron fittings. Make-up water piping to chillers or water towers shall be either galvanized steel or copper pipe.

606.2 Cross-Connections

A direct cross connection shall not be permitted between the potable water supply and any other circulating water system except as approved in 921.1.4 of the Standard Plumbing Code.

TABLE 604
PIPE SPECIFICATIONS

Materials	Standards	Type	Max. Pressure	Max. Temp.	Max. Size	Type Joint
PE Sch. 40	ASTM D 2104	II	75 psi	73.4°F	—	Mechanical
PE (SDR-PR)	ASTM D 2239 ANSI B 72.1	II	75 psi	73.4°F	—	Mechanical
PVC Sch. 40		I Normal Impact	50 psi	100°F	6″	Solvent
PVC Sch. 40	ASTM D 1785	II High Impact	50 psi	100°F	3″	Solvent
PVC Sch. 80		I Normal Impact	50 psi	100°F	12″	Solvent
PVC Sch. 80	ANSI B 72.2	II High Impact	50 psi	100°F	6″	Solvent
PVC Sch. 80		I Normal Impact	50 psi	100°F	6″	Threaded
PVC Sch. 80		II High Impact	50 psi	100°F	1 1/4″	Threaded
Steel	ASTM A120 ASTM A53	Schedule 40	125 psi	—	—	Threaded, Welded, or Mechanical Grooved Couplings/ Fittings
Copper	ASTM B 88	K,L and M	200 psi non-shock	310°F	—	Joined by brazing filler metal

TABLE 604 (Continued)
PIPE SPECIFICATIONS

Materials	Standards	Type	Max. Pressure	Max. Temp.	Max. Size	Type Joint
PB (SDR 11)	ASTM D3309 including Appendix	II	100 psi	@ 180°F	2″	Insert, Mechanical or Fusion
PB (SDR 15) (SDR 11.5) (SDR 9) (SDR 7)	ASTM D2662 including Appendix	II	125 psi 160 psi 200 psi 250 psi	@ 73°F @ 73°F @ 73°F @ 73°F	6″	Insert or Mechanical
PB (SDR 13.5) (SDR 9)	ASTM D2666 including Appendix	II	160 psi 250 psi	@ 73°F @ 73°F	2″	Mechanical or Fusion
PB (SDR 17) (SDR 13.5) (SDR 11) (SDR 9)	ASTM D3000 including Appendix	II	125 psi 160 psi 200 psi 250 psi	@ 73°F @ 73°F @ 73°F @ 73°F	6″	Mechanical Fusion or Flange

607 FUEL PIPING

607.1 Natural Gas Piping

All natural gas fuel piping shall be sized, installed, tested, and placed in operation in accordance with the requirements of the Standard Gas Code.

607.2 Liquefied Petroleum Gas (LPG) Piping

All LPG fuel piping shall be sized, installed, tested, and placed in operation in accordance with the requirements of the Standard Gas Code.

607.3 Liquid Fuel Piping

607.3.1 Piping materials and design.

607.3.1.1 All piping shall be wrought iron, steel or brass pipe, or brass or copper tubing except piping may be of materials other than these if used underground. Such piping shall be designed to specifications embodying priciples recognized as good engineering design for the material used and shall be approved by the authority having jurisdiction.

607.3.1.2 Wall thicknesses of wrought iron and steel pipe shall be in accordance with design methods outlined in ANSI B36.10. Listed flexible metal hose may be used to reduce the effect of jarring and vibration or where rigid connections are impracticable and shall be installed in full compliance with its listing.

607.3.1.3 Piping used in the installation of oil burners and appliances other than conversion range oil burners shall be not smaller than 3/8-inch iron pipe size or 3/8-inch OD tubing except that 1/4-inch pipe or 5/16-inch OD tubing may be used in the suction line of systems where the top of the tank is below the level of the oil pump. Copper tubing shall have 0.035-inch nominal and 0.032-inch minimum wall thickness.

607.3.1.4 Pipe shall be connected with standard fittings and tubing with fittings of listed type. Pipe connectors made of combustible materials or depending upon the frictional characteristics of combustible materials shall not be used inside of buildings or above ground outside of buildings. If used below ground outside of buildings, connectors shall be of listed type and installed in accordance with their listing. All threaded joints and connections shall be made tight with suitable lubricant or pipe compound. Unions requiring gaskets or packings, right or left couplings, and sweat fittings employing solder having a melting point of less than 1000°F shall not be used in oil lines. Cast iron fittings shall not be used.

607.3.1.5 Piping shall be substantially supported and protected against physical damage and where necessary protected against corrosion. All buried piping shall be protected against corrosion. Drop pipes from shop piping mains to burners are subject to physical damage and it may be necessary to enclose them in heavier pipe or the equivalent means to safeguard against breakage.

607.3.1.6 Proper allowance shall be made for expansion, contraction, jarring and vibration. Pipe lines other than tubing, connected to underground tanks, except straight fill lines and test wells, shall be provided with double swing joints, flexible connectors, or otherwise arranged to permit the tanks to settle without impairing the tightness of the pipe connections.

607.3.2 Fill and return piping

607.3.2.1 A fill pipe shall terminate outside of a building at a point at least 2 ft from any building opening at the same or lower level. A fill pipe shall terminate in a manner designed to minimize spilling when the filling hose is disconnected. Fill opening shall be equipped with a tight metal cover designed to discourage tampering.

607.3.2.2 A return line from a burner or pump to a supply tank shall enter the top of the tank.

607.3.2.3 Cross connections, except between two supply tanks not exceeding 660 gal aggregate capacity permitting gravity flow from one tank to another, shall be prohibited.

607.3.2.4 An auxiliary tank shall be filled by a pump transferring the oil from the supply tank.

607.3.2.5 An auxiliary tank shall be located at a level above the top of the supply tank from which it is filled.

607.3.2.6 An auxiliary tank shall be provided with an overflow pipe drainage to the supply tank and extending into the top of the supply tank not more than 1 inch. This requirement does not apply to an auxiliary tank specifically listed for use without an overflow pipe.

607.3.2.7 An overflow pipe from an auxiliary tank and a return line from a burner or pump shall have no valves or obstructions.

607.3.3 Supply connections

607.3.3.1 All piping, except the burner supply line from a tank having a capacity not over 660 gal and the cross connection between two tanks having an aggregate capacity of 550 gal or less, shall be connected into the top of a supply tank. When two tanks are cross connected, the tops of the tanks shall be on the same horizontal plane.

607.3.3.2 The burner supply connection to a tank having a capacity of more than 660 gal or to two or more tanks having an aggregate capacity of more than 660 gal shall be connected into the top of each tank, except as permitted by 607.3.3.6.

607.3.3.3 A transfer pump or an automatic pump may be used to deliver oil from a supply tank to a burner or to an auxiliary tank. Except as permitted by 607.3.3.6 a transfer pump shall not be connected to a tank having a capacity over 660 gal or to two tanks having an aggregate capacity of over 660 gal.

607.3.3.4 The pressure at the oil supply inlet to an appliance shall not be greater than 3 psi.

607.3.3.5 Where supply tanks are set below the level of the burner, the oil piping shall be so laid as to pitch toward the supply tank without traps.

607.3.3.6 For commercial and industrial installations the oil supply from tanks of any capacity permitted by this Code may be in accordance with the following:

1. The burner supply line may be connected to an outside above-ground supply tank at a point below the liquid level but each such connection

shall be provided with an internal or external shutoff valve located as close as practicable to the shell of the tank. External valves and their connection to the tank shall be of steel.

2. A transfer pump may be used.

607.3.4 Liquid fuel vent piping

607.3.4.1 Liquid fuel vent pipes shall be so laid as to drain toward one tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage above-ground. Vent pipes from tanks may be connected into one outlet pipe. The outlet pipe shall be at least one pipe size larger than the largest individual vent pipe connected thereto. The point of connection between two or more vent pipes shall not in any case be lower than the top of any fill pipe opening. The lower end of a vent pipe shall enter the tank through the top and shall extend into the tank not more than 1 inch.

607.3.4.2 Liquid fuel pipes shall terminate outside of buildings at a point not less than 2 ft measured vertically or horizontally from any building opening. Outer ends of vent pipes shall terminate in a weather-proof vent cap or fitting or be provided with a weather-proof hood. All vent caps shall have a minimum free open area equal to the cross-sectional area of the vent pipe and shall not employ screens finer than No. 4 mesh. Vent pipes shall terminate sufficiently above the groud to avoid being obstructed with snow or ice. Vent pipes from tanks containing heaters shall be extended to a location where oil vapors discharging from the vent will be readily diffused. If the static head with a vent pipe filled with oil exceeds 10 psi, the tank shall be designed for the maximum static head which will be imposed.

607.3.4.3 Liquid fuel vent pipes shall not be cross connected with fill pipes, lines from burners or overflow lines from auxiliary tanks.

607.3.5 Pressurized tank feed. Air or other gases shall not be used to pressurize tanks.

607.3.6 Oil gaging

607.3.6.1 All tanks in which a constant oil level is not maintained by an automatic pump shall be equipped with a method of determining the oil level.

607.3.6.2 Test wells shall not be installed inside buildings. For outside service they shall be equipped with a tight metal cover designed to discourage tampering.

607.3.6.3 The gaging of inside tanks by means of measuring sticks shall not be permitted. An inside tank provided with fill and vent pipes shall be provided with a device to indicate either visually or audibly at the fill point when the oil in the tank has reached a predetermined safe level.

607.3.6.4 Gaging devices such as liquid level indicators or signals shall be designed and installed so that oil vapor will not be discharged into a building from the liquid fuel supply system.

607.3.6.5 A tank used in connection with any oil burner shall not be equipped with a glass gage or any gage which when broken, will permit the escape of oil from the tank.

607.3.7 Valves

607.3.7.1 A readily accessible manual shutoff valve shall be installed at each point where required to properly control the flow of fuel in normal operation and where required to avoid oil spillage during servicing. The valve shall be installed to close against the supply and an automatically operated device designed to shut off the oil supply in case of fire in the immediate vicinity of the burner shall be provided.

607.3.7.2 Where a shutoff is installed in the discharge line of an oil pump not an integral part of a burner, a pressure relief valve shall be connected into the discharge line between the pump and the shutoff valve and arranged to return surplus oil to the supply tank or to bypass it around the pump, unless the pump includes an internal bypass.

607.3.7.3 Any fuel oil line incorporating a heater shall be provided with a relief valve arranged to discharge to the return line when any valve, pump, or other device may prevent the release of excessive pressure because of the expansion of the oil when heated.

607.3.7.4 Where oil is supplied to a burner requiring uniform flow by gravity feed and a constant level valve is not incorporated in the burner assembly or the oil is not supplied by an automatic pump, a constant level valve shall be installed in the supply line at the gravity tank or as close thereto as practicable, to insure uniform delivery of oil to the burner. The vent opening of such constant level valve shall be connected by piping or tubing to the outside of the building, unless the constant level is provided with an antiflooding device. Vent piping or tubing of constant level valves shall not be connected to tanks or tank vents.

608 REFRIGERANT PIPING

608.1 General

608.1.1 All refrigerant piping shall be sized, installed, tested and placed in operation in accordance with Chapter 4 of this Code and the ASHRAE Handbook of Fundamentals.

608.1.2 Rigid or flexible metal enclosures or pipe ducts shall be provided for soft, annealed copper tubing and used for refrigerant piping erected on the premises and containing other than Group 1 refrigerants. No enclosures shall be required for connections between condensing unit and the nearest riser box provided such connections do not exceed 6 ft in length.

608.2 Materials For Refrigerant Pipe And Tubing

608.2.1 No less than Schedule 80 wall thickness carbon steel or wrought iron pipe shall be used for Group 2 and Group 3 refrigerant liquid lines for sizes 1 1/2 inches and smaller. No less than Schedule 40 wall thickness carbon steel or wrought iron pipe shall be used for Group 1 refrigerant liquid lines 6 inches and smaller, Group 2 and Group 3 refrigerant liquid lines sizes 2 inches through 6 inches, and Group 1, Group 2, and Group

3 refrigerant vapor lines 6 inches and smaller. Butt-welded carbon steel and butt-welded wrought iron pipe shall not be used for refrigerant liquid lines.

608.2.2 Cast iron pipe shall not be used for Group 1, Group 2 or Group 3 refrigerant lines.

608.2.3 Standard iron pipe size, copper and red brass (not less than 80% copper) pipe may be used and shall conform to ASTM B 42 and ASTM B 43.

608.2.4 Watertube size hard copper tubing used for refrigerant piping erected on the premises shall conform to ASTM B 88 for dimensions and specifications, except that copper tubing with outside diameter of 1/4 inch and 3/8 inch shall have a minimum nominal wall thickness of not less than 0.030 inch and 0.034 inch, respectively.

608.2.5 Soft annealed copper tubing used for refrigerant piping erected on the premises shall not be used in sizes larger than 1 3/8-inch OD standard size. Mechanical joints shall not be used on soft annealed copper tubing on sizes larger than 7/8-inch OD standard size. Tubing shall conform to ASTM B 280.

608.2.6 Copper tubing joints used in refrigerating systems containing Group 2 or Group 3 refrigerants shall be brazed. Soldered joints shalll not be used in such refrigerating systems.

608.2.7 Type 3003-0 aluminum tubing with high pressure fittings may be used with all refrigerants except methyl chloride, and those others known to attack aluminum.

608.3 Joints And Refrigerant-Containing Parts In Air Ducts

Joints and all refrigerant-containing parts of a refrigerating system located in an air duct of an air-conditioning system carrying conditioned air to and from humanly occupied space shall be constructed to withstand, without leakage, a temperature of 700° F.

608.4 Exposure Of Refrigerant Pipe Joints

Exposure of Refrigerant Pipe Joints. Refrigerant pipe joints erected on the premises shall be exposed for visual inspection prior to being covered or enclosed.

608.5 Stop Valves

608.5.1 All systems containing more than 6 lb of a Group 2 or 3 refrigerant, other than systems utilizing non-positive displacement compressors, shall have stop valves installed as follows:

1. Each inlet of each compressor, compressor unit, or condensing unit;
2. Each discharge outlet of each compressor, compressor unit, or condensing unit, and of each liquid receiver.

608.5.2 All systems containing 100 lb or more of a refrigerant, other than systems utilizing nonpositive displacement compressors, should have stop valves, in addition to those in 608.5.1, on each inlet of each liquid receiver except that none shall be required on the inlet of a receiver in a condensing unit nor on the inlet of a receiver which is an integral part of the condenser.

608.5.3 Stop valves used with soft annealed copper tubing or hard drawn copper tubing 7/8-inch standard size (0.875 OD) or smaller shall be securely mounted, independent of tubing fastenings or supports.

608.5.4 Stop valves shall be suitably labeled if their purpose is not obvious. Numbers may be used to label the valves provided a key to the numbers is located near the valves.

608.6 Location Of Refrigerant Piping

608.6.1 Refrigerant Piping crossing an open space which affords passageway in any building shall be not less than 7 1/2 ft above the floor unless against the ceiling of such space.

608.6.2 Free passageway shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter, or other shaft containing a moving object, or in any shaft which has openings to living quarters or to main exit hallways. Refrigerant piping shall not be placed in public hallways, lobbies, or stairways, except that such refrigerant piping may pass across a public hallway if there are no joints in the section in the public hallway, and provided nonferrous tubing of 1-inch nominal diameter (1 1/8-inch OD) and smaller be contained in a rigid metal pipe.

608.6.3 Piping installed in concrete floors shall be encased in pipe duct. Where piping passes through concrete or masonry walls, ceilings, floors or beams, such piping shall be provided with metal sleeves or thimbles of which shall be at least 3/8 inch larger than the outside diameter of the piping plus the insulation. All voids between piping and casing shall be adequately enclosed with an approved material.

609 TESTS AND INSPECTIONS

Work shall not be concealed prior to inspection and tests. All pipe, except cast iron and plastic as approved in this Code, shall be tested with nitrogen, compressed air or other inert gas (not oxygen) or hydrostatically at a minimum of 1 1/2 times the operating pressure. Cast iron pipe shall be tested hydrostatically only. Approved plastic piping shall be tested at 1 1/2 times the operating pressure of the system.

610 PIPING INSULATION

610.1 General

610.1.1 All coverings or insulation used on heating and cooling systems shall be of materials suitable for the operating temperature of the system. The insulation, jackets, and lap-seal adhesives shall be tested as a composite product and shall have a flamespread of not more than 25 and a smoke developed rating of not more than 450 when tested in accordance with ASTM E 84.

610.1.2 Pipe insulation and coverings used in plenum chambers shall have a flamespread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with ASTM E 84.

610.2 Piping Insulation Thermal Performance

610.2.1 Piping installed to service buildings and within buildings shall be thermally insulated in accordance with Table No. 610.

EXCEPTIONS: Piping insulation is not required in the following cases:

1. Piping installed within HVAC equipment.
2. Piping at fluid temperatures between 55° F and 120° F when not required for energy conservation purposes.
3. When the heat loss and/or heat gain of the piping without insulation does not increase the energy requirement of the building.
4. When piping is installed in basements, cellars or unventilated crawl spaces having insulated walls in one and two family dwellings.

610.2.2 Insulation thicknesses in Table No. 610 are based on insulation having thermal resistivity in the range of 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75° F. Minimum insulation thickness shall be increased for materials having values less than 4.0, or may be reduced for materials having values greater than 4.6 as follows:

1. For materials with thermal resistivity greater than 4.6, the minimum insulation thickness may be reduced as follows:

$$\frac{(4.6 \text{ x Table 610 Thickness})}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

2. For materials with thermal resistivity less than 4.0, the minimum insulation thickness shall be increased as follows:

$$\frac{(4.0 \text{ x Table 610 Thickness})}{\text{Actual Resistivity}} = \text{New Minimum Thickness}$$

610.2.3 In locations where steam or hot water piping may be contacted by personnel, sufficient insulation shall be installed to maintain a surface temperature not exceeding 130° F based on operating temperature and ambient air conditions.

610.2.4 Chilled condenser water, condensate and refrigeration piping containing liquids or gases, which would result in formation of condensation if exposed, shall be suitably insulated to prevent such condensation.

TABLE 610
MINIMUM PIPE INSULATION

Piping System Types	Fluid Temperature Range, °F	Insulation Thickness In Inches For Pipe Sizes[2]: Run-Outs 2"[1]	1" And Less	1 1/4" To 2"	2 1/2" To 4"	5" and Larger
Heating Systems						
Steam and hot water						
High pressure/temp.	306-450	1 1/2	2 1/2	2 1/2	3	3 1/2
Med. pressure/temp.	251-305	1 1/2	2	2 1/2	2 1/2	3
Low pressure/temp.	201-250	1	1 1/2	1 1/2	2	2
Low temperature	120-200	1/2	1	1	1 1/2	1 1/2
Steam condensate (for feed water)	Any	1	1	1 1/2	2	2
Cooling Systems						
Chilled water, refrigerant, or brine	40-55	1/2	1/2	3/4	1	1
	Below 40	1	1	1 1/2	1 1/2	1 1/2

1. Runouts not exceeding 12 ft in length to individual terminal units.
2. For piping exposed to outdoor air, increase thickness by 1/2 inch.

CHAPTER 7
INCINERATORS

701 SCOPE

The application of this Chapter is intended to regulate and control the design, construction, quality of material, use, location and maintenance of all incinerators. Installation and alteration of incinerators shall be governed by all applicable provisions of this Code.

702 APPROVED STANDARDS

Construction and installation of equipment and appurtenances complying with the Incinerator Standards of the Incinerator Institute of America, dated November 1968, and operation of incinerators in accordance with incinerator Operator's Manual of the Incinerator Institute of America, dated March 1968, and not in conflict with this Code, will be approved.

703 CONTROLLED AIR PACKAGE UNITS

Equipment designed and constructed as controlled air packaged units and having complied with the Incinerator Institute of America Standards recommended velocity profiles in a physical arrangement that permits established mixing, combustion, and separation parameters that results in stack emissions acceptable to the Environmental Protection Agency or state or local governing agencies will be approved for installation and operation under this Code.

704 ALTERNATE MATERIALS AND METHODS

In existing buildings or premises in which incinerator installations are to be altered, repaired, or renovated, the Mechanical Official may permit deviations from the provisions of this Code provided that such deviations are in keeping with the intent of the Code to protect the health, safety and welfare of the occupant of such premises and the general public.

705 LOCATIONS AND CLEARANCES

705.1 Commercial And Industrial

All commercial and industrial incinerators installed indoors shall be located in rooms separated from the rest of the building by a minimum of 1 hour fire resistant construction. More restrictive requirements may be required due to occupancy or building type classification which may be determined by reference to the Standard Building Code.

705.2 One And Two Family

In one and two family dwellings, residential type incinerators need not be in a separate room.

705.3 Outdoor Location

Outdoor installation of incinerators shall be so located as not to introduce any direct exposure to adjacent buildings, structures, or outside permanent storage areas of combustible material while the incinerator is in operation.

706 CLASSIFICATION OF INCINERATORS

Incinerators shall be classified as follows:

1. Class I — Portable, packaged, completely assembled, direct-fed incinerators, having not over 5 cu ft storage capacity of 25 lb per hour burning rate, suitable for Type 2 waste.
2. Class IA — Portable, packaged or job-assembled, direct-fed incinerators 5 cu ft to 15 cu ft primary chamber volume; or a burning rate of 25 lb per hour up to, but not including, 100 lb per hour of Type 0, Type 1, or Type 2 waste; or a burning rate of 25 lb per hour up to, but not including, 75 lb per hour of Type 3 waste.
3. Class II — Fuel-fed, single chamber incinerators with more than 2 sq ft burning area, suitable for Type 2 waste. This type of incinerator is served by one vertical flue functioning both as a chute for charging waste and to carry the products of combustion to atmosphere. This type of incinerator installed in apartment houses or multiple dwellings not more than five stories high. This type of incinerator is prohibited.
4. Class IIA — Chute-fed multiple chamber incinerators, with more than 2 sq ft burning area, suitable for Type 1 or Type 2 waste. (Not recommended for industrial wastes). This type of incinerator is served by a vertical chute for charging wastes from two or more floors above the incinerator and a separate flue for carrying the products of combustion to atmosphere.
5. Class III — Direct-fed incinerators with a burning rate of 100 lb per hour and over, suitable for Type 0, Type 1 or Type 2 waste.
6. Class IV — Direct-fed incinerators with a burning rate of 75 lb per hour or over, suitable for Type 3 waste.
7. Class V — Municipal incinerators suitable for Type 0, Type 1, Type 2 or Type 3 wastes, or a combination of all four wastes, rated in tons per hour or tons per 24 hours.
8. Class VI — Crematory and pathological incinerators, suitable for Type 4 waste.
9. Class VII — Incinerators designed for specific by-product wastes, Type 5 or Type 6.

707 CLASSIFICATION OF WASTE

Classification of waste shall be as follows:

1. Type 0 — Trash, a mixture of highly combustible waste such as paper, cardboard, cartons, wood boxes, and combustible floor sweeping, from commercial and industrial activities. The mixtures contain up to 10% by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags and plastic or rubber scraps.
2. Type 1 — Rubbish, a mixture of combustible waste, such as paper, cardboard cartons, wood scrap, foilage and combustible floor sweepings, from domestic, commercial and industrial activities. The mixture contains up to 20% by weight of restaurant or cafeteria waste, but contains little or no treated plastic or rubber wastes.
3. Type 2 — Refuse, consisting of an approximately even mixture of rubbish and garbage by weight. This type of waste is common to apartment

and residential occupancy, consisting of up to 50% moisture, 7% noncombustible solids, and has a heating value of 4300 Btu per lb as fired.

4. Type 3 — Garbage, consisting of animal and vegetable wastes from restaurants, cafeterias, hotels, hospitals, markets, and like installations. This type of waste contains up to 7% moisture, up to 5% noncombustible solids, and has a heating value of 2500 Btu per pound as fired.

5. Type 4 — Human and animal remains, consisting of carcasses, organs, and solid organic wastes from hospitals, laboratories, abattoirs, animal pounds, and similar sources, consisting of up to 85% moisture, 5% noncombustible solids, and having a heating value of 1000 Btu per lb as fired.

6. Type 5 — Byproduct waste, gaseous, liquid or semi-liquid, such as tar, paints, solvents, sludge, fumes, etc. from industrial operations. Btu values must be determined by the individual materials to be destroyed.

7. Type 6 — Solid byproduct waste, such as rubber, plastics, wood waste, etc., from industrial operations. Btu values must be determined by the individual materials to be destroyed.

708 GAS-FIRED INCINERATORS

708.1 Installation

Listed gas-fired incinerators shall be installed as close as practicable to a vent and with at least 12 inches clearance between sides and combustible construction, except that appliances approved for installation at lesser clearances may be installed in accordance with their listing. In no case shall the clearance be such as to interfere with the requirements for combustion air and accessibility. Incinerators of the wall type shall be installed in a noncombustible wall communicating directly with a chimney flue.

708.2 Connecting Draft Hoods

A draft hood shall not be connected into a flue pipe of an incinerator. Where conditions permit, it is preferable to have the flue pipe connected to a separate chimney flue.

708.3 Flue Pipes, Clearance

Flue pipes shall have at least 18 inches clearance from combustible construction and shall not pass through combustible construction unless guarded at the point of passage.

708.4 Flue Pipes, Material

The flue pipe from an incinerator to a vent shall be galvanized steel at least 0.0276-inch (24 ga) thick or of material having equivalent or superior heat and corrosion-resistant properties. Joints shall be secured by sheet metal screws.

708.5 Pilot Devices

Automatic pilot devices having a response time of not more than 5 sec shall be installed on all gas burners in unlisted commercial incinerators installed in buildings.

709 GAS BURNERS

709.1 Less Than 400,000 BTU

Gas burner equipment up to, but not exceeding, 400,000 Btu per hour may be of either the atmospheric or power burner type. In either case, a continuous burning or intermittent stable pilot adequate to ensure safe, reliable ignition shall be installed. A flame safeguard shall be used so that no gas can flow to the main burner unless satisfactory ignition is assured. The response time of this flame safeguard to de-energize the gas shut-off device on flame failure shall not exceed 2 to 4 sec.

709.2 Greater Than 400,000 BTU

Above 400,000 Btu per hour input, the burner equipment shall be of the power type which utilizes a forced draft blower to supply air needed for combustion under controlled conditions. A continuous burning or intermittent pilot shall be used to ensure safe and reliable ignition. Automatic spark ignition shall be used on pilots for burners with input above 1,000,000 Btu per hour. A suitable flame safeguard shall be utilized so that no gas can flow to the main burner unless satisfactory ignition is assured. On burners with inputs from 400,000 to 1,000,000 Btu per hour, the response time of the flame safeguard to de-energize the gas shut-off device on flame failure shall not exceed 5 sec. In capacities above 1,000,000 Btu per hour, the response time of the aforementioned flame safeguard shall be not more than 4 sec.

709.3 Burner Assembly

The burner assembly shall consist of the main burner, pilot burner, automatic valve, the necessary manual valves and accessory equipment, plus interconnecting pipes and fittings with provision for rigid mounting. The burner shall be constructed so that parts cannot be incorrectly located or incorrectly fitted together. Power burners sealed to incinerator wall with capacities above 100,000 Btu per hour shall be supplied with a means of providing air supply before the main gas valve can be energized.

709.4 Electric Motors

Electrical motors over 1/12 horsepower on power burner equipment shall be designed for continuous duty and shall be provided with thermal overload protection, or current-sensitive devices.

709.5 Complete Shutoff System

When a complete automatic pilot shutoff system is utilized, the controls shall be readily accessible and arranged so that the main burner gas can be manually shut off during lighting of pilot. When a complete automatic system is not utilized, a readily-accessible manually-operated, quarter-turn lever handle, plug type valve shall be provided to shut off or turn on the gas supply to the main burner manifold. This valve shall be upstream from all controls except the pilot control valve.

709.6 Additional Requirements

For additional gas requirements, see the Standard Gas Code.

710 SCRUBBER OR GAS WASHER

710.1 Dust Emissions

The total dust emissions from the flue gas scrubber shall be not more than 0.4 lb dry dust per 1000 lb flue gas, corrected to 50% excess air.

710.2 Internal Volume

The scrubber may be separate from or an integral part of the incinerator, but no internal volume of the scrubber shall be included as a part of the incinerator internal volume.

710.3 Linings

Lined scrubbers shall have a welded or gasketed casing of not less than 0.1046-inch (12 ga) steel. The density of the refractory lining shall not be less than 120 lb per cu ft. The thickness of the refractory shall in no case be less than 2 inches and adequately anchored to the casing.

710.4 Draft Fans

All scrubbers requiring an induced draft fan shall have the motor horsepower sized for cold start-up. All induced draft fans with the impeller in the flue gas stream must be equipped with a cleanout door and drain. The induced draft fan, if provided, shall be interlocked with the sprays.

710.5 Access Doors

All scrubbers shall be equipped with an access door for cleanout.

710.6 Dampers

A damper shall be located either between the incinerator and scrubber, or at the inlet of the induced draft fan, with a by-pass arrangement of breechings or flue connections to by-pass the scrubber and induced draft fan.

711 STACKS AND CHIMNEYS

Masonry chimneys for commercial and industrial type incinerators shall be designed and constructed in accordance with the requirements of Chapter 3. Metal stacks shall be designed and constructed as specified in Chapter 3.

712 SPARK ARRESTERS

All chimneys and stacks shall terminate in a spark arrester. Spark arresters shall be constructed of Series 300 stainless steel wire of not less than 0.063-inch diameter. Wire shall be woven in a mesh with wire spacing of not less than three equal spaces per inch.

713 MARKING INCINERATORS

A name plate shall be conspicuously fastened to the incinerator indicating the manufacturer's name, model number, rated capacity of the unit, classification and the type of waste for which the incinerator is designed.

714 OPERATION OF INCINERATOR

The incinerator operator shall follow the written operating instructions of the manufacturer. A copy of these instructions shall be submitted for approval to the Mechanical Official at the time of application of the permit.

CHAPTER 8
ELECTRICAL REQUIREMENTS

801 ELECTRICAL CONNECTIONS

801.1 General

All electrical connections between fuel fired appliances, mechanical equipment, etc., and the building wiring shall conform to NFiPA 70.

801.2 Ungrounded Leads

A disconnecting means and 115 volt outlet shall be installed within sight and easy reach in the ungrounded leads of each power circuit to electrically operated components. The disconnecting means shall in no case be installed farther than 6 ft from the service side of the equipment.

802 IGNITION AND CONTROL DEVICES

Devices employing or depending upon an electrical current shall not be used to control or ignite a fuel supply if of such a character that failure of the electrical current could result in the escape of unburned fuel or in failure to reduce the supply of fuel under conditions which would normally result in its reduction unless other means are provided to prevent the development of dangerous temperatures, pressures or the escape of fuel.

803 ELECTRICAL GROUND

The fuel piping system shall not be used as a grounding electrode for an electric fuse panel, telephone circuit or lightning arrestor. Electric circuits shall not utilize fuel piping, casing of controls, panels or other metal parts in lieu of an electrical conductor. This provision shall not apply to low voltage control and ignition circuits, and to electronic flame detection device circuits incorporated as part of the appliance.

804 ELECTRICAL CIRCUIT

The electrical circuit employed for operating the automatic main fuel control valve, safety shutoff device, room temperature thermostat, limit control or other electrical devices used with a fuel-burning appliance shall be in accordance with the wiring diagrams supplied with the appliance.

805 CONTINUOUS POWER

All fuel-burning appliances using electrical controls shall have the controls connected into a permanently live electrical circuit, i.e., one that is not controlled by a light switch.

CHAPTER 9
REFERENCE STANDARDS

901 REFERENCED STANDARDS

STANDARD DESIGNATION	SECTION
ACCA Manual J: Load Calculation for Residential Winter and Summer Air Conditioning, 1981	B102
ACCA Manual N: Load Calculation for Commercial Summer and Winter Air Conditioning, 1982	B102
ANSI B 2.1-1960, Pipe Threads	602.12.1
ANSI B 9.1-1971, Safety Code for Mechanical Refrigeration	302.4, 405, 406.2.2
ANSI B 36.10-1975, Welded and Seamless Wrought Steel Pipe	606.1 607.3.1.2
ANSI B 50.11-1965, Synchronous Motors	302.6.2
ANSI B 72.1-1967	Table 604
ANSI B 72.2-1967	Table 604
ANSI B 23.1-1971, Centrifugal Pump for Process Use	302.6.1
ANSI Z21.13, Gas Fired Low-Pressure Steam and Hot Water Heating Boilers	304.2
ANSI Z21.59, Gas Fire High Pressure Steam and Hot Water Boilers	304.2
ASHRAE Applications Handbook, Chapter 57, Solar Energy Utilization for Heating and Cooling, 1982	309.1.6
ASHRAE Handbook of Fundamentals, 1981	608.1.1, B102
ASHRAE Handbook & Product Directory Equipment, 1980	302.4, 502
ASHRAE Handbook & Product Directory-Systems 1980	302.4
ASME Boiler and Pressure Vessel Code: Section I, Power Boilers Section IV, Heating Boilers Section IX, Welding and Brazing Qualifications	304.2, 304.4.2, Table 602.1
ASTM A 53-1977, Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless	Table 602.1 Table 604
ASTM A 120-1977, Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses	Table 602.1, Table 604
ASTM B 42-1982, Specification for Seamless Copper Pipe, Standard Sizes	Table 602.1, 608.2.3
ASTM B 43-1980, Specification for Seamless Red Brass Pipe, Standard Sizes	Table 602.1 608.2.3

ASTM B 88-1981, Specification for Seamless Copper Water Tube	Table 602.1, Table 604, 608.2.4
ASTM B 280-1980, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service	608.2.5
ASTM C 411-1961, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation	309.6.5, 506.1.2
ASTM D 1785-1976, Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120	Table 604
ASTM D 2104-1974, Specification for Polyethylene (PE) Plastic Pipe, Schedule 40	Table 604
ASTM D 2239-1974, Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter	Table 604
ASTM D 2662, Specification for Polybutylene (PB) Plastic Tubing	Table 604
ASTM D 2666, Specification for Polybutylene (PB) Plastic Tubing	Table 604
ASTM D 3000, Specification for Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter	Table 604
ASTM D 3309, Specification for Polybutylene (PB) Plastic Hot-Water Distribution Systems	Table 602.1, Table 604
ASTM D 3667-1978, Specification for Rubber Seals Used in Flat-Plate Solar Collectors	309.5.2
ASTM D 3771-1979, Specification for Rubber Seals Used in Concentrating Solar Collectors	309.5.2
ASTM D 3832-1979, Specification for Rubber Seals Contacting Liquids in Solar Energy Systems	309.5.2
ASTM E 84-1981a, Test Method for Surface Burning Characteristics of Building Materials	202, 309.6.4, 309.7.3, 610.1
ASTM E 136-1982, Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C	202
CABO Model Energy Code	B101
HYDI C 30-1973, Cooling Load Calculation Guide	B102
HYDI H 21-1984, Heat Loss Calculation Guide	B102
Incinerators Institute of America Standards	703
NFiPA 12-1985, Carbon Dioxide Extinguishing Systems	308.7.3

NFiPA 13-1987, Installation of Sprinkler Systems	308.7.3
NFiPA 16-1986, Deluge Foam-Water Sprinkler Systems and Foam-Water Spray Systems	308.7.3
NFiPA 17-1985, Dry Chemical Extinguishing Systems	308.7.3
NFiPA 17A-1986 Wet Chemical Extinguishing Systems	308.7.3
NFiPA 31-1987, Installation of Oil Burning Equipment	306.16.2
NFiPA 70-1987, National Electrical Code	307.4.2, 404.1.5, 404.1.7, 512.2, 801.1
NFiPA 82-1983, Incinerators Waste and Linen Handling Systems and Equipment	307.5
NFiPA 90A-1985, Installation of Air Conditioning and Ventilating Systems	302.4
NFiPA 90B-1984, Installation of Warm Air Heating and Air Conditioning Systems	302.4
NFiPA 91-1983, Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying	308.10.1
NFiPA 96-1984, Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment	308.7.3
NFiPA 214-1983, Water-Cooling Towers	302.4
SBCCI Standard Building Code, 1988 Edition	201.2, 202, 302.7.1, 303.5.1, 306.5.2, 306.6.2, Table 306A, 307.1, 307.4.1, 308.4.6, 309.1.5, 309.4.2, 309.4.3, 404.1.1, 506.1.8, 509.2.1, 705.1, A103.7.4
SBCCI Standard Fire Prevention Code, 1988 Edition	201.2
SBCCI Standard Gas Code, 1988 Edition	201.2, 303.9.3, 306.15.10 306.16.1, 404.1.6, 607.1, 607.2, 709.6

SBCCI Standard Plumbing Code, 1988 Edition	201.2, 302.7.2, 309.11, 309.12, 309.13.1, 404.1.4, 602.11, 606.1, 606.2
SBCCI Standard Unsafe Building Abatement Code, 1988 Edition	102.4
SMACNA Fibrous Glass Duct Construction Standards, 5th Ed., 1979 with 1983 Revisions	502
SMACNA HVAC Duct Construction Standards, Metal and Flexible 1st Ed., 1985	502
UL 127-1981, Factory-Built Fireplaces	306.17.1
UL 181-1981, Factory-Made Air Ducts and Connectors	502, 512.2
UL 737-1982, Fireplace Stoves	306.17.2
UL 910-1981, Test Method for Fire and Smoke Characteristics of Cables	512.2
UL 1482-1983, Room Heaters, Solid-Fuel Type	306.17.2

902 ORGANIZATIONS

The purpose of this reference index is to catalog by name and address those agencies, associations, institutions and others that are referred to in this Code by name, initials or symbols. Further there are those listed, for convenience, whose technical and other services are made available to the Mechanical Official.

ACCA	Air Conditioning Contractors of America 1228 17 Street NW Washington, D.C. 20036
AGA	American Gas Association, Inc. 8501 East Pleasant Valley Road Cleveland, Ohio 44131
ANSI	American National Standards Institute, Inc. 1430 Broadway New York, New York 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, Georgia 30329

ASME	American Society of Mechanical Engineers United Engineering Center 345 East 47th Street New York, New York 10017
ASSE	American Society of Sanitary Engineering 228 Northern Ohio Bank Bldg. 1370 Ontario Street Cleveland, Ohio 44113
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, Pennsylvania 19103
CABO	Council of American Building Officials 5203 Leesburg Pike, Suite 708 Falls Church, VA 22041
CDA	Copper Development Association, Inc. 405 Lexington Avenue New York, New York 10017
CISPI	Cast Iron Soil Pipe Institute 1499 Chain Bridge Road, Suite 203 McLean, VA 22101
CS	Commercial Standards Superintendent of Documents Government Printing Office Washington, D.C. 20402
CSPP	Committee of Steel Pipe Producers American Iron and Steel Institute 1000 16th St. NW Washington, D.C. 20036
FMED	Factory Mutual Engineering Division Standards-Laboratories Department 1151 Boston-Providence Turnpike Norwood, Mass. 02060
FS	Federal Specifications Superintendent of Documents Government Printing Office Washington, D.C. 20234
HYDI	The Hydronics Institute 35 Russo Place Berkeley Heights, NJ 07922

MSS	Manufacturers Standardization Society of the Valve and fittings Industry 420 Lexington Avenue New York, New York 10017
NBS	National Bureau of Standards (Department of Commerce) Superintendent of Documents Government Printing Office Washington, D.C. 20402
NFiPA	National Fire Protection Association Batterymarch Park Quincy, Massachusetts 02269
TIMA	National Insulation Manufacturers Association 7 Kirby Plaza Mount Kisco, New York 10549
NLPGA	National L-P Gas Association 1301 West 22nd Street Oak Brook, ILL 60521
NFS	National Sanitation Foundation NSF Building 3475 Plymouth Road Ann Arbor, Michigan 48106
PPI	Plastics Pipe Institute A Division of The Society of the Plastics Industry, Inc. 250 Park Avenue New York, New York 10017
SGA	Southern Gas Association 924 Life Building Dallas, Texas 75202

SMACNA	Sheet Metal & Air Conditioning Contractors National Association, Inc. 8224 Old Courthouse Road Tysons Corner Vienna, Virginia 22180
SPR	Simplified Practice Recommendations National Bureau of Standards Government Printing Office Washington, D.C. 20402
UBPVLS	Uniform Boiler and Pressure Valve Laws Society, Inc. 57 Pratt Street Hartford, Connecticut 06103
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, Illinois 60062

APPENDIX A
RECOMMENDED SUPPLEMENTAL ADMINISTRATIVE PROVISIONS

The provisions contained in this appendix are intended to supplement Chapter 1 — Administration of this Code, when neither the state nor local government statutes or ordinances conflict with the provisions contained herein.

Provisions of this appendix can be incorporated into Chapter 1 of this Code, in accordance with the section numbers shown.

A101.3 Scope

A101.3.4 Maintenance. All mechanical systems, both existing and new, and all parts thereof, shall be maintained in a safe condition. All devices or safeguards which are required by this Code in a system when installed, altered, or repaired, shall be maintained in good working order. The owner, or his designated agent, shall be responsible for the maintenance of the mechanical systems.

A101.4 Mechanical Department

A101.4.1 Mechanical Official Qualifications. The Mechanical Official shall have at least 10 years experience or equivalent, as an architect, engineer, inspector, contractor, or superintendent of construction, or any combination of these, for 5 years of which he shall have been in responsible charge of work. He shall be appointed by the applicable governing body. He shall not be removed from office except for cause after full opportunity has been given him to be heard on specific charges before each applicable governing body.

A101.4.2 Inspector Qualifications. The Mechanical Official, with the approval of the applicable governing body, may appoint such number of officers, inspectors, assistants and other employees as shall be authorized from time to time. A person shall not be appointed as an inspector who has not had at least 5 years experience as a mechanical inspector, engineer, architect, or competent mechanic in charge of mechanical installations.

A101.4.3 Deputy Mechanical Official. The Mechanical Official may designate as his deputy an employee in the department who shall, during the absence or disability of the Mechanical Official, exercise all the powers of the Mechanical Official.

A101.4.4 Restrictions On Employees. An officer or employee connected with the department, except one whose only connection is as a member of the board established by this Code, shall not be financially interested in the furnishing of labor, material, or appliances for the construction, alteration, or maintenance of a mechanical system, or in the making of plans or of specifications thereof, unless he is the owner of such building. Such officer or employee shall not engage in any other work which is inconsistent with his duties or conflicts with the interests of the department.

A101.4.5 Records. The Mechanical Official shall keep, or cause to be kept, a record of the business of the department. The records of the department shall be open to public inspection.

A101.4.6 Liability. Any officer or employee, or member of the Board of Adjustments and Appeals, charged with the enforcement of this Code, acting for the applicable governing body in the discharge of his duties, shall not thereby render himself personally liable, and is hereby relieved from all personal liability, for any damage that may accrue to persons or property as a result of any act required or permitted in the discharge of his duties. Any suit brought against any officer or employee or member because of such act performed by him in the enforcement of any provision of this Code shall be defended by the Department of Law until the final termination of the proceedings.

A101.4.7 Reports. The Mechanical Official shall annually submit a report covering the work of the department during the preceding year. He shall incorporate in said report a summary of the decisions of the Board of Adjustments and Appeals during said year.

A103.1 Permit Application

A103.1.1 When Required. Any owner, authorized agent, or contractor who desires to install, enlarge, alter, repair, move, or replace a mechanical system, the installation of which is regulated by this Code, or to cause any such work to be done, shall first make application to the Mechanical Official and obtain the required permit for the work.

A103.1.2 Work Authorized. A permit shall carry with it the right to install in any building or structure, or part thereof, mechanical systems, provided the same are shown on the drawings and set forth in the specifications filed with the application for the permit; but where these are not shown on the drawings and covered by the specifications submitted with the application, special permits shall be required.

A103.1.3 Minor Repairs. Ordinary minor repairs may be made with the approval of the Mechanical Official without a permit, provided that such repairs shall not violate any of the provisions of this Code. Permits shall not be required for the following:

1. any portable heating appliance;
2. any portable ventilation equipment;
3. any portable cooling unit;
4. any steam, hot or chilled water piping within any heating or cooling equipment regulated by this Code;
5. replacement of any part which does not alter its approval or make it unsafe;
6. any portable evaporative cooler, and
7. any self-contained refrigeration system containing 10 lb or less of refrigerant and actuated by motors of 1 horsepower or less.

A103.1.4 Information Required. Each application for a permit, with the required fee, shall be filed with the Mechanical Official on a form furnished for that purpose, and shall contain a general description of the proposed work and its location and any other information as may be required by the Mechanical Official. The application shall be signed by the owner or his authorized agent.

A103.1.5 Time Limitations. An application for a permit for any proposed work shall be deemed to have been abandoned 6 months after the date of filing for the permit, unless before then a permit has been issued. One or more extensions of time for periods of not more than 90 days each may be allowed by the Mechanical Official for the application, provided the extension is requested in writing and justifiable cause is demonstrated.

A103.2 Drawings And Specifications

A103.2.1 Requirements. When required by the Mechanical Official, two or more copies of specifications, and of drawings drawn to scale with sufficient clarity and detail to indicate the nature and character of the work, shall accompany the application for a permit. Such drawings and specifications shall contain information, in the form of notes or otherwise, as to the quality of materials, where quality is essential to conformity with this Code. Such information shall be specific, and this Code shall not be cited as a whole or in part, nor shall the term "legal" or its equivalent be used, as a substitute for specific information.

A103.2.2 Additional Data. The Mechanical Official may require details, computations, stress diagrams, and other data necessary to describe the installation and basis of calculations and they shall bear the signature of the person responsible for the design.

A103.2.3 Designers Name. All drawings, specifications, and accompanying data shall bear the name and address of the designer. For buildings or structures of Group E - Educational, Group I - Institutional and Group A - Assembly Occupancy, and all buildings or structures three stories or more in height or 5000 sq ft or more in area, except one and two family dwellings, such designer shall be an architect or engineer legally registered under the laws of this state regulating the practice of architecture or engineering and shall affix his official seal to said drawings, specifications and accompanying data.

A103.3 Examination Of Contract Documents

A103.3.1 Plan Review. The Mechanical Official shall examine or cause to be examined each application for a permit and the accompanying contract documents, consisting of drawings, specifications, computations and additional data, and shall ascertain by such examinations whether the construction indicated and described is in accordance with the requirements of this Code and all other pertinent laws or ordinances.

A103.3.2 Affidavits. The Mechanical Official may accept a sworn affidavit from a registered architect or engineer stating that the plans submitted conform to this Code and he may without any examination or inspection accept such affidavit, provided the architect or engineer who made such affidavit agrees to submit to the Mechanical Official copies of inspection reports as inspections are performed and upon completion of the mechanical system a certification that the system has been installed in accordance with the requirements of this Code. Where the Mechanical Official relies upon such affidavit, the architect or engineer shall assume full responsibility for the compliance with all provisions of this Code and other pertinent laws or ordinances.

A103.4 Issuing Permits

A103.4.1 Action On Permits. The Mechanical Official shall act upon an application for a permit without unreasonable or unnecessary delay. If the Mechanical Official is satisified that the work described in an application for a permit and the contract documents filed therewith conform to the requirements of this Code and other pertinent laws and ordinances, he shall issue a permit to the applicant.

A103.4.2 Refusal To Issue Permit. If the application for a permit and the accompanying drawings, specifications, computations and additional data describing the work do not conform to the requirements of this Code or other pertinent laws or ordinances, the Mechanical Official shall not issue a permit, but shall return the drawings to the applicant with his refusal to issue such permit. Such refusal shall, when requested, be in writing and shall contain the reason for refusal.

A103.5 Contractor License

It shall be the duty of every contractor who shall make contracts for the installation or repair of mechanical systems for which a permit is required, and every contractor making such contracts and subletting the same, or any part thereof, to pay a license tax as provided in the general license ordinance, and to register his name in a book provided for that purpose, with the Mechanical Official, giving full name, residence and place of business, and, in case of removal from one place to another to have made corresponding change in said register accordingly; and it shall be the further duty of every such person to give good and sufficient bond in a sum prescribed and as required by the applicable governing body, conditioned to conform to the mechanical regulations, the regulation of this section, and other ordinances or laws of the applicable governing body.

A103.6 Conditions Of The Permit

A103.6.1 Permit Intent. A permit issued shall be construed to be a license to proceed with the work and shall not be construed as authority to violate, cancel, alter, or set aside any of the provisions of this Code, nor shall such issuance of a permit prevent the Mechanical Official from thereafter requiring a correction of errors in plans or in construction, or of violations of this Code. Every permit issued shall become invalid unless the work authorized by such permit is commenced within 6 months after its issuance, or if the work authorized by such permit is suspended or abandoned for a period of 6 months after the time the work is commenced. One or more extensions of time, for periods not more than 90 days each, may be allowed for the permit, provided the extension is requested in writing and justifiable cause is demonstrated. Such extensions shall be in writing by the Mechanical Official.

A103.6.2 Permit Issued On Basis of an Affidavit. Whenever a permit is issued in reliance upon an affadavit or whenever the work to be covered by a permit involves installation under conditions which, in the opinion of the Mechanical Official, are hazardous or complex, the Mechanical Official shall require that the architect or engineer who signed the affidavit or made the drawings or computations shall supervise such work, be responsible for its conformity with the permit, provide copies of inspection reports as inspections are performed, and upon completion make and file with the Mechanical Official written affidavit that the work has been done in conformity with the approved plans and with the structural provisions of this Code. In the event such architect or engineer is not available, the owner shall employ in his stead a competent person or agency whose qualifications are approved by the Mechanical Official.

A103.6.3 Approved Plans. When the Mechanical Official issues a permit, he shall endorse, in writing or by stamp, both sets of plans "Reviewed for Code Compliance". One set of drawings so reviewed shall be retained by the Mechanical Official and the other set shall be returned to the applicant. The permitted drawings shall be kept at the site of work and shall be open to inspection by the Mechanical Official or his authorized representative.

A103.7 Fees

A103.7.1 Prescribed Fees. A permit shall not be issued until the fees prescribed in this section have been paid. Nor shall an amendment to a permit be approved until the additional fee, if any, due to an increase in the estimated cost of the building or structure, has been paid.

A103.7.2 Work Commencing Before Permit Issuance. If any person commences any work on a mechanical system before obtaining the necessary permit, he shall be subject to a penalty of double the permit fees.

A103.7.3 Accounting. The Mechanical Official shall keep a permanent and accurate accounting of all permit fees and other monies collected, the names of all persons upon whose account the same was paid, along with the date and amount thereof.

A103.7.4 Schedule of Permit Fees. On all mechanical systems requiring a mechanical permit, a fee for each mechanical permit shall be paid as required at the time of filing the application, in accordance with the schedule established by the applicable governing body. (See Appendix C for recommended fee schedule.)

A103.7.5 Building Permit Valuations. If, in the opinion of the Mechanical Official, the valuation appears to be underestimated on the application, permit shall be denied, unless the applicant can show detailed estimated cost to meet the approval of the Mechanical Official. Permit valuations shall include total cost including materials and labor.

A103.8 Inspections

A103.8.1 Existing Buildings. Before issuing a permit, the Mechanical Official may examine or cause to be examined any mechanical system for which an application has been received for a permit to enlarge, alter, repair, move, replace, or change a mechanical system. He shall inspect the mechanical systems, from time to time, during and upon completion of the work for which a permit was issued. He shall make a record of every such examination and inspection and of all violations of this Code.

A103.8.2 Manufacturers and Fabricators. When deemed necessary by the Mechanical Official, he shall make an inspection of materials or assemblies at the point of manufacture or fabrication. He shall make a record of every such examination and inspection and of all violations of this Code.

A103.8.3 Inspection Service. The Mechanical Official may make, or cause to be made, the inspections required by this section. He may accept reports of inspectors of recognized inspection services provided that after investigation he is satisfied as to their qualifications and reliability. A certificate called for by any provision of this Code shall not be based on such reports unless the same are in writing and certified by a responsible officer of such service.

A103.8.4 Posting of Permit. Work requiring a mechanical permit shall not commence until the permit holder or his agent posts the mechanical permit card in a conspicuous place on the front of the premises. The permit shall be protected from the weather and located in such position as to permit the Mechanical Official to conveniently make the required entries thereon. This permit card shall be maintained in such position by the permit holder until the Certificate of Approval is issued by the Mechanical Official.

A103.8.5 Required Inspections. The Mechanical Official upon notification from the permit holder or his agent shall make the following inspections of buildings and such other inspections as may be necessary, and shall either approve that portion of the construction as completed or shall notify the permit holder or his agent of any violations to comply with this Code:

1. Underground Fuel Piping Inspection: To be made after trenches or ditches are excavated, fuel piping installed, and before any backfill is put in place.
2. Rough-In Inspection: To be made after the roof, framing, fire-blocking and bracing are in place and all ducting, and other concealed components are complete, and prior to the installation of wall or ceiling membranes.
3. Final Inspection: To be made after the building is complete, the mechanical system is in place and properly connected, and the structure is ready for occupancy.

A103.8.6 Written Approval. Work shall not be done on any part of the mechanical system beyond the point indicated in each successive inspection without first obtaining the written approval of the Mechanical Official. Such written approval shall be given only after an inspection has been made of each successive step in the construction as indicated by the foregoing inspections.

A103.9 Certificate of Approval

A103.9.1 Rough-In Inspection. Upon the satisfactory completion of the rough-in inspection, approval shall be so noted on the Mechanical Permit Card. This approval shall give the date of the rough-in inspection and the initials of the Mechanical Inspector.

A103.9.2 Final Inspection. Upon the satisfactory completion and final test of the mechanical system, a Certificate of Approval shall be issued by the

Mechanical Official to the permit holder. The building shall not be occupied prior to completion of the work on said system and issuance of the Certificate of Approval.

A103.9.3 Temporary Approval. A temporary certificate of approval may be issued for a portion or portions of a mechanical system which may safely be operated prior to final completion of the mechanical system.

A105.4 Board Members And Procedures

A105.4.1 Makeup of the Board. There is hereby established a Board to be called the Board of Adjustments and Appeals, which shall consist of five members. Such Board shall be composed of one architect, one engineer, one member at large from the mechanical industry, one contractor that installs mechanical equipment and one member at large from the public. The said Board shall be appointed by the applicable governing body.

A105.4.2 Terms of Office. Of the members first appointed, two shall be appointed for a term of 1 year, two for a term of 2 years, one for a term of 3 years, and thereafter they shall be appointed for terms of 4 years. Vacancies shall be filled for an unexpired term in the manner in which original appointments are required to be made. Continued absence of any member from regular meetings of the Board shall, at the discretion of the applicable governing body, render any such member liable to immediate removal from office.

A105.4.3 Quorum. Three members of the Board shall constitute a quorum. In varying the application of any provisions of this Code or in modifying an order of the Mechanical Official, affirmative votes of the majority present, but not less than three affirmative votes, shall be required. A Board member shall not act in a case in which he has a personal interest.

A105.4.4 Secretary of Board. The Mechanical Official shall act as Secretary of the Board of Adjustments and Appeals and shall make a detailed record of all its proceedings, which shall set forth the reasons for its decisions, the vote of each member, the absence of a member, and any failure of a member to vote.

A105.4.5 Procedure. The Board shall establish rules and regulations for its own procedure not inconsistent with the provisions of this Code. The Board shall meet at regular intervals, to be determined by the Chairman, or in any event, the Board shall meet within 10 days after notice of appeal has been received. Every decision shall be promptly filed in writing in the office of the Mechanical Official, and shall be open to public inspection, a certified copy shall be sent by mail or otherwise to the appellant and a copy shall be kept publicly posted in the office of the Mechanical Official for 2 weeks after filing.

A105.4.6 Decisions. The Board of Adjustments and Appeals shall, in every case, reach a decision without unreasonable or unnecessary delay. If a decision of the Board of Adjustments and Appeals reverses or modifies a refusal, order, or disallowance of the Mechanical Official, or varies the application of any provision of this Code, the Mechanical Official shall immediately take action in accordance with the decision.

A107 VIOLATIONS AND PENALTIES

Any person, firm, corporation or agent who shall violate a provision of this Code, or fail to comply therewith, or with any of the requirements thereof, or who shall install, construct, alter, repair, replace or move any mechanical system, or has installed, altered, repaired, moved or replaced a mechanical system in violation of a detailed statement or drawing submitted and permitted thereunder, shall be guilty of a misdemeanor. Each such person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this Code is committed or continued, and upon conviction of any such violation such person shall be punished within the limits and as provided by state laws.

APPENDIX B
GUIDELINES FOR ESTIMATING HEAT LOSS AND GAIN

B101 COMPLIANCE

All heat loss and heat gain design criteria shall comply with the Model Energy Code.

B102 GUIDELINES TO ACHIEVE THE DESIGN CRITERIA

The following methods shall apply in estimating heat loss and heat gain in buildings; other equivalent methods may be used providing approval is granted by the Mechanical Official.

1. Residential Occupancy. To estimate heat loss and heat gain in residential occupancy, ACCA Manual J, ASHRAE Handbook of Fundamentals or The Hydronic Institute C-30 and H-21 shall be used.
2. Other than Residential Occupancy. To estimate heat loss and heat gain for other than residential occupancy, ASHRAE Handbook of Fundamentals or ACCA Manual N shall be used.

APPENDIX C
SCHEDULE OF PERMIT FEES

C101 PERMIT FEES

C101.1 Initial Fee

For issuing each permit $10.00

C101.2 Additional Fees

C101.2.1 Fee for inspecting heating, ventilating, ductwork, air-conditioning and refrigeration systems shall be $10.00 for the first $1000.00, or fraction thereof, of valuation of the installation plus $2.00 for each additional $1000.00 or fraction thereof.

C101.2.2 Fee for inspecting repairs, alterations and additions to an existing system shall be $5.00 plus $2.00 for each $1000.00 or fraction thereof.

C101.2.3 Fee for inspecting boilers (based upon Btu input):

33,000 Btu (1 BHp) to 165,000 (5 BHp) .... $ 5.00
165,001 Btu (5 BHp) to 330,000 (10 BHp) 10.00
330,001 Btu (10 BHp) to 1,165,000 (52 BHp) 15.00
1,165,001 Btu (52 BHp) to 3,300,000 (98 BHp) 25.00
over 3,300,000 Btu 35.00

C102 FEE FOR REINSPECTION

In case it becomes necessary to make a reinspection of a heating, ventilation, air conditioning or refrigeration system, or boiler installation, the installer of such equipment shall pay a reinspection fee of $5.00.

C103 TEMPORARY OPERATION INSPECTION FEE

When preliminary inspection is requested for purposes of permitting temporary operation of a heating, ventilating, refrigeration, or air conditioning system, or portion thereof, a fee of $5.00 shall be paid by the contractor requesting such preliminary inspection. If the system is not approved for temporary operation on the first preliminary inspection, the usual reinspection fee shall be charged for each subsequent preliminary inspection for such purpose.

C104 SELF CONTAINED UNITS LESS THAN TWO TONS

In all buildings, except one and two family dwellings, where self-contained air conditioning units of less than two tons are to be installed, the fee charged shall be that for the total cost of all units combined (see C101.2.1 for rate).

INDEX

CONVERSION FACTORS FOR THE MOST COMMON UNITS USED IN BUILDING DESIGN AND CONSTRUCTION

Conversion factors are taken to **six** significant figures, where appropriate. **Underlined** values denote **exact** conversions.

METRIC TO CUSTOMARY				CUSTOMARY TO METRIC	
		LENGTH			
1 km	= 0.621 371	mile (international)	1 mile (international)	= 1.609 344	km
	= 49.7096	chain	1 chain	= 20.1168	m
1 m	= 1.093 61	yd	1 yd	= 9.9144	m
	= 3.280 84	ft	1 ft	= 0.3048	m
1 mm	= 0.039 370 1	in		= 304.8	mm
			1 in	= 25.4	mm
			(1 U.S. survey foot	= 0.304 800 6	m)*
		AREA			
1 km^2	= 0.386 101	$mile^2$ (U.S. survey)	1 $mile^2$ (U.S. survey)	= 2.590 00	km^2
1 ha	= 2.471 04	acre (U.S. survey)	1 acre (U.S. survey)	= 0.404 687	ha
1 m^2	= 1.195 99	yd^2		= 4046.87	m^2
	= 10.7639	ft^2	1 yd^2	= 0.836 127	m^2
1 mm^2	= 0.001 550	in^2	1 ft^2	= 0.092 903	m^2
			1 in^2	= 645.16	mm^2
		VOLUME, MODULUS OF SECTION			
1 m^3	= 0.810 709 x 10^{-3}	acre feet	1 acre ft	= 1233.49	m^3
	= 1.307 95	yd^3	1 yd^3	= 0.764 555	m^3
	= 35.3147	ft^3	100 board ft	= 0.235 974	m^3
	= 423.776	board ft	1 ft^3	= 0.028 316 8	m^3
1 mm^3	= 61.0237 x 10^{-6}	in^3	1 in^3	= 28.3168	L (dm^3)
				= 16 387.1	mm^3
				= 16.3871	mL (cm^3)

METRIC TO CUSTOMARY			CUSTOMARY TO METRIC		
(FLUID) CAPACITY					
1 L	= 0.035 314 7	ft^3	1 gal (U.S. liquid)**	= 3.785 41	L
	= 0.264 172	gal (U.S.)	1 qt. (U.S. liquid)	= 946.353	mL
	= 1.056 69	qt (U.S.)	1 pt (U.S. liquid)	= 473.177	mL
1 mL	= 0.061 023 7	in^3	1 fl oz (U.S.)	= 29.5735	mL
	= 0.033 814	fl oz (U.S.)			
			**1 gallon (UK) approx. 1.2 gal (U.S.)		
SECOND MOMENT OF AREA					
1 mm^4	= 2.402 51 x 10^{-6}	in^4	1 in^4	= 416 231	mm^4
				= 0.416 231 x 10^{-6}	m^4
PLANE ANGLE					
1 rad	= 57° 17′ 45″	(degree)	1° (degree)	= 0.017 453 3	rad
	= 57.2958°	(degree)		= 17.4533	mrad
	= 3437.75′	(minute)	1′ (minute)	= 290.888	urad
	= 206 265″	(second)	1″ (second)	= 4.848 14	urad
VELOCITY, SPEED					
1 m/s	= 3.280 84	ft/s	1 ft/s	= 0.3048	m/s
	= 2.236 94	mile/h	1 mile/h	= 1.609 344	km/h
1 lm/h	= 0.621 371	mile/h		= 0.447 04	m/s
VOLUME RATE OF FLOW					
1 m^3/s	= 35.3147	ft^3/s	1 ft^3/s	= 0.028 316 8	m^3/s
	= 22.8245	million gal/d	1 ft^3/min	= 0.471 947	L/s
	= 0.810 709 x 10^{-3}	acre ft/s	1 gal/min	= 0.063 090 2	L/s
1 L/s	= 2.118 88	ft^3/min	1 gal/h	= 1.051 50	mL/s
	= 15.850 3	gal/min	1 million gal/d	= 43.8126	L/s
	= 951.022	gal/h	1 acre ft/s	= 1233.49	m^3/s

METRIC TO CUSTOMARY			CUSTOMARY TO METRIC		

TEMPERATURE INTERVAL

1 °C	= 1K	= 1.8 °F	1 °F	= 0.555 556	°C or K
				= 5/9 °C	= 5/9 K

EQUIVALENT TEMPERATURE VALUE ($t\,°_c = T_K - 273.15$)

$t°_C$	= $5/9\,(t_F - 32)$		t_F	= $9/5\,t°_c + 32$	

MASS

1 kg	= 2.204 62	lb (avoirdupois)	1 ton (short)***	= 0.907 185	metric ton
	= 35.2740	oz (avoirdupois)		= 907.185	kg
1 metric ton	= 1.102 31	ton (short, 2000 lb.)	1 lb	= 0.453 592	kg
	= 2204.62	lb	1 oz	= 28.3495	g
1 g	= 0.035 274	oz	1 pennyweight	= 1.555 17	g
	= 0.643 015	pennyweight			
			***(1 long ton (2240 lb)	= 1016.05	kg)

MASS PER UNIT AREA

1 kg/m^2	= 0.204 816	lb/ft^2	1 lb/ft^2	= 4.882 43	kg/m^2
1 g/m^2	= 0.029 494	oz/yd^2	1 oz/yd^2	= 33.9057	g/m^2
	= $3.277\,06 \times 10^{-3}$	oz/ft^2	1 oz/ft^2	= 305.152	g/m^2

DENSITY (MASS PER UNIT VOLUME)

1 kg/m^3	= 0.062 428	lb/ft^3	1 lb/ft^3	= 16.0185	kg/m^3
	= 1.685 56	lb/yd^3	1 lb/yd^3	= 0.593 276	kg/m^3
1 t/m^3	= 0.842 778	ton/yd^3	1 ton/yd^3	= 1.186 55	t/m^3

FORCE

1 MN	= 112.404	tonf (ton-force)	1 tonf (ton-force)	= 8.896 44	kN
1 kN	= 0.112 404	tonf	1 kip (1000 lbf)	= 4.448 22	kN
	= 224.809	lbf (pound-force)	1 lbf (pound-force)	= 4.448 22	N
1 N	= 0.224 809	lbf			

METRIC TO CUSTOMARY			CUSTOMARY TO METRIC		

MOMENT OF FORCE, TORQUE

1 Ṅm	= 0.737 562	lbḟft	1 lbḟft	= 1.355 82	Ṅm
	= 8.850 75	lbḟin	1 lbḟin	= 0.112 985	Ṅm
1 kṄm	= 0.368 781	tonḟft	1 tonḟft	= 2.711 64	kṄm
	= 0.737 562	kiṗft	1 kiṗft	= 1.355 82	kṄm

FORCE PER UNIT LENGTH

1 N/m	= 0.068 521 8	lbf/ft	1 lbf/ft	= 14.5939	N/m
1 kN/m	= 0.034 260 9	tonf/ft	1 lbf/in	= 175.127	N/m
			1 tonf/ft	= 29.187 8	kN/m

PRESSURE, STRESS, MODULUS OF ELASTICITY (FORCE PER UNIT AREA) (1 Pa = 1 N/m^2)

1 MPa	= 0.072 518 8	tonf/in^2	1 tonf/in^2	= 13.7895	MPa
	= 10.4427	tonf/ft^2	1 tonf/ft^2	= 95.7605	kPa
	= 145.038	lbf/in^2	1 kip/in^2	= 6.894 76	MPa
1 kPa	= 20.8854	lbf/ft^2	1 lbf/in^2	= 6.894 76	kPa
			1 lbf/ft^2	= 47.8803	Pa

WORK, ENERGY, HEAT (1 J = 1 Ṅm = 1 Ẇs)

1 MJ	= 0.277 778	kWh	1 kWh (550 ḟtlbf/s)	= 3.6	Mj
1 kJ	= 0.947 817	Btu	1 Btu (Int. Table)	= 1.055 06	kJ
1 J	= 0.737 5o2	ḟtlbf		= 1055.06	J
			1 ḟtlbf	= 1.355 82	J

COEFFICIENT OF HEAT TRANSFER

1 W/(m^{2}K)	= 0.176 110	Btu/(ft^{2}h.°F)	1 Btu/(ft^{2}h.°F)	= 5.678 26	W/(m^{2}K)

THERMAL CONDUCTIVITY

1 W/(ṁK)	= 0.577 789	Btu/(ḟtḣ°F)	1 Btu/(ḟtḣ °F)	= 1.730 73	W/(ṁK)

METRIC TO CUSTOMARY			CUSTOMARY TO METRIC		
ILLUMINANCE					
lx (lux)	= 0.092 903	lm/ft^2 (footcandle)	1 lm/ft^2 (footcandle)	= 10.7639	lx (lux)
LUMINANCE					
1 cd/m^2	= 0.092 903	cd/ft^2	1 cd/ft^2	= 10.7639	cd/m^2
	= 0.291 864	foot lambert	1 foot lambert	= 3.426 26	cd/m^2
1 kcd/m^2	= 0.314 159	lambert	1 lambert	= 3.183 01	kcd/m^2

North Carolina State Building Code
Volume III – MECHANICAL

1993 REVISIONS TO THE 1991 EDITION

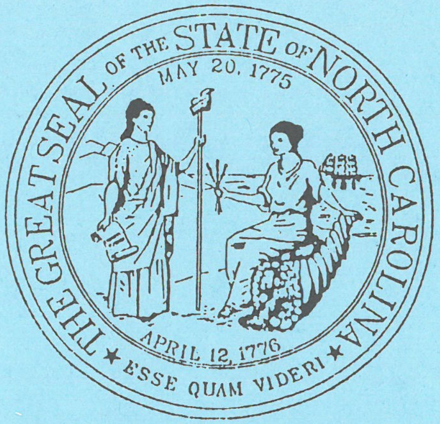
INSTRUCTIONS

Items needed for a complete 1993 North Carolina State Building Code, Volume III – Mechanical.

1. 1991 North Carolina Mechanical Code,
2. 1992 North Carolina Revisions, and
3. 1993 North Carolina Revisions.

To update the 1992 NC Edition with the 1993 Revisions, replace (white & blue) sheets by page number using the 1993 Revision package. Place all blue sheets in the Code, even if the sheet contains only information about sheets to be removed. When this is complete, you have a 1993 NC Edition.

North Carolina
State Building Code
Volume III – MECHANICAL



1993 Revisions
TO THE
1991 EDITION

1988 Standard Mechanical Code with North Carolina Amendments

(Revisions Adopted Through September 15, 1992 Effective January 1, 1993)

**North Carolina Building Code Council
and
North Carolina Department of Insurance
Post Office Box 26387
Raleigh, North Carolina 27611**

REVISION MARKS NOTATIONS

Broken vertical bars in the margin indicate September 1990 Revisions.

Open stars in the margin indicate September 1990 Deletions. ☆

Solid stars in the margin indicate 1991 Deletions. ★

Solid vertical bars in the margin indicate 1991 Edition.

Double bars in the margin indicate: 1992 Revisions.

Triple bars in the margin indicate 1993 Revisions.

INFORMATION SHEET
1993 AMENDMENTS

The 1988 Standard Mechanical Code has been amended by the North Carolina Building Code Council as follows:

1. Standard Mechanical Code changes adopted by the Council:
301.3, 303.3, 303.4, 303.7, 303.8, 306.3, 306.15.7.3, 306.15.7.4, 306.17.3.6, Table 306A, Table 306C, 307.1, 509.1, 509.2, and Chapter 9.

2. Additional changes adopted by the Council:
Chapter 1, 202 Definitions (Boiler Room, Furnace Room, and Mechanical Room), 301.3.2.2, 301.4, 302.2, 303.4, 303.5, 303.6, 304, 307.2, 308.2.4, 308.4.1.1, 308.5.3, 308.6.2, 308.8, 308.9, 504.1.3, 504.1.4, 510.2, 515, 517, 603.4, 607, 801.2, Chapter 9 (NFiPA 72E), and Appendix A and C.

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NORTH CAROLINA STATE
BUILDING CODE PUBLICATIONS

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Volume I–GENERAL CONSTRUCTION CODE

Volume IA–ADMINISTRATION & ENFORCEMENT REQUIREMENTS

Volume IC–ACCESSIBILITY CODE

Volume II–PLUMBING CODE

Volume IV–ELECTRICAL CODE

Volume V–FIRE PREVENTION CODE

Volume VI–GAS CODE

Volume VII–RESIDENTIAL CODE

Volume VIII–MODULAR CONSTRUCTION REQUIREMENTS

CHAPTER 3
AIR CONDITIONING, HEATING AND VENTILATION EQUIPMENT

301 GENERAL

301.1 Scope

This chapter is intended to insure the safe design, construction, installation, and repair of equipment used in systems pertaining to air conditioning (space cooling), heating, and ventilation.

301.2 Approval

All listed equipment shall be installed in accordance with its listing and the equipment shall be labeled accordingly, including the seal or mark of the testing agency which certifies the listing. All unlisted equipment shall be installed in accordance with this Code. Equipment installed outside shall be supported on pre-cast or poured concrete, masonry units, approved prefabricated inorganic materials, structural steel or pressure treated wood.

301.3 Structural Safety

301.3.1 General In the process of installing or repairing any air conditioning, heating, and ventilation equipment, the finished floors, walls, ceilings, tile work or any other part of the building or premises which must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the Standard Building Code.

301.3.2 Cutting, Notching And Bored Holes

301.3.2.1 Notches on the ends of joists shall not exceed one-fourth the depth. Holes bored for pipes or cable shall not be within 2 inches of the top or bottom of the joist and the diameter of any such hole shall not exceed one-third of the depth of the joist. Notches for pipes in the top or bottom of joists shall not exceed one-sixth of the depth and shall not be located in the middle one-third of the span.

301.3.2.2 In exterior walls and bearing partitions, any wood stud may be cut or notched to a depth not exceeding 25% of its width. Cutting or notching of studs to a depth not greater than 40% of the width of the stud is permitted in nonbearing partitions supporting no loads other than the weight of the partition.

EXCEPTION: Cutting and notching of studs may be increased to 65% of the width of the stud in exterior or interior walls and bearing partitions, provided that one of the following conditions is met:

1. The wall section is reinforced with 1/2" exterior grade plywood or equivalent reinforcement on the notched side of the wall. Plywood if used, shall reach from the floor to ceiling and at least one stud further on each side of the section that has been notched or cut.

2. The exterior walls of a kitchen may be reinforced by placing 1/2" plywood or equivalent reinforcement on the notched side of the wall. Plywood, if used, shall reach from the floor to counter-top height and at least one stud further on each side of the section that has been notched or cut.

301.3.2.3 A hole not greater in diameter than 40% of the stud width may be bored in any wood stud. Bored holes not greater than 60% of the width of the stud are permitted in nonbearing partition or in any wall where each bored stud is doubled provided no more than two such successive double studs are bored.

301.3.2.4 In no case shall the edge of the bored hole be nearer than 5/8 inch to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

301.4 Firestopping

All openings around pipes, tubing, wiring, conduit, etc., shall be firestopped in accordance with Chapter 10 of Volume I.

302 AIR CONDITIONING EQUIPMENT

302.1 Scope

This section covers the location, installation, alteration, replacement, repair and maintenance of air conditioning equipment. The requirements of 303.2, 303.3, 303.4, 303.5 and 303.6 of this Code shall apply to air conditioning equipment.

302.2 Labeling

302.2.1 Listing of Heating and Air Conditioning Equipment Heating and air conditioning equipment (electric, gas and oil) shall be listed by a nationally recognized testing agency and shall be installed in accordance with its listing. When test standards are not available, or when sufficient different makes of listed equipment are not reasonably available locally [three or more manufacturers], equipment constructed in accordance with applicable NEC, ASME, ARI or ANSI standards using listed component parts such as burners, heaters, safety controls, wiring and safety valves and installed in strict compliance with the manufacturer's recommendations will be acceptable. Equipment accepted and certified by FM and FIA are also acceptable.

Other equipment used in environmental comfort control systems such as humidifiers, air handling fans and power roof ventilators and fan coil units, shall be either listed or shall have motors which comply with NEMA standards, wiring complying with the National Electric Code and shall be used only for service recommended by the manufacturer.

302.2.2 Listing of appliances other than Heating & Air Conditioning & Ventilating Equipment (Such as dryers, ranges, gas logs, and similar devices). These types of appliances shall be listed by a national recognized testing agency and installed according to the listing. The authority having jurisdiction shall accept without further examination and test the listings of UL or AGA.

TABLE 303.8 (Continued)
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

COMMERCIAL-INDUSTRIAL TYPE LOW HEAT APPLIANCES Any and All Physical Sizes Except as Noted		APPLIANCES				
		Above Top of Casing or Appliance See Note 8	From Top and Sides of Warm-Air Bonnet or Plenum	From Front	From Back See Note 8	From Sides See Note 8
Boilers and Water Heaters						
100 cu ft or less Any psi Steam	All Fuels	18	–	48	18	18
50 psi or Less Any size	All Fuels	18	–	48	18	18
Infra-red Heaters (See also "Hazardous Locations" Section 302.b)		18	–	60	18	18
Unit Heaters						
Floor Mounted or Suspended-Any Size	Steam or Hot Water	1	–	1	1	
Suspended–100 cu ft or less	Oil or Comb. Gas–Oil	6	–	24	18	18
Suspended–100 cu ft or less	Gas	6	–	18	18	18
Floor Mounted–Any Size	All Fuels	18	–	48	18	18
Ranges–Restaurant Type						
Floor Mounted	All Fuels	48	–	48	18	18
Other Low-Heat Industrial Appliances						
Floor Mounted or Suspended	All Fuels	18	18	48	18	18

TABLE 303.8 (Continued)
STANDARD INSTALLATION CLEARANCES (in) FOR HEAT PRODUCING APPLIANCES[1]

COMMERCIAL-INDUSTRIAL TYPE MEDIUM HEAT APPLIANCES		APPLIANCES: Above Top of Casing or Appliance See Note 9	APPLIANCES: From Top and Sides of Warm-Air Bonnet or Plenum	APPLIANCES: From Front	APPLIANCES: From Back See Note 9	APPLIANCES: From Sides See Note 9
Boilers and Water Heaters						
Over 50 psi						
Over 100 cu ft	All Fuels	48	–	96	36	36
Other Med-Heat Industrial Appliances						
All Sizes	All Fuels	48	36	96	36	36
Incinerators						
All Sizes	–	48	–	96	36	36
INDUSTRIAL TYPE HIGH-HEAT APPLIANCES						
High-Heat Industrial Appliances						
All Sizes	All Fuels	180	—	360	120	120

1. Standard clearances may be reduced by providing protection to combustible material in accordance with Table 303.9.
2. An appliance may be installed on a combustible floor when conforming to 303.7.
3. Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 ft the volume of a room shall be computed on the basis of a ceiling height of 8 ft.
4. The minimum dimension shall be that required for servicing the appliance including access for cleaning and normal care, tube removal, etc.
5. For a listed oil, combination gas-oil, gas, or electric furnace this dimension may be 2 inches if the furnace limit control cannot be set higher than 250°F or this dimension may be 1 inch if the limit control cannot be set higher than 200°F.

*Except for the protection described in (e), all clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material.

† Spaces shall be of noncombustible material.

NOTES:

1. Asbestos millboard referred to above is a different material from asbestos cement board. It is not intended that asbestos cement board be used in complying with these requirements when asbestos millboard is specified.
2. The clearance from specified forms of protection shall be such as not to interfere with the requirements for accessibility in 303.2.1.
3. Where the required clearance with no protection is less than 6 inches, the required clearance for approved gas appliances may be reduced 1 inch per inch thickness of fiberglass 0.75 lb density added to protect combustible material. The insulation may be applied to the duct plenum, or combustible material to be protected.

303.10 Fuel Piping & Connections

303.10.1 Each appliance shall be designed for use with the type of fuel to which it will be connected. Such appliance shall not be converted from the fuel specified on the rating plate for use with a different fuel without securing reapproval from the Mechanical Official.

303.10.2 The tank, piping valves for appliances burning oil shall be installed in accordance with the requirements of Chapter 6 of this Code.

When 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 anti-siphon valve or other siphon breaking device shall be installed in lieu of the shutoff valve.

303.10.3 All appliances designed to burn gas shall be connected to the gas supply outlet in accordance with the Standard Gas Code.

303.11 Electric Heating Equipment

303.11.1 Electric duct heaters shall be listed and bear the seal or mark of an approved testing agency and be equipped with an approved automatic reset air outlet temperature limit control that will limit the outlet air temperature to not more than 200°F. The electric elements of the heater shall be equipped with fusible links or a manual reset temperature limit control that will prevent outlet air temperature in excess of 250°F.

303.11.2 Every electric comfort heating appliance shall bear a permanent and legible factory applied nameplate on which shall appear the following:

1. Name and trademark of the manufacturer.
2. The catalog (model) number or equivalent.
3. The electric rating in volts, ampacity and phase.
4. Btu output rating.
5. Individual marking for each electrical component in amperes or watts, volts and phase.
6. Required clearances from combustibles.
7. A seal indicating approval of the appliance by an approved testing agency.

303.11.3 Every electric comfort heating appliance shall be connected in accordance with Chapter 8 of this Code.

303.12 Panel Heating Systems

303.12.1 Panel heating is a method of radiant space heating in which heat is supplied by large heated areas of room surfaces. The heating element usually consist of warm water piping, warm air ducts, or electrical resistance elements embedded in or located behind ceiling, wall, or floor surfaces.

303.12.2 The installation of panel heating systems shall be designed and installed in strict accordance with the accepted engineering practices and the requirements of this Code.

303.12.3 All piping shall be standard weight steel pipe, type M copper tubing, or polybutylelene plastic pipe or tubing rated at 100 psi at 180°F.

307 VENTILATION SYSTEMS

307.1 Required Systems

A separate and individual system, which shall not be part of any other system, shall be provided for ventilating each room containing any of the following materials; flammable vapors, corrosive vapors, noxious gases, or flammable dusts. For commercial food heat-processing equipment see 308. Any ventilation required involving materials incompatible with each other shall have separate ventilation systems for each of the incompatible materials. Vestibule ventilation for smokeproof enclosures shall be in accordance with the Standard Building Code. The requirements of 303.2, 303.3, 303.4, 303.5 and 303.6 shall apply to ventilation equipment.

307.2 Reserved For Future Use

307.3 Ducts — General

307.3.1 Every duct and plenum used in a ventilation system shall be constructed of approved material and construction as set forth in Chapter 5.

307.3.2 Ducts shall be substantially airtight throughout and have no openings other than those required for proper operation and maintenance of the system.

307.3.3 The type of metal duct bracing, the distance of duct joints on center, the type of duct transverse joint connections, and the type of duct lateral seams, shall comply with Chapter 5.

307.3.4 Every duct shall be securely attached to the building as set forth in Chapter 5. No nails or screws shall be driven through the duct walls into the building construction and ducts shall be supported on noncombustible straps or hangers without penetration of the duct walls.

307.3.5 Every duct or plenum which is a portion of a ventilation system used for exhausting any solid particles shall be constructed so as to permit thorough cleaning of the entire duct system. Any such duct or plenum, having any section or sections inaccessible from the duct entry or discharge, shall be provided with cleanout openings. All cleanout openings shall be equipped with tight-fitting sliding or hinged doors constructed of metal equal or greater in thickness than the ducts. Such doors shall be equipped with a substantial method latching, sufficient to hold the door tightly closed. These doors shall be so designed that they can be opened easily without the use of a tool.

307.4 Motors, Fans and Filters

307.4.1 Motors and fans shall be of sufficient capacity to provide the required air movement as specified in the Standard Building Code. Every motor and fan shall be so installed as to afford access for servicing or maintenance.

307.4.2 Fan motors, except NEMA Class I explosion proof motors, shall not be installed inside the ducts or under hoods in any ventilation system conveying flammable vapors or combustible dusts, nor shall any belt or chain driven apparatus be inside any such duct or under any such hood unless the belt or chain and any pulley connection therewith is entirely enclosed and grounded except motors and receptacles listed for the class, group and division of flammable vapors or combustible dusts as indicated in Article 500, NFiPA 70.

307.4.2.1 Every fan blade located in any duct shall be of rigid noncombustible construction. In any ventilation system conveying flammable vapors or combustible dust, the fan blade, shaft and casing shall be of a nonsparking material. Bearings for fans shall be self-lubricating or shall be lubricated from outside the duct.

307.4.3 Air filters, other than grease hood filters regulated by 308, shall be of a type that, in a clean state, will not burn freely. Liquid adhesive coatings used on filters shall have a flash point of 350°F, Cleveland open cup tester, or higher. Filters qualifying as Class I or Class 2 shall be accepted as meeting these requirements. Evaporative coolers containing a combustible evaporation medium, such as excelsior, shall not be used.

307.4.4 Rotary fans without fan blade protection shall provide for not less than 8 ft of clearance from the finished floor level to the bottom side of the unprotected fan blades.

EXCEPTION: Fan blades of low speed residential type ceiling fans installed within dwelling units shall be located at least 6 ft 8 inches from the finished floor.

307.5 Safety Devices

Whenever a fire damper is installed it shall be installed and constructed to comply with Chapter 5. Ducts discharging combustible material directly into any combustion chamber shall conform to the requirements of NFiPA 82.

307.6 Dry Cleaning Plants

Type I and Type II Systems. The ventilation system shall provide a complete and continuous air change at least once every 3 minutes in dry cleaning and dry dyeing rooms. The system shall be provided with means for remote control and shall operate automatically when any dry cleaning or dry dyeing equipment is in use.

308 EXHAUST SYSTEMS

308.1 Systems Required

308.1.1 Exhaust system shall be provided, maintained and operated for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders, and any other equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas, or smoke, in such quantities as to be irritating or injurious to health or safety, and shall mechanically discharge such exhaust to the outdoor atmosphere. The total outdoor air supplied shall be equal in volume to that removed.

308.1.2 All equipment and system service rooms, which house sources of

308.6 Hoods

308.6.1 An exhaust hood shall be installed for all commercial, industrial, institutional and other food heat-processing equipment producing smoke or grease-laden air.

EXCEPTION: Domestic equipment installed within a dwelling unit.

308.6.2 The hood shall be designed with a sufficient air volume to properly exhaust all grease and smoke vapor produced by the equipment which it serves. Unless the hood is designed and certified by a licensed architect or professional engineer or is an approved prefabricated hood tested and certified by the manufacturer the following requirements shall be met:

1. Canopy-type hoods shall be at least 2 ft deep from bottom edge to top edge of hood and shall overhang the equipment they serve at least 6 inches on all open sides.
2. The bottom edge of a canopy-type hood shall be a maximum of 7 ft above the floor.
3. Canopy hoods open on all sides shall have a minimum exhaust capacity of 150 cfm per square foot of hood area.
4. Canopy-type hoods open on three or less sides shall have a minimum exhaust capacity of 100 cfm per sq ft of hood area.
5. Backshelf-type hoods having an intake within 3 ft of vapor producing surface shall have a minimum exhaust capacity of 300 cfm per linear foot of cooking surface within a maximum distance of 1 ft from the face of the hood to the front edge of the equipment they are serving.
6. Provisions shall be made to admit air to the room where the hood is located at a rate not less than that which is exhausted by the hood. The make-up air restrictions of Section 3202.5.2 of Volume I do not apply to non-canopy type backshelf kitchen exhaust hoods.

308.6.3 All hoods shall be constructed and installed in accordance with the following:

1. Hoods shall be constructed of and supported by steel 0.0478-inch (18 ga) minimum thickness or stainless steel 0.0359-inch (20 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official.
2. Hoods shall be securely supported by noncombustible supports.
3. All seams and joints shall be made liquid-tight with a continuous external weld.
4. Hoods shall be so designed and installed to provide for thorough cleaning of the entire hood.
5. When grease troughs or gutters are provided, they shall drain to a collecting receptacle designed, fabricated and installed to be readily accessible for cleaning.

308.6.4 Every portion of the hood shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the hood side.

308.6.5 Each hood shall be equipped with a properly sized grease removal device of one of the following types:

1. Grease extractors specifically listed for this service and installed in accordance with the terms of its listing.
2. Grease filters or other grease removal devices specifically listed for use with commercial cooking equipment installed with the height of the lowest edge of the grease filter or other removal device located above the cooking or heating surface not less than the distances shown in Table 308.

308.6.6 Filters shall be tight fitting and firmly held in place, yet be easily accessible and removable without special tools. They shall be installed at a minimum angle of 45° from the horizontal. A drip tray designed and located to collect the grease from the filters and drain to an enclosed noncombustible container shall be provided beneath the lower edge of the filters. The container shall have a maximum capacity of 1 gallon unless otherwise approved by the Mechanical Official.

308.7 Fire Extinguishing Equipment

308.7.1 Duct systems, grease removal devices and exhaust hoods serving food heat processing equipment producing smoke or grease-laden air shall be protected by both an automatic fire extinguishing system and a portable extinguisher in accordance with this section. When listed grease extractors complying with 308.6.5(1) are provided for all cooking equipment, the duct fire extinguishing equipment may be omitted when approved by the Mechanical Official. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment protected by an extinguishing system or located under ventilating equipment protected by an extinguishing system.

TABLE 308
MINIMUM DISTANCE BETWEEN LOWEST EDGE OF GREASE FILTER AND COOKING OR HEATING SURFACE

	Duct System and Hood With Fire-Extinguishing System[1] (ft)
No Exposed Flame: Grills, French Fryers, etc.	1.5
Exposed Flame and Burners	2
Exposed Charcoal and Charbroil Type Fires	4

1. Fire-extinguishing system shall be of an approved type.

308.7.2 Alkaline dry chemical-type portable fire extinguishers shall be installed in the kitchen area for the protection of the cooking equipment. Extinguishers shall have a minimum rating of 40B (sodium bicarbonate or potassium bicarbonate base) and shall be conspicuously located and readily accessible along exit paths from the area. The extinguishers shall be a minimum of 10 ft and maximum of 20 ft from the cooking equipment. The top of the extinguishers shall be a maximum of 5 ft above the floor and shall be protected from physical damage.

308.7.3 Automatic systems shall be listed specifically for this type service and shall be installed in accordance with the terms of their listing. At least one manual control for activation shall be located a minimum of 10 ft and a maximum of 20 ft from the cooking equipment unless an alternate location is specifically approved by the Mechanical Official. The following types of extinguishing systems may be provided when installed in accordance with the provisions of the following applicable standards when approved by the Mechanical Official.

1. Carbon Dioxide Extinguishing System, NFiPA 12.
2. Installation of Sprinkler Systems, NFiPA 13.
3. Installation of Foam-Water Sprinkler Systems and Foam-Water Spray Systems, NFiPA 16.
4. Dry Chemical Extinguishing Systems, NFiPA 17.
5. Wet Chemical Extinguishing Systems, NFiPA 17A.
6. Fixed pipe extinguishing equipment conforming to the requirements of NFiPA 96.

308.7.4 Fat fryers, ranges, griddles, broilers, and similar cooking equipment which may be a source of ignition of grease in the exhaust system shall also be protected by approved fire extinguishing equipment.

308.7.5 Fire extinguishing equipment designed for manual operation shall have instructions posted conspicuously in the kitchen or cooking area.

308.8 Residential Range Hoods and Range Clearance

308.8.1 Residential range hoods when installed shall be vented to the outside by a Type B labeled vent or single wall pipe having a clearance of 1 inch from combustible material. Vents serving range hoods shall not terminate in an attic crawl space or any area inside the building. Listed unvented range hoods may be used when installed in accordance with the terms of their listing.

308.8.2 The vertical clearance above the cooking top of a range shall be 30 inches to combustible materials or metal cabinets except the clearance may be reduced to not less than 24 inches as follows:

1. The underside of the combustible material or metal cabinet above the cooking top is protected with not less than 1/4 inch insulating millboard covered with sheet metal not less than 0.0122 inch, or
2. A metal ventilating hood of sheet metal not less than 0.0122 inch is installed above the cooking top with a clearance of not less than 1/4 inch between the hood and the underside of the combustible material or metal cabinet, and the hood is at least as wide as the appliance is and is centered over the appliance.

308.9 Clothes Dryers

308.9.1 Dryers shall be exhausted to the outside.

308.9.2 The minimum size of a dryer exhaust shall be 4 inches in diameter.

308.9.3 Dryer exhaust ducts located within a fire rated wall, partition, floor or roof assembly shall be minimum 30 gauge galvanized steel or other non-combustible material.

CHAPTER 4
REFRIGERATION

401 SCOPE AND PURPOSE

401.1 The purpose of this chapter is to promote the safe design, construction, installation, and operation of mechanical refrigerating systems.

401.2 This chapter applies to mechanical refrigerating systems and heat pumps and to parts replaced and components added to existing systems.

401.3 This code does not apply where water is the primary refrigerant.

401.4 Equipment listed by an approved, nationally recognized testing laboratory is deemed to meet the design, manufacturing, and factory testing requirements section of this code for the refrigerant or refrigerants for which the equipment was designed.

402 REFRIGERATING SYSTEM CLASSIFICATION

402.1 Refrigerating systems are defined by the method employed for extracting or delivering heat as follows:

402.1.1 A direct system is one in which the evaporator or condenser of the refrigerating system is in direct contact with the air or other substances to be cooled or heated.

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

402.1.2.1 An indirect open spray system is one in which a secondary coolant is in direct contact with the air or other substance to be cooled or heated.

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

402.1.2.3 An indirect closed system is one in which a secondary coolant passes through a closed circuit in the air or other substance to be cooled or heated.

402.1.2.4 An indirect vented closed system is one in which a secondary coolant passes through a closed circuit in the air or other substance to be cooled or heated, but the evaporator or condenser is placed in an open or appropriately vented tank.

402.2 Refrigerating System Classification

The refrigerating system shall be classified according to the degree of probability that a leakage or refrigerant could enter an occupancy classified area as follows:

402.2.1 High-Probability System. Any system in which the basic design, or the location of components, is such that a leakage of refrigerant from a failed connection, seal, or component could enter the normally occupied area.

High-probability systems include: any direct system, or indirect open spray system, or any arrangement in which refrigerant containing parts in the refrigerant circuit are located in such a way that refrigerant leakage could enter the normally occupied area.

402.2.2 Low-Probability System. Any system that cannot be considered as a high-probability system. This class includes indirect closed and double indirect but only on condition that all joints and connections in the refrigerant circuit are effectively isolated from the normally occupied area.

403 REFRIGERANT CLASSIFICATION

403.1 Refrigerants are classified into safety groups illustrated in the following matrix:

Highly[1] Flammable	Group A3	Group B3
Moderately[2] Flammable	Group A2	Group B2
No Flame Propagation	Group A1	Group B1
	Low Toxicity[1]	Higher Toxicity[1]

[1] Highly flammable refrigerants have a lower flammable limit (LFL) of less than or equal to 0.00625 lb/ft^3 (0.10Kg/m^3) or a heat of combustion of greater than or equal to 8174 Btu/lb (19,000 KJ/kg).

[2] Moderately flammable refrigerants have a lower flammable limit (LFL) or more than 0.00625 lb/ft^3 (0.10kg/m^3) and a heat of combustion of less than 8174 Btu/lb (19, 000 KJ/kg).

"Low toxicity" is defined as a TLV-TWA level (or toxicity measure consistent therewith) of 400 ppm or greater: "higher toxicity" is defined as a level of less than 400 ppm.

403.2 For the purposes of this code, refrigerants are divided into groups as shown in Table 4-1

TABLE 4-1
REFRIGERANTS AND AMOUNTS[c]

Refrigerant	Name	Chemical Formula	Quantity of Refrigerant per Room Volume: Lb/ 1000 $ft^{3,a}$	Vol. %	g/m^3
Group A1					
R-11	Trichlorefluoromethane	CCl_3F	1.6	0.4	250.
R-12	Dichlorodifluoromathane	$CC!_2F_2$	1.2	4.0	200.
R-13	Chlorotrifluoromethane	$CClF_3$	31	12	500.
R-1381	Bromotrifluoromathane	CBF_3	22	5.7	350.
R-14	Tetrafluoromathane (Carbon tetrafluoride)	CF_4	25	11	400.
R-22	Chlorodifluoromathane	$CHClF_2$	9.4	4.2	150.
R-113	Trichlorotrifluoroathane	CCl_2FCClF_2	1.9	0.4	300.
R-114	Dichloretetrafluoroethane	$CClF_2CClF_2$	9.4	2.1	150.
R-115	Chloropantafluoroethane	$CClF_2CF_2$	38	9.4	600.
R-134a[b]	1,1,1,2-Tetrafluoroethane	CH2FCF3	16	6.0	250.
R-C318	Oatefluorocyolobutane	C_4F_8	50	9.7	800.
R-400	R-12 and R-114	$CCl_2F_2/C_2Cl_2F_4$	d	d	d
R-500	R-12/152a (73.8/26.2)	CCl_2F_2/CH_3CHF_2	16	4.7	250.
R-502	R-22/115 (48.8/51.2)	$CHClF_2/CClF_2CF_3$	19	6.5	300.
R-503	R-23/13 (40.1/59.9)	$CHF_3/CClF_3$	25	11	400.
R-744	Carbon Dioxide	CO_2	5.7	5.0	900.
Group A2					
R-142b	1-Chloro- 1,1,-Difluoroethane	CH_2CClF_2	3.7	1.4	60.
R-152a	1, 1-Difluoroethane	CH_3CHF_2	1.2	0.7	20.
Group A3					
R-170	Ethane	C_3H_6	0.5	0.64	8.
R-290	Propane	C_3H_8	0.5	0.44	8.
R-500	Butane	C_4H_{10}	0.5	0.34	8.
R-600a	2-Mathyl propane (isobutane)	$CH\ (CH_3)_3$	0.5	0.34	8.
R-1150	Ethene (Ethylene)	C_2H_4	0.4	0.52	6.
R-1270	Propene (Propylene)	C_3H_6	0.4	0.34	6.
Group B1					
R-123[b]	2, 2-Diohlere-1,1,1-Trifluorethane	$CHCl_2CF_3$	0.004	0.001	0.06
R-764	Sulfur Dioxide	SO_2	0.016	0.01	0.26
Group B2					
R-40	Chlorenethane (Methyl Chloride)	CH_3Cl	1.3	1.0	21.
R-611	Methyl Fernate	$HCOOCH_3$	0.78	0.5	12.
R-717	Ammonia	NH_3	0.022	0.05	.35

[a] To correct for height, H(ft), above sea level, multiply these values by $(1 -2.42 \times 10^{-6}H)$. To correct for height, h(km), above sea level, multiply these values by $(1 -7.94 \times 10^{-2}h)$.
[b]Toxicity classification is based on recommended exposure limits provided by chemical suppliers. This rating is provisional and will be reviewed when toxicological testing is completed.
[c] The basis of the table amounts is given as follows:

Group A1 - 80% of the cardiac sensitization level for R-11, R-12, R-13B1, R-22, R-113, R-114, R-134a, R-500, and R-502. 100% of the IDLH (21 for R-744. Others are limited by levels where oxygen deprivation begins to occur.

Group A2, A3 Approximately 20% of LFL.

Group B1 - 100% of IDLH for R-764, and 100% of the measure consistent with the TLV for R-123.

Group B2, B3-100% of IDLH or 20% of LFL, whichever is lower.

[d]The quantity of each component shall comply with the limits set in Table 4-1 for the pure compound, and the total volume % of all components shall not exceed 12 volume %.

404 REQUIREMENTS FOR REFRIGERANT USE

404.1 System Selection

Refrigerating systems shall be applied in accordance with Table 4-2 and the requirements of Section 404.2, 404.3, and 404.4. To use Table 4-2, determine the occupancy class per Section 404 of the Standard Building Code, refrigerant group per Table 4-1, and type of system per Section 403, then locate the rules that apply. When more than one rule exists, each is a limitation on the other.

TABLE 4-2
SYSTEM APPLICATION REQUIREMENTS

Refrigerant Group	System Probability	Occupancy		
		Institutional	Public Assm., Residential Commerical	Industrial
A1	High	1	2	3
	Low	4	4	4
A2	High	5	5	3,6,8
	Low	7	7	7
A3	High	9	9	3,6,8
	Low	9	9	7
B1	High	1,6	2,6	3,6
	Low	4	4	4
B2	High	5,6	5,6	3,6,8
	Low	7	7	7
B3	High	9	9	3,6,8
	Low	9	9	7

404.2 General Restrictions - Occupancies Other Than Industrial

404.2.1 Stairways and Exitways. No portion of a refrigerating system shall be installed in or on an exit stairway, landing, entrance, or exit.

404.2.2 Hallways and Lobbies. No portion of a refrigerating system shall interfere with free passage through exits or exit access corridors, and a refrigerating system installed in a hallway or lobby shall be limited to:

(1) unit systems containing not more than the quantities of Group A1 refrigerants specified in Table 4-1 or

(2) sealed absorption systems as specified in Table 4-3.

404.2.3 Unventilated Space. When the refrigerant containing parts of a system are located in one or more unventilated spaces, the volume of the smallest, enclosed, occupied space, other than a machinery room, shall be used to determine the permissible quantity of refrigerant in the system.

404.2.4 Ventilated Space. When an evaporator or condenser is located in an air duct system, the volume of the smallest occupied space or unpartitioned building story, served by the duct will determine the permissible quantity of refrigerant in the system.

EXCEPTION: if air flow to any enclosed space cannot be reduced below one-quarter of its maximum, the entire space served by the air duct system may be used to determine the permissible quantity of refrigerant in the system.

404.2.5 Plenums. When the space above a suspended ceiling is continuous and part of the air return system, this space may be included in calculating the volume of the enclosed space.

404.3 General Restrictions - Industrial Occupancy

404.3.1 Safeguards. Means shall be taken to adequately safeguard piping, controls, and other refrigeration equipment to minimize possible accidental damage or rupture by external sources.

404.3.2 Electrical Classification. For the electrical classification of occupied spaces in which piping or other refrigeration equipment for Group A2, A3, B2 or B3 refrigerants is located, refer to Rule 8 in Section 404.

404.4 System Application Requirements

The following rules for system application requirements shall be applied as specified in Table 4-2, based on refrigerant group, system probability, and occupancy.

Blends that may fractionate to change in flammability or toxicity are treated according to their worst case classification. For example, an A1/A2 blend would follow the rules for A2 refrigerants. The amount of blend allowed would correspond to the limit on the quantity of A2 refrigerant in the blend. The total of the blend is limited as in footnote d, Table 4-1.

RULES:

1. The refrigerant amount is limited to 50% of those listed in Table 4-1, except Rule 2 applies in kitchens, laboratories, and mortuaries. If any portion of a refrigerant system containing more than one pound of refrigerant (except R-744) is in a room with a flame sustaining device, this device shall be provided with a hood to exhaust combustion products to the open air. Otherwise Rules 5 and 6 shall be followed.
2. The refrigerant amount is limited as listed in Table 4-1.
3. The refrigerant amount is unlimited when:

   (1) The area is on the ground floor and is separated from the nonrefrigerated areas of the building by tight-fitting doors;

   (2) free escape from the area is unhampered;

   (3) the number of persons in a refrigerated space on any floor above the first floor (ground level or deck level) is equal to or less than one person per 108 ft^2 (10 m^2) of floor area; or, if the number of persons exceeds one per 108 ft^2 (10 m^2), the refrigerated space shall be provided with the required number of doors opening directly into approved buildings exits. Such refrigerated space shall be cut off from the rest of the building by tight construction with tight-fitting doors.

   (4) vapor activated alarms are located in areas where refrigerant vapor from a leak is likely to concentrate so as to provide warning at the following levels: Group A1, below 19.5% volume oxygen; Group A2 and A3, at levels listed in Table 4-1; and Groups B1, B2, and B3 (except ammonia), no higher than their TLV (or toxicity measure consistent therewith).

   Otherwise the rules for commercial occupancy apply.

4. When the quantity of refrigerant in the largest system exceeds Table 4-1 amounts, all refrigerant containing parts, except piping and those parts outside the building, shall be installed in a machinery room per section 411(m).
5. Refrigerant amounts and types of systems are limited as shown in Table 4-3.
6. Applications involving air conditioning for human comfort are not allowed.
7. When the quantity of refrigerant in the largest system exceeds Table 4-1 amounts all refrigerant containing parts, except piping and those parts outside the building, shall be installed in a machinery room per 408.5. Otherwise, Rule 5 applies to the amount of Group A2, A3, B2, or B3 refrigerant in the system.

   When the machinery room is used, the limitations on refrigerant quantities are as follows:

   550 lb (250 kg) — Institutional
   1100 lb (500 kg) — Public Assembly
   No limit except Rule 8 — Residential
   No limit except Rule 8 — Commercial
   No limit except Rule 8 — Industrial
8. When the quantity of refrigerant exceeds Table 4-1 amounts, all refrigerant containing parts except piping, evaporators, condensers, and parts outside the building shall be installed in a machinery room per Section 408.5. In addition, refrigerants of Groups A2, A3, B2, and B3 shall meet the following requirements:

   (1) The special machinery room requirements of Section 408.6 apply.

   (2) Except for ammonia, amounts in excess of 1100 lb (500 kg) shall be approved by the authority having jurisdiction.

   (3) Except for ammonia, when the quantity of refrigerant in any one system exceeds the amounts in Table 4-1 for any room in which part of the system is installed, then no flame producing device or hot surface above 800°F (426.5°C) shall be permitted and such room shall not be considered a Class I, Division 2, location.
9. Use of these refrigerants is prohibited except in laboratories in commercial occupancies. Only unit system containing not more than 6.6 lb (3 kg) of Group A3 or B3 refrigerant shall be used unless the laboratory in commercial occupancies. Only unit system containing not more than 6.6 lb (3 kg) of Group A3 or B3 refrigerant shall be used unless the laboratory is occupied by less than one person per 108 ft^2 (10 m^2) of floor area, in which case the requirements of industrial occupancy shall apply.

TABLE 4-3
MAXIMUM PERMISSIBLE QUANTITIES OF REFRIGERANTS FOR USE WITH RULE 5

Type of Refrigeration System	Maximum Pounds (kg) for Various Occupancies			
	Institutional	Public	Residential	Commercial
Sealed Absorption System				
in public hallways or lobbies	0 (0)	0 (0)	3.3 (1.5)	3.3 (1.5)
in adjacent outdoor locations	0 (0)	0 (0)	22 (10)	22 (10)
in other than public hallways or lobbies	0 (0)	6.6 (3)	6.6 (3)	22 (10)
Unit Systems				
in other than public hallways or lobbies	0 (0)	0 (0)	6.6 (3)	22 (10)

*Table 3 referenced in Table 2, Rule 5.

405 DESIGN AND CONSTRUCTION OF EQUIPMENT SYSTEMS

405.1 Materials

405.1.1 All materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Some refrigerants are corrosive to certain materials when moisture of air, or both, are present. No material shall be used that will deteriorate because of the refrigerant, the oil, or their combination in the presence of air or moisture.

405.1.2 Aluminum, zinc, magnesium, or their alloys shall not be used in contact with methyl chloride. Magnesium alloys shall not be used in contact with any halogenated refrigerants.

405.1.3 Copper and its alloys shall not be used in contact with ammonia except as a component of bronze alloys for bearings or for other nonrefrigerant containing uses.

405.1.4 Aluminum and its alloys are suitable for use in ammonia systems.

405.2 Design Pressure

405.2.1 Design pressure shall not be less than the pressure arising under all operating, shipping, and standby conditions. When selecting the design pressure, suitable allowance shall be provided for setting pressure limiting devices and pressure relief devices to avoid nuisance shutdowns and loss of refrigerant at maximum operating conditions. Minimum design pressure shall not be less than 15 psig (103.4 kPa gage) and, except as noted in 405.2.2, 405.2.3 and 405.2.4, shall not be less than 97% of the saturation pressure (gage) corresponding to the following temperatures:

(1) Lowsides of all systems equal to the ASHRAE summer 1% design dry-bulb for the location but not lower than 86°F (30°C).

(2) Highsides of all water-cooled and evaporatively cooled systems 36°F (20°C) higher than the highest water temperature of the ASHRAE summer 1% wet-built for the location, as applicable, but not lower than 104°F (40°C).

(3) Highsides of all air-cooled systems 36°F (20°C) higher than the highest ASHRAE summer 1% design dry-bulb for the location but not lower than 122°F (50°C).

405.2.1.1 The design pressure selected should exceed maximum pressure attained under any anticipated normal operating condition, including conditions created by reasonable fouling of heat exchange surfaces.

405.2.1.2 Standby conditions are intended to include all normal conditions that may be attained in the system when not operating. Selection of the design pressure for lowside component shall also consider pressure developed in the lowside of the system from equalization, or heating due to changes in ambient temperature, after the system has stopped.

405.2.1.3 The design pressure for both lowside and highside components that are shipped as part of a gas or refrigerant charged system shall be selected with consideration of internal pressures arising from exposure to maximum temperatures anticipated during the course of shipment.

405.2.2 The design pressure for either the highside or lowside need not exceed the critical pressure of the refrigerant unless such pressures are anticipated during operating, standby or shipping conditions.

405.2.3 When part of a limited charge system is protected by a pressure relief device, the design pressure of the part need not exceed the setting of the pressure relief device.

405.2.4 When a compressor is used as a booster and discharges into the suction side of another compressor, the booster compressor shall be considered as part of the lowside.

405.2.5 Any components connected to pressure vessels and subject to the same pressure as the pressure vessel shall a design pressure no less than the pressure vessel.

405.3 Refrigerant-Containing Pressure Vessels

405.3.1 6-Inch Inside Diameter or Less

405.3.1.1 Pressure vessels having an inside diameter of 6 in. (152 mm) or less shall be listed either individually or as part of an assembly by an approved, nationally recognized testing laboratory or shall meet the design, fabrication, and testing requirements of Section VIII of the ASME Boiler and Pressure Vessel Code except that such vessels having an internal or external design pressure 15 psi (103.4 kPa gage) or less are exempt from this requirement.

405.3.1.2 If a pressure relief device is used to protect a pressure vessel having an inside diameter of 6 in. (152 mm) or less, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand a pressure at least 2.5 times the pressure setting of the relief device.

405.3.1.3 Fusible plugs shall be suitable protection from overpressure resulting from fire for pressure vessels having an inside diameter of 6 in (152 mm) or less.

405.3.1.4 If a fusible plug is used to protect a pressure vessel having an inside diameter of 6 in. (152 mm) or less, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand a pressure 2.5 times the saturation pressure of the refrigerant used, corresponding to the temperature stamped on the fusible plug, or 2.5 times its critical pressure, whichever is less. (Section 407)

405.3.2 Inside Diameter Greater than 6 inches. Pressure vessels exceeding 6 in. (152 mm) in inside diameter having internal or external design pressure greater than 15 psig (103.4 kPa gage) shall comply with the rules of Section VIII of the ASME Boiler and Pressure Vessel Code[9] covering the requirements for design, fabrication, inspection, and testing during construction of unfired pressure vessels.

405.3.3 Pressure Vessels for 15 psi or Less. Pressure vessels having an internal or external design pressure 15 psig (103.4 kPa gage) or less shall have an ultimate strength to withstand at least 3.0 times the design pressure and shall be tested with a pressure no less than 1.33 times their design pressure.

405.4 Refrigerant Piping, Valves, Fittings and Related Parts

405.4.1 All Refrigerants

405.4.1.1 Refrigerating piping, valves, fittings, and related parts having maximum internal or external design pressure greater than 15 psig (103.4 kPa gage) shall be listed either individually or as a part of an assembly or a system by an approved, nationally recognized laboratory or shall comply with the ANSI Code for Refrigeration Piping B31.5 where applicable.

405.4.1.2 The following minimum requirements apply for unprotected refrigerant containing pipe or tubing:

(1) Copper wafer tube used for refrigerant piping shall conform to ASTM Specification B88 Types K or L.

(2) Annealed copper tube used for refrigerant piping shall conform to ASTM Specification B280.

(3) Copper tube may be connected by brazed joints or by soldered joints. (For Groups A2, A3, B2 and B3, refrigerants.)

405.4.2 All Refrigerants Except Group A1 and Ammonia

405.4.2.1 Rigid flexible metal enclosures shall be provided for annealed copper tube erected on the premises except that no enclosures shall be required for connections between a condensing unit and the nearest protected riser, provided such connections do not exceed 6 ft (1.83 m) in length.

405.4.2.2 Joints on refrigerant-containing copper tube that are made by the addition of filler metal shall be brazed.

405.5 Components Other than Pressure Vessels and Piping

405.5.1 Every pressure containing component of a refrigerating system, other than pressure vessels, piping, pressure gages, and control mechanisms, shall be listed either individually or as part of a complete refrigerating system or a subassembly by an approved, nationally recognized testing laboratory or shall be designed, constructed, and assembled to have an ultimate strength sufficient to withstand three times the design pressure for which it is rated, except waterside components exempted from the rule of Section VIII of the ASME Boiler and Pressure Vessel Code shall be designed, constructed, and assembled to have an ultimate strength sufficient to withstand 150 psig (103.4 kPa) or two times the design pressure which it is rated, whichever is greater.

405.5.2 Liquid level gage glasses shall have automatically closing shutoff valves, and such glasses shall be protected against damage.

EXCEPTION: Liquid level gage glasses of the bull's eye or reflex type shall be exempt from these requirements

405.5.3 When a pressure gage is permanently installed on the highside of a refrigerating system, its dial shall be graduated to at least 1.2 times the design pressure.

405.5.4 Liquid receivers or parts of a system designed to receive the refrigerant charge during pumpdown shall have sufficient capacity to receive the pumpdown charge without the liquid occupying more than 90% of the volume when the temperature of the refrigerant is 90°F (32°C).

EXCEPTION: Where no shutoff valve is provided between the condenser outlet and receiver inlet, there shall be sufficient capacity to receive the pumpdown charge without the liquid occupying more than 100% of the receiver volume plus 30% of the condenser volume.

405.6 Service Provision

405.6.1 All serviceable components of refrigerating systems shall be safely accessible.

405.6.2 All systems shall have provisions to handle safely the refrigerant charge for service purposes. Properly located stop valves, liquid transfer valves, refrigerant storage tanks and adequate venting for safe disposal may be required for this purpose.

405.6.3 Systems containing more than 6.6 lb (3 kg) of refrigerant (except Group A1), other than systems utilizing nonpositive displacement compressors, shall have stop valves-installed at the following locations:

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

405.6.4 Systems containing more than 100 lb (50 kg) of refrigerant, other than systems using nonpositive displacement compressors, or systems having a pumpout receiver for storage of the refrigerant charge, or self-contained systems, shall have stop valves installed at the following locations:

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

405.6.5 Stop valves used with annealed copper tube or copper water tube of 0.875 in. (22 mm) outside diameter or smaller shall be securely mounted, independent of tubing fastening or support.

405.6.6 Stop valves shall be suitably labelled if the components to and from which the valve regulates flow are not in view at the valve location. Numbers may be used to label the valves, provided a key to the numbers is located within sight of the valves and has letters at least 0.5 in. (12.7 mm) high.

405.6.7 Multistage and other complicated systems shall have a piping diagram in permanent form fixed within a frame and permanently fastened to a wall or partition near the compressor. An independent light source for the diagram shall be provided.

405.7 Factory Tests

405.7.1 Every refrigerant-containing part of every system shall be tested and proved tight by the manufacturer at not less than the design pressure for which it is rated.

405.7.2 Pressure vessels shall be tested in accordance with Section 405.3.

405.7.3 The test pressure applied to the highside of each factory-assembled refrigerating system shall be at least equal to the design pressure of the component in the highside that has the lowest-rated design pressure. The test pressure applied to the lowside of each factory-assembled refrigerating system shall be at least equal to the lowside of each factory-assembled refrigerating system shall be at least equal to the design pressure of the component in the lowside that has the lowest-rated design pressure.

In pressure-testing systems using nonpositive displacement compressors, the entire system shall be considered for test purposes as the lowside pressure.

405.8 Nameplate

Each unit system and each separate condensing unit, compressor, or compressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, nationally registered trademark or tradename, identification number, the design pressure, and the refrigerant for which it is designed. The refrigerant shall be designed according to ANSI/ASHRAE 34, Number Designation and Safety Classification of Refrigerants.

406 PRESSURE-LIMITING DEVICES

406.1 When Required

Pressure-limiting devices shall be provided on all systems operating above atmospheric pressure, except that a pressure-limiting device may be omitted on any factory-sealed system containing less than 22 lb (10 kg) of Group A1 refrigerant that has been listed by an approved, nationally recognized testing laboratory.

406.2 Setting

When required by 409.1, the maximum setting to which a pressure limiting device may readily be set by use of the adjusting means provided shall not exceed the design pressure of the highside of the system that is not protected by a pressure-relief device or 90% of the setting of the pressure relief device installed on the highside of a system, except as provided below. The pressure limiting device shall stop the action of the pressure imposing element at a pressure no higher than the maximum setting.

On systems using nonpositive displacement compressors, the pressure limiting device may be set at the design pressure of the highside of the system provided the pressure relief device is (1) located in the lowside, (2) subject to lowside pressure, and (3) there is a permanent (unvalved) relief path between the highside and the lowside of the system.

406.3 Connection

Pressure limiting devices, when required by 406.1, shall be connected between the pressure imposing element and any stop valve on the discharge side with no intervening stop valves in the line leading to the pressure limiting device.

TABLE 4-4
LENGTH ("L" in Feet) OF DISCHARGE PIPING FOR PRESSURE-RELIEF DEVICES OF VARIOUS DISCHARGE CAPACITIES

Required Discharge Capacity C_r, # Air/Min[c]	Standard wall iron, pipe size in inches[b]						Standard wall pipe, pipe size in inches[b]					
	½	¾	1	1¼	1½	2	½	¾	1	1¼	1½	2
	Relief Valve Setting 150 psig[a]						*Relief Valve Setting 200 psig*[a]					
5	68	276	(d)				115	470	(d)			
10	17	69	231				29	118	394			
15	7	31	102				13	52	175			
20	4	17	58	226			7	29	98			
25	3	11	37	145			5	19	63	248		
30	2	8	26	100	218		3	13	44	172		
40		4	14	57	122		2	7	25	97	210	
50		3	9	36	78	274		5	16	62	134	
60		2	6	25	54	190		3	11	43	93	
70			5	18	40	140		2	8	32	68	238
80			4	14	31	105		2	6	24	52	182
90			3	11	24	84			5	19	41	144
100			2	9	20	68			4	15	33	117
125				6	12	44			2	10	21	75
150				4	9	30				7	15	52
175				3	6	22				5	11	38
200				2	5	17				4	8	29
	Relief Valve Setting 250 psig[a]						*Relief Valve Setting 300 psig*[a]					
5	176		(d)				248		(d)			
10	44	179					62	254				
15	20	80	267				28	114				
20	11	45	150				15	54	212			
25	7	29	96				10	41	136			
30	5	20	67	263			7	28	94			
40	3	11	37	147			4	16	53	208		
50	2	7	24	94	204		3	10	34	134		
60		5	17	66	142		2	7	24	93	200	
70		4	12	48	104			5	17	68	147	
80		3	9	37	80			4	13	52	113	
90		2	7	29	63	220		3	10	41	89	
100		2	6	24	51	178		2	8	33	72	252
125			4	15	33	114		2	5	21	46	162
150			3	11	23	79			4	15	32	112
175			2	8	17	58			3	11	24	82
200			2	6	13	44			2	8	18	63
	Relief Valve Setting 350 psig[a]						*Relief Valve Setting 400 psig*[a]					
5	335		(d)				433		(d)			
10	84	380					108	492				
15	37	169					48	219				
20	21	95	285				27	123	369			
25	13	61	183				17	79	236			
30	9	42	127				12	55	164			
40	5	24	71	281			7	31	92	364		
50	3	15	46	180			4	20	59	233		
60	2	11	32	125	270		3	14	41	162	349	
70	2	8	23	92	198		2	10	30	119	257	
80		6	18	70	152		2	8	23	91	197	
90		5	14	56	120			6	18	72	155	
100		4	11	45	97	339		5	15	58	126	439
125		2	7	29	62	217		3	9	37	81	281
150		2	5	20	43	151		2	7	26	56	195
175			4	15	32	111		2	5	19	41	143
200			3	11	24	85			4	15	31	110

[a] To convert psig to kPa gage, multiply psig by 6.895.
[b] To convert inches to millimetres, multiply inches by 25.4.
[c] To convert # air/min to kg air/sec, multiply # air/min by 7.559×10^{-3}.
[d] To convert feet to meters, multiply feet by 0.3048.

407 PRESSURE-RELIEF PROTECTION

407.1 General Requirements

407.1.1 Every refrigerating system shall be protected by a pressure relief device or some other means designed to safely relieve pressure due to fire or other abnormal conditions.

407.1.2 All pressure vessels shall be protected in accordance with the requirements of the occupancy in which they are located.

407.1.3 A pressure relief device to relieve hydrostatic pressure to another part of the system should be used on the portion of the liquid containing parts of the system that can be isolated from the system during operation or service and that may be subjected to overpressure from hydrostatic expansion of the contained liquid due to temperature rise.

407.1.4 Evaporators located downstream, or upstream within 18 in (460 mm), of a heating coil shall be fitted with a pressure relief device discharging in accordance with this section, except that such a relief valve shall not be required on self-contained or unit systems if the volume of the lowside of the system, which may be shut off by valves, is greater than the specific volume of the refrigerant at critical conditions of temperature and pressure, as determined by the following formula:

$$V_1/[W_1 - (V_2 - V_1)/V_{gt}] \text{ shall be greater than } V_{gc}$$

where:

V_1 = lowside volume, $ft^3 (m^3)$
V_2 = total volume of systems, ft^3
W_1 = total weight of refrigerant in system, lb (kg)
V_{gt} = specific volume of refrigerant vapor at 110°F (43.5°C), ft^3/lb (m^3/kg).
V_{gc} = specific volume at critical temperature and pressure, ft^3/lb (m^3/kg)

407.1.5 All pressure relief devices shall be direct-pressure actuated. Each part of a refrigerating system that can be valved off and that contains one or more pressure vessel having internal diameter greater than 6 in. (152 mm) and containing liquid refrigerant shall be protected by a pressure relief device.

407.1.6 Stop valves shall not be located between the pressure relief device and the part or parts of the system protected thereby, except when parallel relief devices are so arranged that only one can be rendered inoperative at a time for testing or repair purposes.

407.1.7 All pressure-relief devices and fusible plugs shall be connected as nearly as practicable directly to the pressure vessel or other parts of the system protected thereby, above the liquid refrigerant level and installed so that they are readily accessible for inspection and repair and so that they cannot be readily rendered inoperable. Fusible plugs may be located above or below the liquid refrigerant level except on the lowside.

407.1.8 The seats and discs of pressure relief devices shall be constructed of suitable material to resist refrigerant corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used. Seats and discs shall be limited in distortion, by pressure or other cause, to a set pressure change of not more than 5% in a span of five years.

407.2 Setting of Pressure Relief Devices

407.2.1 Pressure Relief Valve Setting. All pressure relief valves shall start to function at a pressure not to exceed the design pressure of the parts of the system protected.

407.2.2 Rupture Member Setting. All rupture members used in lieu of, or in series with, a valve shall have a nominal rated rupture pressure not to exceed the design pressure of the parts of the system protected. The conditions of application shall conform to the requirements of paragraph UG-127 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code. Rupture members installed ahead of relief valves need not be larger, but shall not be smaller, than the relief valve inlet.

407.3 Marking of Relief Devices and Fusible Plugs

407.3.1 All pressure relief valves for refrigerant containing components shall be set and sealed by the manufacturer or an assembler as defined in paragraph UG-136(c)(4) of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code. Each pressure relief valve shall be marked by the manufacturer or assembler with the data required in Paragraph UG-129(a) of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code.

EXCEPTION: relief valves for systems with design pressures of 15 psig (103.4 kPa gage) or less may be marked by the manufacturer with pressure-setting capacity.

407.3.2 Each rupture member for refrigerant pressure vessels shall be marked with the data required in Paragraph UG-129(e) of Section VIII Division 1, of the ASME Boiler and Pressure Vessel Code.

407.4 Pressure Vessel Protection

407.4.1 Pressure vessel shall be provided with pressure relief protection in accordance with rules in Paragraphs UG-125 to UG-136 inclusive, of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code, with such additional modifications as are necessary for control of refrigerants.

407.4.2 Pressure vessels over 3 ft^3 (0.085 $m^{3)}$ internal gross volume, containing liquid refrigerant, except as specified in 407.4.4, which may be shut off by valves from other parts of a refrigerating system shall be protected by a pressure relief device sized per 407.2 to prevent the pressure in the pressure vessel from rising more than 10% above the setting of the pressure relief device.

407.4.2.1 Pressure vessels over 3 ft^3 (0.085 m^3) but less than 10 ft^3 (0.285 m^3) internal gross volume, under conditions specified in 407.4.2, may use a single pressure relief device.

407.4.2.2 Pressure vessels of 10 ft^3 (0.285 m^3) internal gross volume or more, under conditions specified in 407.4.2, using a pressure relief valve shall have a second pressure relief valve, in parallel, as described in 407.1.6. Each pressure relief valve shall have sufficient capacity to prevent the pressure in the pressure vessel from rising more than 10% above the setting of the pressure-relief valve.

Pressure-relief valves discharging into lowside of the system. Under the conditions permitted in 407.4.8.1, except as specified in 407.4.8.6, a single relief (not rupture member) of the required relieving capacity may be used on vessels of 10 ft^3 (0.283 m^3)or more.

407.4.3 Pressure vessels with internal gross volume of 3 ft^3 or less containing liquid refrigerant, except as specified in 404.4.4, which may be shut off by valves from all other parts of a refrigerant system, shall be protected by a pressure relief device or fusible plug. Pressure vessels of less than 3 in (76.1 mm) inside diameter are exempt from the requirements.

407.4.4 Pressure vessels having internal diameter greater than 6 in (152 mm), used as, or part of, an evaporator, insulated or installed in insulated space, which may be shut off by valves from all other parts of a refrigerating system shall be protected by a pressure-relief device except a second parallel pressure relief valve is not required. Pressure vessels used as evaporators, which have internal diameters of 6 in (152 mm) or less, are exempt from pressure-relief device requirements.

407.4.5 The required discharge capacity of the pressure relief device or fusible plug for each pressure vessel shall be determined by the following:

$$C = fDL$$

where:

C = minimum required discharge capacity of the relief device in lb of air per minute (Kg/s)
D = outside diameter of vessel in feet (m)
L = length of vessel in feet (m)
f = factor dependent upon type of refrigerant

Refrigerant	**Value of f**
When used on the lowside of a limited charge cascade system	
R-170, R-744, R-1150	1.0(0.082)
R-13, R-13B1, R-503	2.0(0.163)
R-14	2.5(0.203)
Other Applications	
R-717	0.5(0.041)
R-11, R-40, R-113, R-123, R-142b, R-152a, R-290, R-600, R-600a, R-611, R-764	1.0(0.082)
R-12, R-22, R-114, R-134a, R-C318,	1.6(0.163)
R-500, R-1270	25(0.203)

When pressure relief device or fusible plug is used to protect more than one pressure vessel, the required capacity shall be the sum of the capacities required for each pressure vessel.

407.4.6 The rated discharge capacity of a pressure-relief device expressed in pounds of air per minute (kilograms of air per minute), shall be determined in accordance with paragraph UG-131, Section VIII, Division of the ASME Boiler and Pressure Vessel Code. All pipe and fittings between the pressure relief valve and the parts of the system it protects shall have at least the area of the pressure relief valve inlet.

407.4.7 The rated discharge capacity of a rupture member or fusible plug discharging to atmosphere under critical flow conditions in pounds of air per minute (kg/s) shall be determined by the following formulas:

$C = 0.8P_1d^2$ $(C = 1.36 \times 10^6 P_1 d^2)$

$d = 1.12 (C/P_1)^{0.5}$ $(d = 857.5(C/P_1)^{0.5})$

where:

C = rated discharge capacity in pounds of air per minute (kg/s)

d = smallest of the internal diameter of the inlet pipe, retaining flanges, fusible plug, and rupture member in inches (millimeters)

where:

for rupture members,

P1 = (rated pressure psig kPa gage x 1.10) + 14.7 (101.33)

for fusible plugs,

P_1 = absolute saturation pressure, corresponding to the stamped temperature melting point of the fusible plug, or the critical pressure, of the refrigerant used, whichever is smaller, psia (kPa).

407.4.8 Pressure relief devices and fusible plugs on any system containing a Group A3 or B3 refrigerant, or any system containing more than 6.6 lb (3 kg) of Group A2, B1, or B2 refrigerant, and on any system containing more than 110 lb (50 kg) of Group A1 refrigerant shall discharge to the atmosphere at a location not less than 15 ft (4.57 m) above the adjoining ground level and not less than 20 ft (6.1 m) from any window, ventilation opening, or exit in any building. The discharge termination shall be fashioned in such a manner to prevent direct spray of discharged refrigerant on personnel in the vicinity and foreign material or debris from entering the discharge piping. Discharge piping connected to the discharge side of a fusible plug or rupture member shall have provisions to prevent plugging the pipe in the vent the fusible plug or rupture member functions.

407.4.8.1 Pressure relief valves may discharge into the lowside of the system provided the pressure relief devices are not a type affected by back pressure and provided the lowside of the system is equipped with pressure relief devices. The relief device on the lowside of the system shall have sufficient capacity to protect the pressure vessels that are relieved into the lowside of the system, or to protect all pressure vessels on the lowside of the system whichever relieving capacity is the largest, as computed by the formula in Section 407. Such a lowside pressure relief device shall be set in accordance with 10.2.1 and vented to the outside of the building.

407.4.8.2 Optional Ammonia Discharge. Where ammonia is used, the preferred discharge is to atmosphere. An optional discharge may be used into a tank of water that shall be used for no other purpose except ammonia absorption. At least one gallon of fresh water shall be provided for each pound (1 m^3 for each 120 kg) of ammonia in the system. The water used shall be prevented from freezing without the use of salt or chemicals. The tank shall be substantially constructed of not less than 1/8 in (3.2 mm) or No. 11 U.S. gage iron or steel. No horizontal dimension of the tank shall be greater than one half the height. The tank shall have a hinged cover, or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank near the bottom.

EXCEPTION: An indirect ammonia water absorption unit system installed outdoors adjacent to single-family residence is not required to comply with 407.4.8 provided the discharge is shielded and dispersed.

407.4.8.3 Optional Sulphur Dioxide Discharge. Where sulphur dioxide is used, the discharge may be into a tank of absorptive solution that shall be used for no other purpose except sulphur dioxide absorption. There shall be one gallon of standard dichromate solution (2.5 lb sodium dichromate per gallon of water or 300 kg per m^3 for each pound (1 m^3 for each 120 kg) of sulphur dioxide in the system. Solutions made with caustic soda or soda ash may be used in place of sodium dichromate provided the quantity and strength have the equivalent sulphur dioxide absorbing power. The tank shall be substantially constructed of not less than 1/8 in (3.2 mm) or No. 11 U.S. gage iron or steel. The tank shall have a hinged cover or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure relief valve shall discharge the sulphur dioxide in the center of the tank near the bottom.

407.4.8.4 The size of the discharge pipe from the pressure relief device or fusible plug shall not be less than the outlet size of the pressure relief device or fusible plug. If the discharge from more than one relief device or fusible plug is connected into a common header, the size and maximum equivalent length of the discharge header shall be determine by the sum of the rated discharge capacities of all relief valves discharging into the header, at the lowest pressure setting of any of the relief valves discharging into the header.

407.4.8.5 The maximum length of the discharge piping permitted to be installed on the outlet of a pressure relief device or fusible plug shall be determined as follows:

$$L = P^2 d^5/16C^2 \quad [L = 7 \times 10^{-13} P^2 d^5/36C^2]$$

where:

C = minimum required discharge capacity in pounds of air per minute (kg/s)
d = internal diameter of pipe in inches (mm)
L = length of discharge pipe in feet (m).

For relief valves and ruptures discs:

P = (Rated pressure x 1.1) + 14.7 [101.33].

For fusible plugs:

P = pressure as defined in 407.4.7..

See Table 4-4 for the results of computations using the relief valve formula.

407.4.8.6 Positive Displacement Compressor

When required to be equipped with a stop valve in the discharge connection, every Group A1 refrigerant positive displacement compressor operating above 15 psig (103.4 kPa) and every other refrigerant group having a positive displacement compressor shall be equipped by the manufacturer with a pressure relief device of adequate size and pressure setting to prevent rupture of the compressor or any other component located between the compressor and the stop valve on the discharge side. The pressure relief device shall discharge into the low pressure side of the system or in accordance with 407.4.8.

408 INSTALLATION REQUIREMENTS

408.1 Foundations

Foundations and supports for condensing units or compressor units shall be of substantial and noncombustible construction when more than 6 in (152 mm) high.

408.2 Refrigerant Parts in Air Duct

Joints and all refrigerant containing parts of a refrigerating system located in an air duct carrying conditioned air to and from an occupied space shall be constructed to withstand a temperature of 700°F (353.3°C) without leakage into the airstream.

408.3 Refrigerant Pipe Joint Inspection

Refrigerant pipe joints erected on the premises shall be exposed to view for visual inspection prior to being covered or enclosed.

408.4 Location of Refrigerant Piping

408.4.1 Refrigerant piping crossing an open space that affords passageway in any building shall be not less than 7.25 ft (2.2 m) above the floor.

408.4.2 Exits and exit access corridors shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter, or other shaft containing a moving object or in any shaft that has openings to living quarters or to main exits. Refrigerant piping shall not be placed in exits, lobbies or stairways, except that such refrigerant piping may pass across an exit if there are no joints in the section in the exit and provided nonferrous tubing of 1.12 in. (28.6 mm) outside diameter and smaller be contained in a rigid metal pipe.

408.4.3 Refrigerant piping may be installed vertically through floors from one story to another only as follows:

(1) It may be installed from the basement to the first floor, from the top floor to machinery penthouse or to the roof, or between adjacent floors served by the refrigerating system.

(2) The piping may be carried in an approved, rigid and tight, continuous fire resisting pipe duct or having no openings into floors not served by the refrigerating system, or it may be carried on the outer wall of the building, provided it is not located in an air shaft, closed court, or in similar spaces enclosed with the outer walls of the building. The pipe duct or shaft shall be vented to the outside or to the space served by the system.

(3) Piping of a direct system containing Group A1 refrigerant need not be enclosed where it passes through space served by that system.

408.4.3.1 Piping penetrations must be protected in accordance with Chapter 10 of the Standard Building Code.

408.4.4 Refrigerant piping may be installed horizontally in closed floors or in open joist spaces. Piping installed in concrete floors shall be encased in pipe duct.

408.5 Machinery Room, General Requirements

408.5.1 When a refrigerating system is located indoors, a machinery room shall be provided when required by 404.4. Machinery rooms serve for accommodating refrigerating machinery but may also house other mechanical equipment. A machinery room shall be so dimensioned that all parts are easily accessible with adequate space for proper service, maintenance and operations. There shall be clear head room of not less than 7.25 ft (2.2 m) below equipment situated over passageways. Access to the machinery room shall be restricted to authorized personnel.

408.5.2 Each refrigerating machinery room shall have a tight-fitting door or doors opening outward, self-closing if they open into the building, and adequate in number to ensure freedom for persons to escape in an emergency. There shall be no opening that will permit passage of escaping refrigerant to other parts of the building.

408.5.2.1 For Group A1 refrigerants, machinery rooms shall be equipped with an oxygen sensor to warn of oxygen levels below 19.5 volume percent since there is insufficient odor warning. The sensor shall be located in an area where refrigerant from a leak is likely to concentrate, and shall actuate an alarm.

408.5.2.2 For all other refrigerants, a refrigerant vapor detector shall be located in an area where refrigerant from a leak is likely to concentrate and an alarm shall be employed. The alarm shall be actuated at a value not greater than the corresponding TLV (or toxicity measure consistent therewith).

EXCEPTION: For ammonia refer to 408.6.7.

408.5.2.3 Periodic tests of the detector(s), alarm(s), and the mechanical ventilating system shall be performed.

408.5.3 Machinery rooms shall be vented to the outdoors utilizing ventilation in accordance with paragraphs 408.5.4.

408.5.4 Mechanical ventilation referred to in paragraph 408.5.3 shall be by one or more power driven fans capable of exhausting air from the machinery room at least in the amount given in the formula in paragraph 408.5.7. To obtain a reduced airflow for normal ventilation, multispeed fans may be used. The air inlets shall be near the machinery and suitably guarded. The discharge of the air shall be to the outdoors in such a manner as not to cause inconvenience or danger. Openings for inlet air shall be positioned to avoid intake of discharged air. Provision shall be made for inlet air to replace that being exhausted. Air supply and exhaust ducts to the machinery room shall serve no other area.

408.5.5 No open flame or apparatus to produce an open flame shall be installed in a machinery room where any refrigerant other than carbon dioxide is used. The use of matches, lighters, halide leak detectors, and similar devices shall not be considered a violation of this part.

408.5.6 Access to the machinery room shall be restricted to authorized personnel.

408.5.7 The minimum ventilation required to exhaust a potential accumulation of refrigerant due to leaks or a rupture of the system shall be capable of removing air from the machinery room in the following quantity:

$$Q = 100 \times G^{0.5} \qquad (Q = 70 \times G^{0.5})$$

where:

Q = the airflow in cu ft per minute (liters per second)

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

A sufficient part of the mechanical ventilation shall be operated to provide normal volumes equal to the larger of the following:

(1) 0.5 cfm per sq ft (2.54 L/s per sq meter) of machinery room area.

(2) Volume required to maintain a minimum temperature rise above ambient of 18°F (10°C) based on all of the heat producing machinery in the room.

When a refrigerating system is located outdoors more than 20 ft (6.1 m) from any building opening and is enclosed by a penthouse, lean-to, or other open structure, natural ventilation may be employed as an alternative to mechanical ventilation. The requirements for such natural ventilation are as follows:

The free aperture cross section for the ventilation of the machinery room shall amount to at least:

$$F = G^{0.5} \quad (F = 0.138G^{0.5})$$

where:

F = the free opening area in square feet (square meter)

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

Locations of the opening shall be with due regard for the relative density of the refrigerant to air.

408.6 Machinery Room, Special Requirements

In cases specified in Table 4-2, the machinery room shall meet the following special requirements in addition to those in 408.5

408.6.1 There shall be no flame producing device or hot surface over 800°F (427°C) permanently installed in the room.

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

408.6.3 Walls, floors, and ceiling shall be tight and of not less than one hour fire resistive construction.

408.6.4 It shall have an exit door that opens directly to the outer air or through a vestibule equipped with self-closing, tight-fitting doors.

408.6.5 Exterior openings, if present, shall not be under any fire escape or any open stairway.

408.6.6 All pipes piercing the interior walls, ceiling, or floor of such a room shall be tightly sealed to the walls, ceiling, or floor through which they pass.

408.6.7 Ventilation in ammonia machinery rooms shall be either (1) run continuously or (2) equipped with a vapor detector that will automatically start the ventilating system and actuate an alarm at the lowest practical detection levels not exceeding 4% by volume, or (3) the machinery room shall conform to Class 1, Division 2, of NFiPA 70.

408.6.8 When refrigerants of Groups A2, A3, B2 other than ammonia, and B3 are used, the machinery room shall conform to Class 1, Division 2, of NFiPA 70.

408.6.9 Remote pilot control of the mechanical equipment in the machinery room shall be provided immediately outside the machinery room solely for the purpose of shutting down the equipment in an emergency.

408.7 Purge Discharge

The discharge of purge systems shall be governed by the same rules as pressure relief devices and fusible plugs and may be piped in conjunction with these devices.

409 FIELD TESTS

409.1 General

409.1.1 Every refrigerant-containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms, and systems that are factory tested, shall be tested and proved tight after complete installation and before operation.

The high and low sides of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or lowside of the system, respectively, except as noted in 409.1.2.

409.1.2 Systems erected on the premises using Group A1 refrigerant and with copper tubing not exceeding 0.62 in (16 mm) in outside diameter may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68°F (20°C) minimum.

409.2 Test Medium

Oxygen or any combustible gas or combustible mixture of gases shall not be used within the system for testing.

The means used to build up the test pressure shall have either a pressure limiting device or pressure reducing device with a pressure relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

409.3 Declaration

A dated declaration of test shall be provided for all systems containing 55 lb (25 kg) or more of refrigerant. The declaration shall give the name of the refrigerant and the field test pressure applied to the highside and the lowside of the system. The declaration of test shall be signed by the installer and, if an inspector is present at the tests, he should also sign the declaration. When requested copies of this declaration shall be furnished to the enforcing authority.

410 GENERAL REQUIREMENTS

410.1 Signs

410.1.1 Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds (kg) of refrigerant required in the system for normal operation, and the field pressure applied.

410.1.2 Metal sign for system containing more than 110 lb (50 kg) of refrigerant. System containing more than 110 lb (50 kg) of refrigerant shall be provided with metal signs having letters not less than 0.5 in (12.7 mm) in height designating the main shutoff valves to each vessel, main steam or electrical control, remote control switch, and pressure limiting device. On all exposed high-pressure and low-pressure piping in each room, where installed outside the machinery room, shall be signs, as specified above, with the name of the refrigerant and letter "HP" or "LP".

410.1.3 When the kind of refrigerant is changed as provided in 410.2 (substitution of refrigerant), there shall be a new sign, of the same type as specified in 410.1, indicated clearly that a substitution has been made and stating the same information for the new refrigerant as was stated for the original.

410.2 Changing Refrigerant

A change in the type of refrigerant in a system shall not be made without the permission of the approving authority, the user, and the makers of the original equipment and due observance of safety requirements.

410.3 Charging and Discharging of Refrigerant

When refrigerant is added to a system, except for a unit system requiring less than 6.6 lb (3 kg) of refrigerant, it shall be charged into the low-pressure side of the system. Any point of the downstream side of the main liquid line stop valve shall be considered as part of the low-pressure side when operating with said stop valve in the closed position. No service containers shall be left connected to a system except while charging or withdrawing refrigerant.

410.4 Withdrawing Refrigerant

Refrigerant withdrawn from refrigerating systems shall be transferred to approved containers only. No refrigerant shall be discharged to sewer, river stream, or lake.

410.5 Containers

Containers used for refrigerants withdrawn from a refrigerating system shall be carefully weighed each time they are used for this purpose, and containers shall not be filled in excess of the permissible filling weight for such containers and such refrigerants as are prescribed in the pertinent regulations of the Department of Transportation.

410.6 Storing Refrigerant

Refrigerant stores in a machinery room shall not be more than 330 lb (150 kg) in addition to the charge in the system and the refrigerant stored in a permanently attached receiver and then only in approved storage containers.

410.7 Respirator

At least one approved respirator (self-contained breathing apparatus) shall be provided at a location convenient to the machinery room.

410.8 Maintenance

All refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and shall be kept readily accessible at all times.

410.9 Responsibility for Operation

It shall be the duty of the person in charge of the premises on which a refrigerating system containing more than 55 lb (25 kg) of refrigerant is installed to place a card conspicuously as near as is practicable to the refrigerant compressor giving directions for the operation of the system, including precautions to be observed in case of a breakdown or leak as follows:

1. instructions for shutting down the system in case of emergency,
2. the name, address, and day and night telephone numbers for obtaining service, and
3. the name, address, and telephone number of the municipal inspection department having jurisdiction and instructions to notify said department immediately in cases of emergency.

410.10 Calibration of Pressure Gages

Pressure gages should be checked for accuracy prior to test and immediately after every occasion of unusually high pressure, equal to full-scale reading, either by comparison with master gages or by setting pointers as determined by a dead-weight gage tester.

straps, rods, lugs or brackets complying with the duct construction standards referenced in 502. Approved nonmetallic ducts and approved duct systems shall be installed and supported in accordance with the terms of their listing. When approved by the Mechanical Official, heavy gage galvanized wire may be used for supports. When duct static pressure exceeds 2-inch water gage, any piercing of the duct wall to attach the duct to a supporting structure shall be sealed.

504.4 Location
Ducts shall not be installed in or within 4 inches of the ground unless the provisions of 507 are met.

504.5 Exposed Ducts
Vertical supply ducts in residential systems which are exposed in closet or rooms shall be covered or lined with a minimum of 1/4-inch thick approved fire resistant material.

504.6 Protection Of Openings
Exposed openings in fan housing shall be protected with screens or gratings to prevent accidents or the entry of foreign material.

504.7 Safety
All mechanical equipment shall be provided with guards or protectors over rotating parts to prevent accidents.

504.8 Lighting
Lights or lighting installed within the enclosure of any duct system shall be enclosed fixtures of the marine (vapor-tight) type. Germicidal lamps are not included.

504.9 Weather Protection
All ducts including linings, coverings and vibration isolation connectors installed on the exterior of the building shall be adequately protected against the elements.

505 FLEXIBLE AIR DUCT CONNECTORS

505.1 General
Flexible air connectors for use between air ducts and air outlets or air outlet units which do not pass through floors of buildings need not conform to the requirements of 503 for ducts if they conform to the following provisions:

1. Air duct connectors up to 8-inch diameter shall be minimum Class 2 materials.
2. Air duct connectors exceeding 8-inch diameter shall be minimum Class 1 materials.
3. Flexible air duct connectors shall not exceed 14 ft in length.
4. Flexible air duct connectors shall not pass through a fire wall or partition having a required fire resistance rating of 1 hour or more. ||

506 INSULATION

506.1 Materials

506.1.1 Coverings and linings, including adhesives when used, shall have a flamespread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating not over 50.

506.1.2 Duct coverings and linings shall not flame, flow, smolder, or smoke when tested in accordance with ASTM C 411 at the temperature to which it is exposed in service. In no case shall the test temperature be below 250°F.

506.1.3 Linings shall be interrupted at the area of operation of a fire damper or fire door.

506.1.4 Linings shall be interrupted for a minimum of 18 inches upstream and 30 inches downstream from electric resistance and fuel burning heaters in a duct system. (See 506.2.)

506.1.5 Listed equipment internally lined shall be considered as meeting the requirements of 506.1.

506.1.6 Duct coverings shall not penetrate a wall or floor required to have a fire resistance rating or required to be firestopped.

506.1.7 Service openings shall not be concealed by duct coverings unless the exact location of the opening is properly labeled.

506.1.8 Foam plastic shall conform to 717 of the Standard Building Code.

506.1.9 External duct work insulation and factory insulated flexible duct work shall be legibly printed or labeled at intervals not greater than 36 inches with the name of the manufacturer, the nominal thickness and density of the insulation or R-value and the flamespread and smoke developed ratings of the composite materials.

506.2 Installation

506.2.1 All ductwork installed in an attic shall be insulated. All metal supply ductwork installed in a ventilated crawl space or other nonconditioned area shall be insulated. Insulation shall be a minimum 2 inches thick, 3/4 pound density blanket or 1 inch thick, 1 1/2 lb density liner. When ducts used for cooling are externally insulated, the insulation shall be covered with a vapor barrier having a maximum permeance of 0.05 perms or aluminum foil having a minimum thickness of 2 mils. When nonmetallic ducts or other approved insulating or lining materials are used, the maximum thermal conductance value of the material shall be 0.23 at 75°F. All exterior ducts insulated shall be properly protected with an approved weatherproof vapor barrier.

506.2.2 Where duct liner has been interrupted, a duct covering of equal thermal performance shall be installed.

506.2.3 All ducts which operate at temperatures in excess of 120°F shall have sufficient thermal insulation to limit the exposed surface temperature to 120°F (vapor barrier not required).

507 DUCTS IN CONCRETE SLABS

507.1 General

507.1.1 Ducts located in or under concrete shall be of metal of sufficient strength encased on all sides with not less than 2 inches of concrete or shall be of other approved material specifically designed for this service.

509.2.2 Construction Practices

509.2.2.1 Framing shall comply with the requirements of the Standard Building Code.

509.2.2.2 Where required, preservatives for decay and termite protection shall be of approved water borne type.

509.2.2.3 Chemical soil treatment shall be applied to both sides of the foundation wall from the footing to the grade level. Approved chemicals shall be used. All excavations for plumbing and other services shall be completed at the time of the chemical soil treatment, or retreatment shall be necessary.

509.2.2.4 After the soil has been treated, a vapor barrier shall be provided within the foundation perimeter, from wall to wall, with joints lapped 4 inches but not sealed. The vapor barrier membrane shall be carefully fitted around pipes and drains and turned up at the foundation wall. The vapor barrier membrane shall be equal to or greater than polyethylene film of 4 mil thickness and a flamespread classification of 200 or less.

509.2.2.5 A noncombustible receptacle shall be placed below each floor register into the air chamber. Such receptacle shall conform to the following:

1. The receptacle shall be securely suspended from the floor members and shall not be more than 18 inches below the opening.
2. The size of the horizontal projected area of the receptacle shall extend 3 inches beyond the opening.
3. The perimeter of the receptacle shall have a vertical lip at least 1 inch high at the open sides if it is at the level of the bottom of the joints or 3 inches high if the receptacle is suspended.

509.2.2.6 The foundation wall shall be insulated along its inner face from the sill vertically to the underfloor plenum grade level and horizontally over the vapor barrier, a distance of 2 ft. The plenum system shall be insulated to provide a thermal resistance, excluding film resistance, of:

$R = (\Delta t\ hr/15)\ (°\ F)(ft^2/Btu)$

Where Δt = the design temperature between the air in the plenum floor system and the minimum outdoor design temperature.

509.2.2.7 Outlets from the plenum shall be provided by one of the following methods:

1. Approved air slots, floor registers or wall registers shall be provided.
2. Floor registers shall be designed for easy removal in order to give access for cleaning.
3. Wall registers shall be connected to the plenum space with a duct or boot complying with the requirements of this chapter.

510 FIRE PROTECTION OF DUCTS

510.1 Fire Door

Duct penetrations of fire walls having a fire resistance rating of 3 hours or more shall be protected by installing a listed fire door satisfactory for Class A openings on both sides of the walls.

510.2 Fire Dampers

510.2.1 Listed fire dampers shall be installed in accordance with the manufacturer's installation instructions in the following locations:

1. Ducts penetrating walls or partitions enclosing exits, boilers, and furnaces having a fire resistance rating of 1 or more hours.
2. Ducts penetrating shaft walls having a fire resistance rating of 1 or more hours. (not sprinklered).
3. Ducts penetrating floors of buildings requiring the protection of vertical openings when the duct is not protected by shafts described in 510.5.
4. Transfer ducts and openings penetrating walls or partitions having a fire resistance rating of one or more hours.

510.2.2 Fire Dampers are not required under the following conditions (unless required above):

1. In buildings which do not require protected floor openings.
2. In duct systems serving only one floor and used only for exhaust of air to the outside and not penetrating a wall or partition having a required fire resistance rating of 2 hours or more or passing entirely through the enclosure for a vertical shaft.
3. Where branch ducts connect to return risers in which the air flow is upward and subducts at least 22 inches long are carried up inside the riser at each inlet.
4. In openings in shaft walls in fully sprinklered buildings which are supervised.
5. Duct systems, of any duct material or combination thereof, penetrating 1-hour rated walls or partitions shall meet the following minimum requirements:
    1. The duct shall be of 0.0217 inch (26 ga) minimum steel.
    2. The duct shall continue with no duct openings for not less than 5 feet from the rated wall, and the duct secured in the opening by steel collars of a gauge equivalent to that of the duct and fastened to both the duct and the enclosure, or other approved method affording equivalent protection. When wall registers occur at the rated wall, a fire damper shall be provided.

510.3 Ceiling Penetration

Ducts penetrating the ceiling of a fire resistant roof/floor and ceiling assembly shall be protected by methods complying with the design of the assembly or by ceiling dampers specifically designed and listed for this type service.

510.4 Smoke Dampers

Unless the air system is designed to provide smoke control or pressurization functions during a fire emergency, smoke dampers with listed operators shall be installed at all duct penetrations of required smoke partitions.

516 STAIRWELL ENCLOSURES

Ducts serving other areas shall not be located in or pass through exit enclosures.

517 RETURN AIR INTAKE FOR RESIDENCES (Non-Engineered Systems)

517.1 If only one central return air grille is installed, it shall be of proper size. The size shall be sufficient to return a volume of air compatible with the CFM requirements and temperature rise limitations specified by the equipment manufacturer. The face velocity of return air grilles shall not exceed 450 fpm. At least one separate return shall be installed on each level of a multilevel structure. For split-level and split-foyer structures one return may serve more than one level if located near the levels served and the total area of the levels does not exceed 1600 sq ft. Return air grilles shall not be located in bathrooms or kitchens. This does not prohibit the installation of a return grille in the dining room or living room portion of a combination kitchen-dining room or kitchen-living room. The return air from one residential living unit shall not be mixed with return air from other living units.

517.2 In buildings with 1600 sq ft or less of conditioned area, a central return is permitted. When the building contains more than 1600 sq ft of conditioned area, additional returns shall be provided. Each return shall not serve more than 1600 sq ft of area and shall be located in the area it serves. Return air may travel through the living space to the return air intake if there are no restrictions, such as solid doors, to the air movement. When panned joists are used for return air, the structural integrity shall be maintained. Air capacity for joists, 16 inches on center shall be a maximum of 375 CFM for 8 inches joists and 525 CFM for 10 inches joists. Wiring shall not be located in spaces used for return air ducts.

North Carolina State Building Code

Volume III – Mechanical

1994 REVISIONS TO THE 1991 EDITION

INSTRUCTIONS

Items needed for a complete 1994 North Carolina State Building Code, Volume III – Mechanical

1. 1991 North Carolina Volume III,
2. 1992 North Carolina Revisions,
2. 1993 North Carolina Revisions, and
3. 1994 North Carolina Revisions.

To update the 1993 NC Edition with the 1994 Revisions, replace (white & blue) sheets by page number using the 1994 Revision package. Place all blue sheets in the Code, even if the sheet contains only information about sheets to be removed. When this is complete, you have a 1994 NC Edition.

North Carolina State Building Code

1994 Revisions TO THE 1991 EDITION

Volume III – Mechanical
(Revisions Adopted Through September 14, 1993
Effective January 1, 1994)

North Carolina Building Code Council
and
North Carolina Department of Insurance
Post Office Box 26387
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CHAPTER 3
AIR CONDITIONING, HEATING AND VENTILATION EQUIPMENT

301 GENERAL

301.1 Scope
This chapter is intended to insure the safe design, construction, installation, and repair of equipment used in systems pertaining to air conditioning (space cooling), heating, and ventilation.

301.2 Approval
All listed equipment shall be installed in accordance with its listing and the equipment shall be labeled accordingly, including the seal or mark of the testing agency which certifies the listing. All unlisted equipment shall be installed in accordance with this Code. Equipment installed outside shall be supported on pre-cast or poured concrete, masonry units, approved prefabricated inorganic materials, structural steel or pressure treated wood.

301.3 Structural Safety
301.3.1 General In the process of installing or repairing any air conditioning, heating, and ventilation equipment, the finished floors, walls, ceilings, tile work or any other part of the building or premises which must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the Standard Building Code.

301.3.2 Cutting, Notching And Bored Holes
301.3.2.1 Notches on the ends of joists shall not exceed one-fourth the depth. Holes bored for pipes or cable shall not be within 2 inches of the top or bottom of the joist and the diameter of any such hole shall not exceed one-third of the depth of the joist. Notches for pipes in the top or bottom of joists shall not exceed one-sixth of the depth and shall not be located in the middle one-third of the span.

301.3.2.2 In exterior walls and bearing partitions, any wood stud may be cut or notched to a depth not exceeding 25% of its width. Cutting or notching of studs to a depth not greater than 40% of the width of the stud is permitted in nonbearing partitions supporting no loads other than the weight of the partition.

EXCEPTION: Cutting and notching of studs may be increased to 65% of the width of the stud in exterior or interior walls and bearing partitions, provided that one of the following conditions is met:

1. The wall section is reinforced with 1/2" exterior grade plywood or equivalent reinforcement on the notched side of the wall. Plywood if used, shall reach from the floor to ceiling and at least one stud further on each side of the section that has been notched or cut.
2. The exterior walls of a kitchen may be reinforced by placing 1/2" plywood or equivalent reinforcement on the notched side of the wall. Plywood, if used, shall reach from the floor to counter-top height and at least one stud further on each side of the section that has been notched or cut.

301.3.2.3 A hole not greater in diameter than 40% of the stud width may be bored in any wood stud. Bored holes not greater than 60% of the width of the stud are permitted in nonbearing partition or in any wall where each bored stud is doubled provided no more than two such successive double studs are bored.

301.3.2.4 In no case shall the edge of the bored hole be nearer than 5/8 inch to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

301.4 Firestopping

All openings around pipes, tubing, wiring, conduit, etc., shall be firestopped in accordance with Chapter 10 of the North Carolina State Building Code, Volume I - General Construction.

302 AIR CONDITIONING EQUIPMENT

302.1 Scope

This section covers the location, installation, alteration, replacement, repair and maintenance of air conditioning equipment. The requirements of 303.2, 303.3, 303.4, 303.5 and 303.6 of this Code shall apply to air conditioning equipment.

302.2 Labeling

302.2.1 Listing of Heating and Air Conditioning Equipment Heating and air conditioning equipment (electric, gas and oil) shall be listed by a nationally recognized testing agency and shall be installed in accordance with its listing. When test standards are not available, or when sufficient different makes of listed equipment are not reasonably available locally [three or more manufacturers], equipment constructed in accordance with applicable NEC, ASME, ARI or ANSI standards using listed component parts such as burners, heaters, safety controls, wiring and safety valves and installed in strict compliance with the manufacturer's recommendations will be acceptable. Equipment accepted and certified by FM and FIA are also acceptable.

Other equipment used in environmental comfort control systems such as humidifiers, air handling fans and power roof ventilators and fan coil units, shall be either listed or shall have motors which comply with NEMA standards, wiring complying with the National Electric Code and shall be used only for service recommended by the manufacturer.

302.2.2 Listing of appliances other than Heating & Air Conditioning & Ventilating Equipment (Such as dryers, ranges, gas logs, and similar devices) These types of appliances shall be listed by a national recognized testing agency and installed according to the listing. The authority having jurisdiction shall accept without further examination and test the listings of UL or AGA.

307 VENTILATION SYSTEMS

307.1 Required Systems and Ventilation Rates

307.1.1 Each building or portion thereof shall be provided with the capability to provide ventilation in accordance with ASHRAE 62, based on building classification and occupant load.

307.1.2 A separate and individual ventilation system, which is not part of any other system, shall be provided for ventilation of each room or space containing flammable vapors, combustible vapors, noxious gases, and flammable dusts or where serving incompatible materials.

307.1.3 For commercial food heat-processing equipment exhaust systems, see 308.

307.1.4 Vestibule ventilation for smokeproof enclosures shall be in accordance with the Standard Building Code.

307.1.5 The requirements of 303.2, 303.3, 303.4 , 303.5 and 303.6 shall apply to ventilation equipment.

307.2 Reserved For Future Use

307.3 Ducts — General

307.3.1 Every duct and plenum used in a ventilation system shall be constructed of approved material and construction as set forth in Chapter 5.

307.3.2 Ducts shall be substantially airtight throughout and have no openings other than those required for proper operation and maintenance of the system.

307.3.3 The type of metal duct bracing, the distance of duct joints on center, the type of duct transverse joint connections, and the type of duct lateral seams, shall comply with Chapter 5.

307.3.4 Every duct shall be securely attached to the building as set forth in Chapter 5. No nails or screws shall be driven through the duct walls into the building construction and ducts shall be supported on noncombustible straps or hangers without penetration of the duct walls.

307.3.5 Every duct or plenum which is a portion of a ventilation system used for exhausting any solid particles shall be constructed so as to permit thorough cleaning of the entire duct system. Any such duct or plenum, having any section or sections inaccessible from the duct entry or discharge, shall be provided with cleanout openings. All cleanout openings shall be equipped with tight-fitting sliding or hinged doors constructed of metal equal or greater in thickness than the ducts. Such doors shall be equipped with a substantial method latching, sufficient to hold the door tightly closed. These doors shall be so designed that they can be opened easily without the use of a tool.

307.4 Motors, Fans and Filters

307.4.1 Motors and fans shall be of sufficient capacity to provide the required air movement as specified in the Standard Building Code. Every motor and fan shall be so installed as to afford access for servicing or maintenance.

307.4.2 Fan motors, except NEMA Class I explosion proof motors, shall not be installed inside the ducts or under hoods in any ventilation system conveying flammable vapors or combustible dusts, nor shall any belt or chain driven apparatus be inside any such duct or under any such hood unless the belt or chain and any pulley connection therewith is entirely enclosed and grounded except motors and receptacles listed for the class, group and division of flammable vapors or combustible dusts as indicated in Article 500, NFiPA 70.
307.4.2.1 Every fan blade located in any duct shall be of rigid noncombustible construction. In any ventilation system conveying flammable vapors or combustible dust, the fan blade, shaft and casing shall be of a nonsparking material. Bearings for fans shall be self-lubricating or shall be lubricated from outside the duct.
307.4.3 Air filters, other than grease hood filters regulated by 308, shall be of a type that, in a clean state, will not burn freely. Liquid adhesive coatings used on filters shall have a flash point of 350°F, Cleveland open cup tester, or higher. Filters qualifying as Class I or Class 2 shall be accepted as meeting these requirements. Evaporative coolers containing a combustible evaporation medium, such as excelsior, shall not be used.
307.4.4 Rotary fans without fan blade protection shall provide for not less than 8 ft of clearance from the finished floor level to the bottom side of the unprotected fan blades.

EXCEPTION: Fan blades of low speed residential type ceiling fans installed within dwelling units shall be located at least 6 ft 8 inches from the finished floor.

307.5 Safety Devices

Whenever a fire damper is installed it shall be installed and constructed to comply with Chapter 5. Ducts discharging combustible material directly into any combustion chamber shall conform to the requirements of NFiPA 82.

307.6 Dry Cleaning Plants

Type I and Type II Systems. The ventilation system shall provide a complete and continuous air change at least once every 3 minutes in dry cleaning and dry dyeing rooms. The system shall be provided with means for remote control and shall operate automatically when any dry cleaning or dry dyeing equipment is in use.

308 EXHAUST SYSTEMS

308.1 Systems Required

308.1.1 Exhaust system shall be provided, maintained and operated for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders, and any other equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas, or smoke, in such quantities as to be irritating or injurious to health or safety, and shall mechanically discharge such exhaust to the outdoor atmosphere. The total outdoor air supplied shall be equal in volume to that removed.

308.1.2 All equipment and system service rooms, which house sources of odors, fumes, noxious gases, smoke, steam, dust, spray, or other contamination shall be such as to prevent spreading of any such contamination to any other occupied parts of the building.

308.1.3 Air exhausted from bath, toilet, urinal, lavatory, locker, coat room or similar rooms shall not be recirculated unless treated by a listed or approved air treatment system.

308.2 General Provisions

308.2.1 If a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical exhaust system for a room, adequate means shall be provided for the natural exit of the excess air supplied. If a mechanical exhaust system only is installed for a room or if a greater quantity of air is removed by a mechanical exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate means shall be provided for the natural supply of the deficiency in the air supplied.

308.2.2 The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a nuisance and from which it cannot again be readily drawn in by a ventilating system. Exhausting air into an attic or crawl space shall be prohibited. Air which is to be used for recirculation may be discharged to a supply system.

EXCEPTION: Attic fans may be permitted to discharge into attic space of residences having private attics.

308.2.3 Mechanical exhaust from bath, toilet, urinal, locker, service sink, closets and similar rooms shall be an independent system and shall not be recirculated unless treated by a listed or approved air treatment system. When exhaust systems are used, they may be combined with similar exhaust except kitchen exhaust shall be on an independent system.

308.2.4 All bathrooms, toilets or restrooms shall have a system of natural or mechanical ventilation to provide 2 cfm per square foot of floor space or 40 cfm per flushing type fixture, whichever is greater. A window or other opening to the outside providing 3 square feet of open space shall be considered adequate to meet ventilation requirements for one flushing type fixture.

308.3 Ducts - General

The materials used in every mechanical exhaust system shall be of sheet metal or other approved materials in accordance with Chapter 5. Materials shall be of non-absorbent and moisture and corrosion resisting character. The design and construction of all equipment and the weight and bracing of all duct work shall be such that will operate under normal conditions without excessive vibrations. (See Chapter 5.) Ducts shall be substantially air-tight. Linings, if used, shall be securely anchored.

308.4 Grease Hood Duct Systems

308.4.1 Duct systems serving exhaust hoods removing smoke and grease laden vapors shall be constructed of and supported by steel 0.0598-inch (16 ga) minimum thickness or stainless steel 0.0478-inch (18 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official. Ducts constructed of materials that are subject to corrosion shall be suitably protected when installed outdoors.

308.4.1.1 All seams and joints shall be made liquid-tight with a continuous external weld. In lieu of a welded connection, the duct may be flanged to the hood in accordance with Figure 308.4, or other equivalent method.

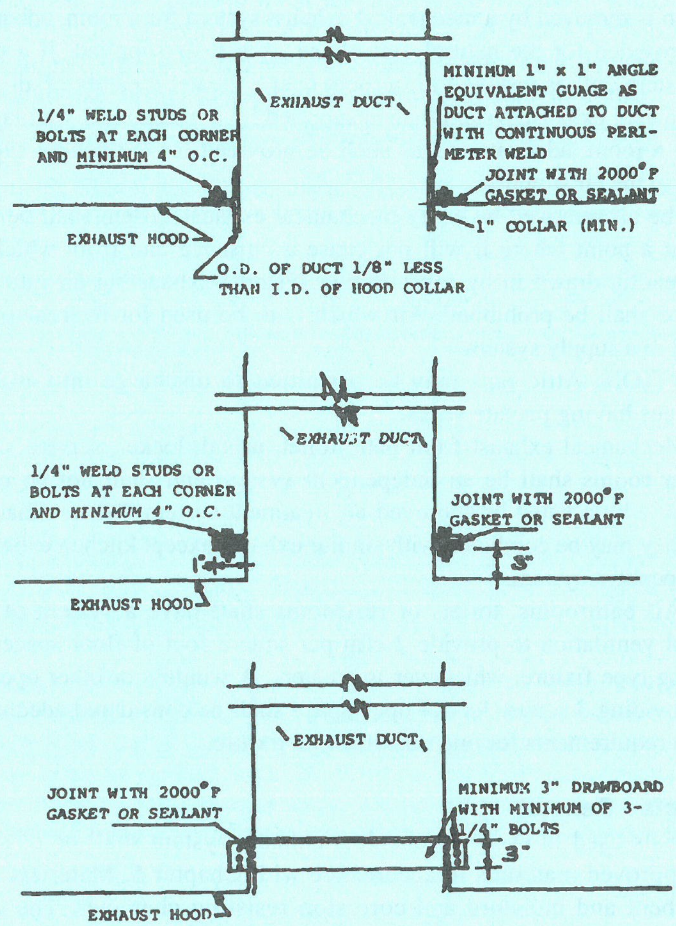

FIGURE 308.4

308.4.1.2 All duct systems furnished as a part of a grease extractor listed by a nationally recognized testing agency are considered as complying with these requirements when installed in accordance with the terms of their listing.

308.4.2 All sections of the duct system shall be constructed and installed without forming dips and traps and shall slope not less than 1 inch per foot toward either the hood or an approved residue trap.

308.4.3 The duct system shall have only those openings required for the proper operation and maintenance of the system. For cleaning purposes, cleanout openings shall be provided at each change in direction of the duct and at any other portion of the system not accessible from the duct inlet or discharge. All cleanout openings shall be located on the sides of the duct and shall be of sufficient size to permit a thorough cleaning of the entire system. Cleanout openings shall be equipped with tight-fitting doors and covers, constructed of metal which is equal to or greater in thickness than that of the ducts. Such doors or covers shall be equipped with a substantial method of latching, sufficient to make them grease-tight. Doors or covers shall be so designed that they can be opened or removed without the use of a tool.

308.4.4 Duct systems shall be properly supported and securely fastened in place at every change in direction and as required in Chapter 5. Supports or fasteners shall not penetrate any duct or plenum.

308.4.5 Duct systems shall be designed and installed in a manner to provide an air velocity within the duct system of not less than 1500 ft per minute.

308.4.6 A separate system and individual duct system shall be provided exclusively for each grease hood, except as provided herein. A single duct system may serve more than one grease hood located in the same story of the building provided that, in addition to other requirements of this Code, the installation also complies with the following:

1. All hoods served by the system shall be located in the same room or adjacent rooms.
2. No portion of the interconnecting duct shall pass through any construction which would require the openings to be fire protected as specified in the Standard Building Code.
3. Grease exhaust duct systems shall not be interconnected with any other building ventilating or exhaust system.

308.4.7 Vertical ducts located within a building of two stories or more shall be enclosed in a continuous enclosure extending from the ceiling above the hood to or through the roof. A minimum clearance of 6 inches shall be maintained between the duct and interior surface of the enclosure. The fire resistance rating of the enclosure shall be a minimum of 1 hour for buildings two through three stories in height and a minimum of 2 hours for buildings four stories or more in height. The enclosure shall be used exclusively to enclose a single grease exhaust system and shall be used for no other purposes.

EXCEPTION: An enclosure material when specifically listed for such use may be applied to the duct and duct support system in lieu of the 1 hour or 2 hour fire rated enclosure.

308.4.8 Openings required in vertical enclosures for access to cleanout openings shall be equipped with approved sliding or hinged doors equal in fire resistance to that of the enclosure.

308.4.9 No damper shall be installed in any portion of the duct system unless specifically listed for such use. This does not prohibit the use of dampers which are part of a listed grease extractor, an approved extinguishing system or an approved fan by-pass system.

308.4.10 Every duct system shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the duct side. Ducts shall not pass through interior walls or partitions having a fire resistance rating of 2 hours or more.

EXCEPTION: Clearance may be reduced to 0 inches when the duct system is protected by material specifically listed for such use.

308.4.11 Motors, fans and exhaust outlets for grease hood duct systems shall comply with all applicable requirements as specified in 307.4 and 308.5.

308.4.12 Fume incinerators, thermal recovery units, air pollution control devices, or other devices, may be installed in ducts or hoods or located in the path of travel of exhaust products when specifically approved for such use and shall not increase the fire hazard.

308.5 Exhaust Outlets

308.5.1 Exhaust outlets for ducts conveying noxious gases, flammable vapors, corrosive vapors, and ducts serving commercial food cooking and processing equipment, shall terminate outside the building and shall be located 10 ft from any adjacent building, parking area, adjacent property line, window, door, or air intake opening and shall be located at least 10 ft above the adjoining grade level. Every exhaust outlet which is located above the roof shall terminate at least 40 inches above the roof surface. The airflow from exhaust outlets conveying grease-laden vapors shall be in a vertical direction away from the roof surface. Where this is not possible, a metal pan at least 1 inch deep shall be provided on the roof surface to catch grease residue.

308.5.2 The exhaust from hoods serving commercial food heat-processing equipment may terminate in an approved engineered air recovery system for recirculation to the room in which the hood is located.

308.5.3 An exhaust duct may terminate through an exterior wall under the following conditions:

1. The wall is of noncombustible construction.
2. The discharge shall have a minimum clearance of 15 ft from adjoining buildings, property lines, air intakes, windows or doors. The lowest edge of the outlet shall be not less than 7 ft above any adjoining grade level, parking areas, driveways or walks that are within 10 ft of the outlet.
3. The discharge of exhaust air is away from the building wall in which it is installed.
4. Clearance to any combustible elements of the building shall be not less than 40 inches from the discharge.
5. If the termination is a louver installed in the wall, the cooking devices shall be exhausted through a water-wash type exhaust system.

308.6 Hoods

308.6.1 An exhaust hood shall be installed for all commercial, industrial, institutional and other food heat-processing equipment producing smoke or grease-laden air.

EXCEPTION: Domestic equipment installed within a dwelling unit.

308.6.2 The hood shall be designed with a sufficient air volume to properly exhaust all grease and smoke vapor produced by the equipment which it serves. Unless the hood is designed and certified by a licensed architect or professional engineer or is an approved prefabricated hood tested and certified by the manufacturer the following requirements shall be met:

1. Canopy-type hoods shall be at least 2 ft deep from bottom edge to top edge of hood and shall overhang the equipment they serve at least 6 inches on all open sides.
2. The bottom edge of a canopy-type hood shall be a maximum of 7 ft above the floor.
3. Canopy hoods open on all sides shall have a minimum exhaust capacity of 150 cfm per square foot of hood area.
4. Canopy-type hoods open on three or less sides shall have a minimum exhaust capacity of 100 cfm per sq ft of hood area.
5. Backshelf-type hoods having an intake within 3 ft of vapor producing surface shall have a minimum exhaust capacity of 300 cfm per linear foot of cooking surface within a maximum distance of 1 ft from the face of the hood to the front edge of the equipment they are serving.
6. Provisions shall be made to admit air to the room where the hood is located at a rate not less than that which is exhausted by the hood. The make-up air restrictions of Section 3202.5.2 of Volume I do not apply to non-canopy type backshelf kitchen exhaust hoods.

308.6.3 All hoods shall be constructed and installed in accordance with the following:

1. Hoods shall be constructed of and supported by steel 0.0478-inch (18 ga) minimum thickness or stainless steel 0.0359-inch (20 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official.
2. Hoods shall be securely supported by noncombustible supports.
3. All seams and joints shall be made liquid-tight with a continuous external weld.
4. Hoods shall be so designed and installed to provide for thorough cleaning of the entire hood.
5. When grease troughs or gutters are provided, they shall drain to a collecting receptacle designed, fabricated and installed to be readily accessible for cleaning.

308.6.4 Every portion of the hood shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the hood side.

EXCEPTION: Clearance may be reduced to 0 inches when the duct system is protected by material specifically listed for such use.

308.6.5 Each hood shall be equipped with a properly sized grease removal device of one of the following types:

1. Grease extractors specifically listed for this service and installed in accordance with the terms of its listing.
2. Grease filters or other grease removal devices specifically listed for use with commercial cooking equipment installed with the height of the lowest edge of the grease filter or other removal device located above the cooking or heating surface not less than the distances shown in Table 308.

308.9.4 Joints in dryer exhaust ducts shall be substantially air tight. Sheet metal screws or other fastening means shall not extend into a duct. Exhaust ducts shall have a smooth interior finish with joints running in the direction of the air flow.

308.9.5 Non-combustible flexible duct, if used, shall be installed without dips or kinks.

308.9.6 Exhaust ducts shall be terminated with a non-screened wall or roof cap equipped with a backdraft damper.

308.9.7 The outlet of the exhaust hood must be at least 12 inches from the ground and/or in accordance with the manufacturer's installation instructions.

308.9.8 Unless specified in the dryer manufacturer's installation instructions, the maximum developed length of a dryer exhaust duct shall not exceed 45' from the dryer to the exhaust termination using a 4" wall or roof cap or a louvered outlet. The maximum length shall not exceed 30' from the dryer to the exhaust termination using a 2 1/2" wall or roof cap, or a louvered outlet. There shall be a deduction of 2 1/2 feet for each 45 degree bend and 10 feet for each 90 degree bend from the maximum length permitted. For installations where this length limitation is exceeded, the minimum exhaust diameter shall be 5 inches with a minimum 4 inch exhaust termination.

308.10 Tire Rebuilding Or Recapping

308.10.1 Each room where rubber cement is used or mixed, or flammable or combustible solvents are applied, shall be ventilated in accordance with the applicable provisions of NFiPA 91.

308.10.2 Each buffing machine shall be connected to a dust collecting system which prevents the accumulation of the dust produced by the buffing process. The system shall discharge the dust to a suitable container. The system and the container shall be cleaned at frequent intervals.

309 SOLAR ENERGY UTILIZATION

309.1 General

309.1.1 This section includes provisions for minimum safe requirements for the construction, installation, alteration and repair of all equipment and systems utilizing solar energy intended to provide energy for space heating, cooling, hot water heating, swimming pool heating or process heating or cooling. Since solar systems are still in the research and development stage, this section is not intended to limit design innovations which will not constitute a hazard.

309.1.2 The purpose of the recommended requirements is to provide for reasonable protection of the public health and safety, while at the same time encouraging consumers, builders, designers, manufacturers, installers and others to utilize solar energy technologies while permitting experimentation and innovation.

309.1.3 Solar energy systems may be installed in, on, or adjacent to existing buildings or appurtenant structures without having the entire building or structure comply as required for new construction, provided the added solar energy systems and the affected portions of the existing building, mechanical, plumbing and electrical systems comply with the applicable provisions of these recommended requirements.

309.1.4 Existing solar energy systems shall be permitted to have their existing use continued provided their use and maintenance is not a hazard to life, health or property. Conditions that endanger life, limb, health or property shall be abated by repair, rehabilitation, demolition, or removal in accordance with the provisions of these recommended requirements, the building code or the reference standards set forth in the Appendices.

309.1.5 Solar energy components also serving as building components shall comply with the applicable provisions of the Standard Building Code and when connected to heating, ventilating, air conditioning and plumbing systems shall also comply with the applicable provisions of this section.

309.1.6 Solar heating systems shall be considered as supplemental or auxiliary systems unless designed to provide the total energy requirements as calculated using ASHRAE Applications Handbook Chapter 57, Solar Energy Utilization for Heating and Cooling, or other solar energy utilization data acceptable to the Mechanical Official. Solar systems and/or equipment which will not supply the total energy requirements, shall have a primary system or equipment with capacity to provide the additional energy needed in order to insure 100% capacity to satisfy the energy demand.

EXCEPTION: Experimental passive and active solar systems for the purpose of collecting technical data may be excluded from total capacity energy requirements when requested by the designer and approved by the Mechanical Official.

309.2 Maintenance And Identification

309.2.1 Solar energy systems shall be maintained in accordance with Volume I-A, Section 1.4.6, unless state or local governments' statutes or ordinances conflict with provisions contained therein.

309.2.2 Materials and equipment shall bear the manufacturer's or installer's label or otherwise be identifiable in accordance with appropriate national standards.

309.3 Design Criteria

309.3.1 The engineering design of passive and active solar systems shall be in accordance with acceptable engineering practice, and standards as listed in the applicable codes and standards adopted by the Mechanical Official. Where a primary fossil fuel or electric energy system with total capacity to satisfy the energy required is provided, and provisions are made for the protection of life, health and property, then no restrictions shall be placed on the design or capacity of the solar system.

309.3.2 When a solar energy system and an auxiliary energy system are interconnected, the maximum allowable temperature or pressure of either system shall not be exceeded in either operational or stagnant modes. The interconnections shall not compromise or by-pass the required safety devices.

309.3.3 Liquid solar energy systems shall be capable of being drained and vented and of being filled without air entrapment.

309.3.4 Solar energy systems and components which are subject to contact by unauthorized personnel and which are maintained at elevated temperatures shall be protected with proper safeguards.
309.3.5 Adequately sized, listed or approved pressure relief devices shall be provided in pressurized solar energy systems and subsystems. Where a pressurized system or portion thereof can be isolated by valving, each such isolated system or portion thereof shall have a listed or approved pressure relief valve. The devices shall be set to relieve the pressure at or below the maximum allowable pressure. Such devices shall drain to approved locations and when connected to the drainage systems shall be connected in accordance with 304.3.3.
309.3.6 Solar energy systems shall be designed to prevent damage by vacuum conditions or shall be provided with listed or approved vacuum relief valves.
309.3.7 Those portions of a solar energy system connected to potable water supply shall be protected with listed or approved temperature relief devices in accordance with applicable provisions of 304.3.3.
309.3.8 Provisions shall be made for thermal expansion at both operating and stagnation temperatures.
309.3.9 Provisions shall be made to prevent damage from freezing of the heat transfer or storage fluids.

309.4 Access And Location

309.4.1 Solar energy collectors, controls, dampers, fans, blowers and pumps shall be accessible for inspection, maintenance, repair and replacement.
309.4.2 No solar energy system shall be installed in a location which obstructs means of egress, or accessibility to the building or structure for the fire fighting apparatus as required by the Standard Building Code.
309.4.3 Solar energy systems, equipment or components shall not be installed in violation of existing zoning, fire, or nuisance regulations which govern general construction of structures and buildings as provided in the Standard Building Code or by the Mechanical Official. No solar installation shall be made which would create a hazard to the general public, as determined by the Mechanical Official.

309.5 Materials, Specifications And Tests

309.5.1 Materials shall be listed or approved and be of an approved type, and shall be designated for the fluids they are to handle and for their intended use. Materials that may be adversely affected by environmental factors shall be protected in an approved manner.
309.5.2 Sealants and gasket materials used in pressurized systems shall be suitable for the combined system pressure and temperature and for the fluids contained. Seals used in solar systems shall comply with ASTM D 3667, ASTM D 3832 and ASTM D 3771.
309.5.3 Heat transfer fluids which are hazardous shall not be used in solar systems except when approved by the Mechanical Official. The flash point of heat transfer liquids shall be:

1. Vented inside: At least 50°F above the design maximum operating temperature and as high as the maximum stagnation temperature of the liquid in the system.

2. Vented outside: At least 50°F above the design maximum operating temperature and greater than the maximum stagnation temperature minus 200°F of the liquid in the system provided the collector, collector manifold and manifold relief valve discharge neither directly nor indirectly into the building and away from open flames and ignition sources.

309.5.4 A flammable gas or liquid shall not be used as a heat transfer fluid unless approved by the Mechanical Official. The flash point of fluid used in factory or high-hazard occupancies may be lower, subject to the approval of the Mechanical Official.

309.6 Collector

309.6.1 Manufactured collectors shall be labeled with the manufacturers name, address and types of transfer fluids compatible with the collector design. Listed collectors shall also include the markings required under the terms of the listing. All collectors, including shop and site-built collectors, shall be labeled to indicate the operating fluid, the maximum allowable temperature and pressure and the direction of fluid flow.

309.6.2 All materials provided in the fluid passages of a collector assembly shall be capable of withstanding the maximum allowable pressure and temperature.

309.6.3 Where leakage can cause an unsafe electrical condition, the construction of the collector shall provide protection against both external leakage of the contained fluid from the collector and internal leakage into the collector from environmental conditions or cleaning operations as performed during intended user maintenance as specified in the installer instructions.

309.6.4 The collector components which are exposed to air circulated to occupied spaces shall be noncombustible or shall have a flamespread rating not exceeding 25 and a smoke developed rating not exceeding 50 when tested in accordance with ASTM E 84.

EXCEPTION: When approved smoke detectors are installed in the duct system from the collector which, when activated, stop all air flow through the collector and sounds an alarm, materials which meet the requirements of 309.6.5 may be used. Minimum sensitivity of approved smoke devices shall be set to operate when smoke reduces the intensity of a l-ft long beam of white light by 4% or the equivalent.

309.6.5 Insulating material shall not flame, smolder, glow or smoke when tested in accordance with ASTM C 411 at the temperature to which it is exposed in service. In no case shall the test temperature be below 250°F. Higher outlet air temperatures may be used when connected to duct materials approved or listed and installed for higher temperature use. 309.6.6 The sustained design outlet temperature of collectors handling air circulated to occupied spaces shall not exceed 250° F.

309.7 Thermal Storage—Air Systems

309.7.1 Heat storage media and thermal storage tank materials including any interior protection coatings, shall not impart toxic elements to air distributed to areas of human occupancy.

309.7.2 Rocks and pebbles used as sensible heat storage shall be washed free of fines and organic materials prior to placement in the rock storage bins.

309.7.3 Materials exposed to the air passage shall be noncombustible or shall have a flame spread rating not exceeding 25 and have a smoke developed rating not exceeding 50 when tested in accordance with ASTM E 84.

EXCEPTION: In one and two family dwellings, materials not meeting the criteria of 309.7.3 may be used when smoke detectors approved for duct installation are installed which, when actuated, stop all air flow through the storage device and sound an alarm. Minimum sensitivity of approved smoke devices shall be set to operate when smoke reduces the intensity of a l-ft long beam of white light by 4% or the equivalent.

309.7.4 Where storage units are located outside or underground, they be adequately protected against the intrusion of water.

309.8 Thermal Storage—Liquid Systems

309.8.1 Pressurized tanks shall be leak tested after installation except when the tank contains markings to indicate prior testing has been accomplished. If testing is required, the test pressure shall be one and one-half times the maximum allowable pressure. Nonpressurized tanks shall be tested visually for leaks by filling.

309.8.2 Potable water systems shall be protected from make-up water cross connections to the solar energy storage system in accordance with the requirements of the Standard Plumbing Code.

309.8.3 All openings into tanks, except vents, shall be tightly covered and secured in place. Vents shall be screened with corrosion-resistant materials having not less than twenty openings per linear inch, or otherwise protected.

309.8.4 Nonpressurized tanks connected to a make-up water system shall have overflows directed to an approved point of disposal. Make-up water piping from the potable water systems shall be connected as required in 606.

309.8.5 The liquid solar energy storage system shall be capable of being emptied.

309.8.6 Shutoff valves shall be provided between the supply system and cold and hot water storage tanks.

309.9 Thermal Storage Units And Tanks

309.9.1 Storage units shall be designed to contain the storage media without structural failure from temperature, pressure or weight.

309.9.2 Storage tanks shall be designed for the application, whether for above ground or below ground installation.

309.9.3 Dissimilar piping materials which are not compatible and are to be joined together shall be electrically isolated to prevent electrolytic and/or galvanic destruction.

309.10 Controls

309.10.1 In solar energy systems the following conditions must be prevented either by inherent design features or by equipping the system with the necessary controls:

1. The addition of energy to the storage media when the temperature of

the storage media has reached its maximum allowable temperature.

2. Thermosiphoning which will allow components to be damaged by freezing.

3. Heat transfer fluids reaching the maximum allowable temperature of the system in liquid systems. The pressure and temperature relief devices required in 309.3.5 through 309.3.7 shall not be considered as controls to satisfy this condition.

4. Damage from thermal shock.

EXCEPTION: Provisions of 309.10.1 shall not apply where adequate data is submitted to demonstrate that these conditions will not occur due to the design and location of the system.

309.10.2 The solar energy system shall revert to a safe mode in the event of manual shutdown or power failure.

309.10.3 All switches and controls shall be clearly identified as to function. All warning lights, when provided, shall indicate the abnormal condition. If manual control adjustments are required during normal operation of the solar system, the control system shall be designed to assure that the safety of the system and the building in which it is installed are not compromised by failure to make those adjustments.

309.11 Distribution

309.11.1 Piping materials shall conform to the manufacturer's recommendations and 602. 1.

309.11.2 Piping shall be sized to limit the sustained fluid velocity to levels recommended by the pipe manufacturer considering the type of fluid.

309.11.3 Joints shall be of a type approved for the piping material being used and the intended use and shall conform to the manufacturer's recommendations and 602.3.

309.11.4 Joints between dissimilar materials shall conform to the manufacturer's recommendations and the Standard Plumbing Code.

309.11.5 Pipes embedded in structural concrete shall conform to 602.5.

309.11.6 Changes in direction of piping shall conform to the manufacturer's recommendations and the Standard Plumbing Code.

309.11.7 Where different sizes of pipe and fittings are to be connected, such connections shall conform to the manufacturer's recommendations and the Standard Plumbing Code.

309.11.8 Piping shall be supported in conformance with the manufacturer's recommendations and 602.4.

309.11.9 Pipe openings in walls, floors or ceilings shall be closed an protected in accordance with 602.5.

309.11.10 Trenching adjacent to footing and trenching, bedding, tunneling and backfilling shall be in conformance with the Standard Plumbing Code.

309.11.11 All piping embedded in structural concrete or masonry shall be tested in accordance with the Standard Plumbing Code. All other piping shall be tested as follows:

1. Prior to piping tests, and after all equipment has been installed, the liquid system shall be flushed to remove sediment, dirt, loose scale, etc., as prescribed by the manufacturer. Strainers shall be cleaned or replaced. During flushing of

the system, the collectors may be disconnected or by-passed to prevent the passage of debris through the collector.

2. Closed solar heating system piping using liquid heat transfer fluids not directly connected to the potable water supply shall be tested for pressures not less than one and one-half times the maximum design operating pressure for a minimum of 15 minutes.

3. The portion of the system connected to the domestic water system shall be tested in the following manner: Upon completion of a section or of the entire water supply system, it shall be tested and proved tight under a water pressure not less than the maximum working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply. Except for plastic pipe systems, the water test may be substituted by an air test of 50 psi. test pressures shall be maintained for a minimum period of 15 minutes without the system leaking. The piping being tested shall remain exposed for inspection and shall not leak during the test.

4. Open systems shall be tested by filling to overflow.

5. Final leak testing shall be at the maximum allowable pressure with the fluid to be used in the system.

6. Testing may be waived by the Mechanical Official.

309.12 Drainage

309.12.1 Solar energy system piping shall be provided with a method for drainage. If the system is drained through the building drainage system, it shall be through an air gap in accordance with the Standard Plumbing Code.

309.12.2 Drains serving heat transfer fluids over 140°F or which are toxic or corrosive shall be protected in accordance with the requirements of the Standard Plumbing Code.

309.12.3 Drains in solar systems where high temperature, high pressure, or hazardous fluids are discharged shall have a warning label. For hazardous fluids, the label shall describe the hazardous properties of the fluid and emergency first aid procedures. Valves regulating such a discharge shall not be readily accessible to unauthorized personnel.

309.13 Health

309.13.1 Potable water systems shall be protected against contamination in accordance with the Standard Plumbing Code.

309.13.2 Heat exchangers used in domestic water heating systems shall be approved for the use intended. The system shall have adequate protection to assure that the potability of the supply and distribution water is properly safeguarded as approved by the Mechanical Official.

309.13.3 Food, drink, or other products manufactured or processed for human or animal consumption shall not be stored, prepared or displayed beneath overhead distribution piping unless such pipes are protected against leakage or condensation reaching such products as required in 610.2.4.

309.14 Air Distribution System

Duct systems shall be constructed and installed in accordance with the requirements of Chapter 5.

CHAPTER 4
REFRIGERATION

401 SCOPE AND PURPOSE

401.1 The purpose of this chapter is to promote the safe design, construction, installation, and operation of mechanical refrigerating systems.

401.2 This chapter applies to mechanical refrigerating systems and heat pumps and to parts replaced and components added to existing systems.

401.3 This code does not apply where water is the primary refrigerant.

401.4 Equipment listed by an approved, nationally recognized testing laboratory is deemed to meet the design, manufacturing, and factory testing requirements section of this code for the refrigerant or refrigerants for which the equipment was designed.

402 REFRIGERATING SYSTEM CLASSIFICATION

402.1 Refrigerating systems are defined by the method employed for extracting or delivering heat as follows:
402.1.1 A direct system is one in which the evaporator or condenser of the refrigerating system is in direct contact with the air or other substances to be cooled or heated.
402.1.2 An indirect system is one in which a secondary coolant cooled or heated by the refrigerating system is circulated to the air or other substance to be cooled or heated. Indirect systems are distinguished by the method of application given below.
402.1.2.1 An indirect open spray system is one in which a secondary coolant is in direct contact with the air or other substance to be cooled or heated.
402.1.2.2 A double indirect open spray system is one in which the secondary substance for an indirect open spray system is heated or cooled by the secondary coolant circulated from a second enclosure.
402.1.2.3 An indirect closed system is one in which a secondary coolant passes through a closed circuit in the air or other substance to be cooled or heated.
402.1.2.4 An indirect vented closed system is one in which a secondary coolant passes through a closed circuit in the air or other substance to be cooled or heated, but the evaporator or condenser is placed in an open or appropriately vented tank.

402.2 Refrigerating System Classification

The refrigerating system shall be classified according to the degree of probability that a leakage or refrigerant could enter an occupancy classified area as follows:
402.2.1 High-Probability System. Any system in which the basic design, or the location of components, is such that a leakage of refrigerant from a failed connection, seal, or component could enter the normally occupied area.
High-probability systems include: any direct system, or indirect open spray system, or any arrangement in which refrigerant containing parts in the refrigerant circuit are located in such a way that refrigerant leakage could enter the normally occupied area.
402.2.2 Low-Probability System. Any system that cannot be considered as a high-probability system. This class includes indirect closed and double indirect but only on condition that all joints and connections in the refrigerant circuit are effectively isolated from the normally occupied area.

403 REFRIGERANT CLASSIFICATION

403.1 Refrigerants are classified by into safety groups illustrated in the following matrix:

Highly[1] Flammable	Group A3	Group B3
Moderately[2] Flammable	Group A2	Group B2
No Flame Propagation	Group A1	Group B1
	Low Toxicity[1]	Higher Toxicity[1]

[1] Highly flammable refrigerants have a lower flammable limit (LFL) of less than or equal to 0.00625 lb/ft^3 (0.10Kg/m^3) or a heat of combustion of greater than or equal to 8174 Btu/lb (19,000 KJ/kg).

[2] Moderately flammable refrigerants have a lower flammable limit (LFL) or more than 0.00625 lb/ft^3 (0.10kg/m^3) and a heat of combustion of less than 8174 Btu/lb (19, 000 KJ/kg).

"Low toxicity" is defined as a TLV-TWA level (or toxicity measure consistent therewith) of 400 ppm or greater: "higher toxicity" is defined as a level of less than 400 ppm.

403.2 For the purposes of this code, refrigerants are divided into groups as shown in Table 4-1

TABLE 4-1
REFRIGERANTS AND AMOUNTS[c]

Refrigerant	Name	Chemical Formula	Quantity of Refrigerant per Room Volume Lb/1000 $ft^{3,a}$	Vol. %	g/m^3
Group A1					
R-11	Trichlorefluoromethane	CCl_3F	1.6	0.4	250.
R-12	Dichlorodifluoromathane	$CC!_2F_2$	1.2	4.0	200.
R-13	Chlorotrifluoromethane	$CClF_3$	31	12	500.
R-1381	Bromotrifluoromathane	CBF_3	22	5.7	350.
R-14	Tetrafluoromathane (Carbon tetrafluoride)	CF_4	25	11	400.
R-22	Chlorodifluoromathane	$CHClF_2$	9.4	4.2	150.
R-113	Trichlorotrifluoroathane	CCl_2FCClF_2	1.9	0.4	300.
R-114	Dichloretetrafluoroethane	$CClF_2CClF_2$	9.4	2.1	150.
R-115	Chloropantafluoroethane	$CClF_2CF_2$	38	9.4	600.
R-134a[b]	1,1,1,2-Tetrafluoroethane	CH2FCF3	16	6.0	250.
R-C318	Oatefluorocyolobutane	C_4F_8	50	9.7	800.
R-400	R-12 and R-114	$CCl_2F_2/C_2Cl_2F_4$	d	d	d
R-500	R-12/152a (73.8/26.2)	CCl_2F_2/CH_3CHF_2	16	4.7	250.
R-502	R-22/115 (48.8/51.2)	$CHClF_2/CClF_2CF_3$	19	6.5	300.
R-503	R-23/13 (40.1/59.9)	$CHF_3/CClF_3$	25	11	400.
R-744	Carbon Dioxide	CO_2	5.7	5.0	900.
Group A2					
R-142b	1-Chloro- 1,1,-Difluoroethane	CH_2CClF_2	3.7	1.4	60.
R-152a	1, 1-Difluoroethane	CH_3CHF_2	1.2	0.7	20.
Group A3					
R-170	Ethane	C_3H_6	0.5	0.64	8.
R-290	Propane	C_3H_8	0.5	0.44	8.
R-500	Butane	C_4H_{10}	0.5	0.34	8.
R-600a	2-Mathyl propane (isobutane)	$CH\ (CH_3)_3$	0.5	0.34	8.
R-1150	Ethene (Ethylene)	C_2H_4	0.4	0.52	6.
R-1270	Propene (Propylene)	C_3H_6	0.4	0.34	6.
Group B1					
R-123[b]	2, 2-Diohlere-1,1,1-Trifluorethane	$CHCl_2CF_3$	0.004	0.001	0.06
R-764	Sulfur Dioxide	SO_2	0.016	0.01	0.26
Group B2					
R-40	Chlorenethane (Methyl Chloride)	CH_3Cl	1.3	1.0	21.
R-611	Methyl Fernate	$HCOOCH_3$	0.78	0.5	12.
R-717	Ammonia	NH_3	0.022	0.05	.35

[a] To correct for height, H(ft), above sea level, multiply these values by $(1 - 2.42 \times 10^{-6}H)$. To correct for height, h(km), above sea level, multiply these values by $(1 - 7.94 \times 10^{-2}h)$.

[b]Toxicity classification is based on recommended exposure limits provided by chemical suppliers. This rating is provisional and will be reviewed when toxicological testing is completed.

[c] The basis of the table amounts is given as follows:

Group A1 - 80% of the cardiac sensitization level for R-11, R-12, R-13B1, R-22, R-113, R-114, R-134a, R-500, and R-502. 100% of the IDLH (21 for R-744. Others are limited by levels where oxygen deprivation begins to occur.

Group A2, A3 Approximately 20% of LFL.

Group B1 - 100% of IDLH for R-764, and 100% of the measure consistent with the TLV for R-123.

Group B2, B3-100% of IDLH or 20% of LFL, whichever is lower.

[d]The quantity of each component shall comply with the limits set in Table 4-1 for the pure compound, and the total volume % of all components shall not exceed 12 volume %.

404 REQUIREMENTS FOR REFRIGERANT USE

404.1 System Selection

Refrigerating systems shall be applied in accordance with Table 4-2 and the requirements of Section 404.2, 404.3, and 404.4. To use Table 4-2, determine the occupancy class per Section 404 of the Standard Building Code©, refrigerant group per Table 4-1, and type of system per Section 403, then locate the rules that apply. When more than one rule exists, each is a limitation on the other.

TABLE 4-2
SYSTEM APPLICATION REQUIREMENTS

Refrigerant Group	System Probability	Occupancy Institutional	Public Assm., Residential Commerical	Industrial
A1	High	1	2	3
	Low	4	4	4
A2	High	5	5	3,6,8
	Low	7	7	7
A3	High	9	9	3,6,8
	Low	9	9	7
B1	High	1,6	2,6	3,6
	Low	4	4	4
B2	High	5,6	5,6	3,6,8
	Low	7	7	7
B3	High	9	9	3,6,8
	Low	9	9	7

404.2 General Restrictions - Occupancies Other Than Industrial

404.2.1 Stairways and Exitways. No portion of a refrigerating system shall be installed in or on an exit stairway, landing, entrance, or exit.

404.2.2 Hallways and Lobbies. No portion of a refrigerating system shall interfere with free passage through exits or exit access corridors, and a refrigerating system installed in a hallway or lobby shall be limited to:

(1) unit systems containing not more than the quantities of Group A1 refrigerants specified in Table 4-1 or

(2) sealed absorption systems as specified in Table 4-3.

404.2.3 Unventilated Space. When the refrigerant containing parts of a system are located in one or more unventilated spaces, the volume of the smallest, enclosed, occupied space, other than a machinery room, shall be used to determine the permissible quantity of refrigerant in the system.

404.2.4 Ventilated Space. When an evaporator or condenser is located in an air duct system, the volume of the smallest occupied space or unpartitioned building story, served by the duct will determine the permissible quantity of refrigerant in the system.

EXCEPTION: if air flow to any enclosed space cannot be reduced below one-quarter of its maximum, the entire space served by the air duct system may be used to determine the permissible quantity of refrigerant in the system.

404.2.5 Plenums. When the space above a suspended ceiling is continuous and part of the air return system, this space may be included in calculating the volume of the enclosed space.

404.3 General Restrictions - Industrial Occupancy

404.3.1 Safeguards. Means shall be taken to adequately safeguard piping, controls, and other refrigeration equipment to minimize possible accidental damage or rupture by external sources.

404.3.2 Electrical Classification. For the electrical classification of occupied spaces in which piping or other refrigeration equipment for Group A2, A3, B2 or B3 refrigerants is located, refer to Rule 8 in Section 404.

404.4 System Application Requirements

The following rules for system application requirements shall be applied as specified in Table 4-2, based on refrigerant group, system probability, and occupancy.

Blends that may fractionate to change in flammability or toxicity are treated according to their worst case classification. For example, an A1/A2 blend would follow the rules for A2 refrigerants. The amount of blend allowed would correspond to the limit on the quantity of A2 refrigerant in the blend. The total of the blend is limited as in footnote d, Table 4-1.

RULES:

1. The refrigerant amount is limited to 50% of those listed in Table 4-1, except Rule 2 applies in kitchens, laboratories, and mortuaries. If any portion of a refrigerant system containing more than one pound of refrigerant (except R-744) is in a room with a flame sustaining device, this device shall be provided with a hood to exhaust combustion products to the open air. Otherwise Rules 5 and 6 shall be followed.
2. The refrigerant amount is limited as listed in Table 4-1.
3. The refrigerant amount is unlimited when:
   (1) The area is on the ground floor and is separated from the nonrefrigerated areas of the building by tight-fitting doors;
   (2) free escape from the area is unhampered;
   (3) the number of persons in a refrigerated space on any floor above the first floor (ground level or deck level) is equal to or less than one person per 108 ft^2 (10 m^2) of floor area; or, if the number of persons exceeds one per 108 ft^2 (10 m^2), the refrigerated space shall be provided with the required number of doors opening directly into approved buildings exits. Such refrigerated space shall be cut off from the rest of the building by tight construction with tight-fitting doors.
   (4) vapor activated alarms are located in areas where refrigerant vapor from a leak is likely to concentrate so as to provide warning at the following levels: Group A1, below 19.5% volume oxygen; Group A2 and A3, at levels listed in Table 4-1; and Groups B1, B2, and B3 (except ammonia), no higher than their TLV (or toxicity measure consistent therewith).

   Otherwise the rules for commercial occupancy apply.
4. When the quantity of refrigerant in the largest system exceeds Table 4-1 amounts, all refrigerant containing parts, except piping and those parts outside the building, shall be installed in a machinery room per section 408.5.
5. Refrigerant amounts and types of systems are limited as shown in Table 4-3.
6. Applications involving air conditioning for human comfort are not allowed.
7. When the quantity of refrigerant in the largest system exceeds Table 4-1 amounts all refrigerant containing parts, except piping and those parts outside the building, shall be installed in a machinery room per 408.5. Otherwise, Rule 5 applies to the amount of Group A2, A3, B2, or B3 refrigerant in the system.

When the machinery room is used, the limitations on refrigerant quantities are as follows:

550 lb (250 kg) — Institutional
1100 lb (500 kg) — Public Assembly
No limit except Rule 8 — Residential
No limit except Rule 8 — Commercial
No limit except Rule 8 — Industrial

8. When the quantity of refrigerant exceeds Table 4-1 amounts, all refrigerant containing parts except piping, evaporators, condensers, and parts outside the building shall be installed in a machinery room per Section 408.5. In addition, refrigerants of Groups A2, A3, B2, and B3 shall meet the following requirements:

(1) The special machinery room requirements of Section 408.6 apply.

(2) Except for ammonia, amounts in excess of 1100 lb (500 kg) shall be approved by the authority having jurisdiction.

(3) Except for ammonia, when the quantity of refrigerant in any one system exceeds the amounts in Table 4-1 for any room in which part of the system is installed, then no flame producing device or hot surface above 800°F (426.5°C) shall be permitted and such room shall not be considered a Class I, Division 2, location.

9. Use of these refrigerants is prohibited except in laboratories in commercial occupancies. Only unit system containing not more than 6.6 lb (3 kg) of Group A3 or B3 refrigerant shall be used unless the laboratory in commercial occupancies. Only unit system containing not more than 6.6 lb (3 kg) of Group A3 or B3 refrigerant shall be used unless the laboratory is occupied by less than one person per 108 ft^2 (10 m^2) of floor area, in which case the requirements of industrial occupancy shall apply.

TABLE 4-3
MAXIMUM PERMISSIBLE QUANTITIES OF REFRIGERANTS FOR USE WITH RULE 5

Type of Refrigeration System	Maximum Pounds (kg) for Various Occupancies: Institutional	Public	Residential	Commercial
Sealed Absorption System				
in public hallways or lobbies	0 (0)	0 (0)	3.3 (1.5)	3.3 (1.5)
in adjacent outdoor locations	0 (0)	0 (0)	22 (10)	22 (10)
in other than public hallways or lobbies	0 (0)	6.6 (3)	6.6 (3)	22 (10)
Unit Systems				
in other than public hallways or lobbies	0 (0)	0 (0)	6.6 (3)	22 (10)

*Table 3 referenced in Table 2, Rule 5.

405 DESIGN AND CONSTRUCTION OF EQUIPMENT SYSTEMS

405.1 Materials

405.1.1 All materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Some refrigerants are corrosive to certain materials when moisture of air, or both, are present. No material shall be used that will deteriorate because of the refrigerant, the oil, or their combination in the presence of air or moisture.

405.1.2 Aluminum, zinc, magnesium, or their alloys shall not be used in contact with methyl chloride. Magnesium alloys shall not be used in contact with any halogenated refrigerants.

405.1.3 Copper and its alloys shall not be used in contact with ammonia except as a component of bronze alloys for bearings or for other nonrefrigerant containing uses.
405.1.4 Aluminum and its alloys are suitable for use in ammonia systems.

405.2 Design Pressure

405.2.1 Design pressure shall not be less than the pressure arising under all operating, shipping, and standby conditions. When selecting the design pressure, suitable allowance shall be provided for setting pressure limiting devices and pressure relief devices to avoid nuisance shutdowns and loss of refrigerant at maximum operating conditions. Minimum design pressure shall not be less than 15 psig (103.4 kPa gage) and, except as noted in 405.2.2, 405.2.3 and 405.2.4, shall not be less than 97% of the saturation pressure (gage) corresponding to the following temperatures:

(1) Lowsides of all systems equal to the ASHRAE summer 1% design dry-bulb for the location but not lower than 86°F (30°C).

(2) Highsides of all water-cooled and evaporatively cooled systems 36°F (20°C) higher than the highest water temperature of the ASHRAE summer 1% wet-built for the location, as applicable, but not lower than 104°F (40°C).

(3) Highsides of all air-cooled systems 36°F (20°C) higher than the highest ASHRAE summer 1% design dry-bulb for the location but not lower than 122°F (50°C).

405.2.1.1 The design pressure selected should exceed maximum pressure attained under any anticipated normal operating condition, including conditions created by reasonable fouling of heat exchange surfaces.

405.2.1.2 Standby conditions are intended to include all normal conditions that may be attained in the system when not operating. Selection of the design pressure for lowside component shall also consider pressure developed in the lowside of the system from equalization, or heating due to changes in ambient temperature, after the system has stopped.

405.2.1.3 The design pressure for both lowside and highside components that are shipped as part of a gas or refrigerant charged system shall be selected with consideration of internal pressures arising from exposure to maximum temperatures anticipated during the course of shipment.

405.2.2 The design pressure for either the highside or lowside need not exceed the critical pressure of the refrigerant unless such pressures are anticipated during operating, standby or shipping conditions.

405.2.3 When part of a limited charge system is protected by a pressure relief device, the design pressure of the part need not exceed the setting of the pressure relief device.

405.2.4 When a compressor is used as a booster and discharges into the suction side of another compressor, the booster compressor shall be considered as part of the lowside.

405.2.5 Any components connected to pressure vessels and subject to the same pressure as the pressure vessel shall a design pressure no less than the pressure vessel.

405.3 Refrigerant-Containing Pressure Vessels

405.3.1 6-Inch Inside Diameter or Less

405.3.1.1 Pressure vessels having an inside diameter of 6 in. (152 mm) or less shall be listed either individually or as part of an assembly by an approved, nationally recognized testing laboratory or shall meet the design, fabrication, and testing requirements of Section VIII of the ASME Boiler and Pressure Vessel

Code except that such vessels having an internal or external design pressure 15 psi (103.4 kPa gage) or less are exempt from this requirement.

405.3.1.2 If a pressure relief device is used to protect a pressure vessel having an inside diameter of 6 in. (152 mm) or less, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand a pressure at least 2.5 times the pressure setting of the relief device.

405.3.1.3 Fusible plugs shall be suitable protection from overpressure resulting from fire for pressure vessels having an inside diameter of 6 in (152 mm) or less.

405.3.1.4 If a fusible plug is used to protect a pressure vessel having an inside diameter of 6 in. (152 mm) or less, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand a pressure 2.5 times the saturation pressure of the refrigerant used, corresponding to the temperature stamped on the fusible plug, or 2.5 times its critical pressure, whichever is less. (Section 407)

405.3.2 Inside Diameter Greater than 6 inches. Pressure vessels exceeding 6 in. (152 mm) in inside diameter having internal or external design pressure greater than 15 psig (103.4 kPa gage) shall comply with the rules of Section VIII of the ASME Boiler and Pressure Vessel Code covering the requirements for design, fabrication, inspection, and testing during construction of unfired pressure vessels.

405.3.3 Pressure Vessels for 15 psi or Less. Pressure vessels having an internal or external design pressure 15 psig (103.4 kPa gage) or less shall have an ultimate strength to withstand at least 3.0 times the design pressure and shall be tested with a pressure no less than 1.33 times their design pressure.

405.4 Refrigerant Piping, Valves, Fittings and Related Parts

405.4.1 All Refrigerants

405.4.1.1 Refrigerating piping, valves, fittings, and related parts having maximum internal or external design pressure greater than 15 psig (103.4 kPa gage) shall be listed either individually or as a part of an assembly or a system by an approved, nationally recognized laboratory or shall comply with the ANSI Code for Refrigeration Piping B31.5 where applicable.

405.4.1.2 The following minimum requirements apply for unprotected refrigerant containing pipe or tubing:

(1) Copper wafer tube used for refrigerant piping shall conform to ASTM Specification B88 Types K or L.

(2) Annealed copper tube used for refrigerant piping shall conform to ASTM Specification B280.

(3) Copper tube may be connected by brazed joints or by soldered joints. (For Groups A2, A3, B2 and B3, refrigerants.)

405.4.2 All Refrigerants Except Group A1 and Ammonia

405.4.2.1 Rigid flexible metal enclosures shall be provided for annealed copper tube erected on the premises except that no enclosures shall be required for connections between a condensing unit and the nearest protected riser, provided such connections do not exceed 6 ft (1.83 m) in length.

405.4.2.2 Joints on refrigerant-containing copper tube that are made by the addition of filler metal shall be brazed.

405.5 Components Other than Pressure Vessels and Piping

405.5.1 Every pressure containing component of a refrigerating system, other than pressure vessels, piping, pressure gages, and control mechanisms, shall be listed either individually or as part of a complete refrigerating system or a subassembly by an approved, nationally recognized testing laboratory or shall be designed, constructed, and assembled to have an ultimate strength sufficient to withstand three times the design pressure for which it is rated, except waterside components exempted from the rule of Section VIII of the ASME Boiler and Pressure Vessel Code shall be designed, constructed, and assembled to have an ultimate strength sufficient to withstand 150 psig (103.4 kPa) or two times the design pressure which it is rated, whichever is greater.

405.5.2 Liquid level gage glasses shall have automatically closing shutoff valves, and such glasses shall be protected against damage.

EXCEPTION: Liquid level gage glasses of the bull's eye or reflex type shall be exempt from these requirements

405.5.3 When a pressure gage is permanently installed on the highside of a refrigerating system, its dial shall be graduated to at least 1.2 times the design pressure.

405.5.4 Liquid receivers or parts of a system designed to receive the refrigerant charge during pumpdown shall have sufficient capacity to receive the pumpdown charge without the liquid occupying more than 90% of the volume when the temperature of the refrigerant is 90°F (32°C).

EXCEPTION: Where no shutoff valve is provided between the condenser outlet and receiver inlet, there shall be sufficient capacity to receive the pumpdown charge without the liquid occupying more than 100% of the receiver volume plus 30% of the condenser volume.

405.6 Service Provision

405.6.1 All serviceable components of refrigerating systems shall be safely accessible.

405.6.2 All systems shall have provisions to handle safely the refrigerant charge for service purposes. Properly located stop valves, liquid transfer valves, refrigerant storage tanks and adequate venting for safe disposal may be required for this purpose.

405.6.3 Systems containing more than 6.6 lb (3 kg) of refrigerant (except Group A1), other than systems utilizing nonpositive displacement compressors, shall have stop valves-installed at the following locations:

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

405.6.4 Systems containing more than 100 lb (50 kg) of refrigerant, other than systems using nonpositive displacement compressors, or systems having a pumpout receiver for storage of the refrigerant charge, or self-contained systems, shall have stop valves installed at the following locations:

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

405.6.5 Stop valves used with annealed copper tube or copper water tube of 0.875 in. (22 mm) outside diameter or smaller shall be securely mounted, independent of tubing fastening or support.

405.6.6 Stop valves shall be suitably labelled if the components to and from which the valve regulates flow are not in view at the valve location. Numbers may be used to label the valves, provided a key to the numbers is located within sight of the valves and has letters at least 0.5 in. (12.7 mm) high.

405.6.7 Multistage and other complicated systems shall have a piping diagram in permanent form fixed within a frame and permanently fastened to a wall or partition near the compressor. An independent light source for the diagram shall be provided.

405.7 Factory Tests

405.7.1 Every refrigerant-containing part of every system shall be tested and proved tight by the manufacturer at not less than the design pressure for which it is rated.
405.7.2 Pressure vessels shall be tested in accordance with Section 405.3.
408.7.3 The test pressure applied to the highside of each factory-assembled refrigerating system shall be at least equal to the design pressure of the component in the highside that has the lowest-rated design pressure. The test pressure applied to the lowside of each factory-assembled refrigerating system shall be at least equal to the lowside of each factory-assembled refrigerating system shall be at least equal to the design pressure of the component in the lowside that has the lowest-rated design pressure.
In pressure-testing systems using nonpositive displacement compressors, the entire system shall be considered for test purposes as the lowside pressure.

405.8 Nameplate

Each unit system and each separate condensing unit, compressor, or compressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, nationally registered trademark or tradename, identification number, the design pressure, and the refrigerant for which it is designed. The refrigerant shall be designed according to ANSI/ASHRAE 34, Number Designation and Safety Classification of Refrigerants.

406 PRESSURE-LIMITING DEVICES

406.1 When Required

Pressure-limiting devices shall be provided on all systems operating above atmospheric pressure, except that a pressure-limiting device may be omitted on any factory-sealed system containing less than 22 lb (10 kg) of Group A1 refrigerant that has been listed by an approved, nationally recognized testing laboratory.

406.2 Setting

When required by 409.1, the maximum setting to which a pressure limiting device may readily be set by use of the adjusting means provided shall not exceed the design pressure of the highside of the system that is not protected by a pressure-relief device or 90% of the setting of the pressure relief device installed on the highside of a system, except as provided below. The pressure limiting device shall stop the action of the pressure imposing element at a pressure no higher than the maximum setting.
On systems using nonpositive displacement compressors, the pressure limiting device may be set at the design pressure of the highside of the system provided the pressure relief device is (1) located in the lowside, (2) subject to lowside pressure, and (3) there is a permanent (unvalved) relief path between the highside and the lowside of the system.

406.3 Connection

Pressure limiting devices, when required by 406.1, shall be connected between the pressure imposing element and any stop valve on the discharge side with no intervening stop valves in the line leading to the pressure limiting device.

TABLE 4-4
LENGTH ("L" in Feet) OF DISCHARGE PIPING FOR PRESSURE-RELIEF DEVICES OF VARIOUS DISCHARGE CAPACITIES

Required Discharge Capacity of ℓ Air/Min[c]	Standard wall iron, pipe size in inches[b] ½	¾	1	1¼	1½	2	Standard wall pipe, pipe size in inches[b] ½	¾	1	1¼	1½	2
	Relief Valve Setting 150 psig[a]						*Relief Valve Setting 200 psig*[a]					
5	68	278	(d)				115	470	(d)			
10	17	69	231				29	118	394			
15	7	31	102				13	52	175			
20	4	17	58	226			7	29	98			
25	3	11	37	145			5	19	83	248		
30	2	8	26	100	218		3	13	44	172		
40		4	14	57	122		2	7	25	87	210	
50		3	9	36	78	274		5	16	62	134	
60		2	8	25	54	190		3	11	43	93	
70			5	18	40	140		2	8	32	68	238
80			4	14	31	105		2	6	24	52	182
90			3	11	24	84			5	19	41	144
100			2	9	20	68			4	15	33	117
125				6	12	44			2	10	21	75
150				4	9	30				7	15	52
175				3	6	22				5	11	38
200				2	5	17				4	8	29
	Relief Valve Setting 250 psig[a]						*Relief Valve Setting 300 psig*[a]					
5	176		(d)				248		(d)			
10	44	179					62	254				
15	20	80	267				28	114				
20	11	45	150				15	54	212			
25	7	29	96				10	41	136			
30	5	20	67	263			7	28	94			
40	3	11	37	147			4	16	53	208		
50	2	7	24	94	204		3	10	34	134		
60		5	17	66	142		2	7	24	93	200	
70		4	12	48	104			5	17	68	147	
80		3	9	37	80			4	13	52	113	
90		2	7	29	63	220		3	10	41	89	
100		2	6	24	51	178		2	8	33	72	252
125			4	15	33	114		2	5	21	48	162
150			3	11	23	79			4	16	32	112
175			2	8	17	58			3	11	24	82
200			2	6	13	44			2	8	18	63
	Relief Valve Setting 350 psig[a]						*Relief Valve Setting 400 psig*[a]					
5	335		(d)				433		(d)			
10	84	380					108	492				
15	37	169					48	219				
20	21	95	285				27	123	369			
25	13	91	183				17	79	236			
30	9	42	127				12	55	164			
40	5	24	71	281			7	31	92	364		
50	3	15	46	180			4	20	59	233		
60	2	11	32	125	270		3	14	41	162	349	
70	2	8	23	92	198		2	10	30	119	257	
80		6	18	70	152		2	8	23	91	197	
90		5	14	56	120			6	18	72	155	
100		4	11	45	97	339		5	15	58	128	439
125		2	7	29	62	217		3	9	37	81	281
150		2	5	20	43	151		2	7	26	56	195
175			4	16	32	111		2	5	19	41	143
200			3	11	24	85			4	15	31	110

[a] To convert psig to kPa gage, multiply psig by 6.895.
[b] To convert inches to millimetres, multiply inches by 25.4.
[c] To convert ℓ air/min to kg air/sec, multiply ℓ air/min by 7.559×10^{-3}.
[d] To convert feet to meters, multiply feet by 0.3048.

407 PRESSURE-RELIEF PROTECTION

407.1 General Requirements

407.1.1 Every refrigerating system shall be protected by a pressure relief device or some other means designed to safely relieve pressure due to fire or other abnormal conditions.

407.1.2 All pressure vessels shall be protected in accordance with the requirements of the occupancy in which they are located.

407.1.3 A pressure relief device to relieve hydrostatic pressure to another part of the system should be used on the portion of the liquid containing parts of the system that can be isolated from the system during operation or service and that may be subjected to overpressure from hydrostatic expansion of the contained liquid due to temperature rise.

407.1.4 Evaporators located downstream, or upstream within 18 in (460 mm), of a heating coil shall be fitted with a pressure relief device discharging in accordance with this section, except that such a relief valve shall not be required on self-contained or unit systems if the volume of the lowside of the system, which may be shut off by valves, is greater than the specific volume of the refrigerant at critical conditions of temperature and pressure, as determined by the following formula:

$$V_1/[W_1 - (V_2 - V_1)/V_{gt}] \text{ shall be greater than } V_{gc}$$

where:

V_1 = lowside volume, $ft^3(m^3)$
V_2 = total volume of systems, ft^3
W_1 = total weight of refrigerant in system, lb (kg)
V_{gt} = specific volume of refrigerant vapor at 110°F (43.5°C), ft^3/lb (m^3/kg).
V_{gc} = specific volume at critical temperature and pressure, ft^3/lb (m^3/kg)

407.1.5 All pressure relief devices shall be direct-pressure actuated. Each part of a refrigerating system that can be valved off and that contains one or more pressure vessel having internal diameter greater than 6 in. (152 mm) and containing liquid refrigerant shall be protected by a pressure relief device.

407.1.6 Stop valves shall not be located between the pressure relief device and the part or parts of the system protected thereby, except when parallel relief devices are so arranged that only one can be rendered inoperative at a time for testing or repair purposes.

407.1.7 All pressure-relief devices and fusible plugs shall be connected as nearly as practicable directly to the pressure vessel or other parts of the system protected thereby, above the liquid refrigerant level and installed so that they are readily accessible for inspection and repair and so that they cannot be readily rendered inoperable. Fusible plugs may be located above or below the liquid refrigerant level except on the lowside.

407.1.8 The seats and discs of pressure relief devices shall be constructed of suitable material to resist refrigerant corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used. Seats and discs shall be limited in distortion, by pressure or other cause, to a set pressure change of not more than 5% in a span of five years.

407.2 Setting of Pressure Relief Devices

407.2.1 Pressure Relief Valve Setting. All pressure relief valves shall start to function at a pressure not to exceed the design pressure of the parts of the system protected.

407.2.2 Rupture Member Setting. All rupture members used in lieu of, or in series with, a valve shall have a nominal rated rupture pressure not to exceed the design pressure of the parts of the system protected. The conditions of application shall conform to the requirements of paragraph UG-127 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code. Rupture members installed ahead of relief valves need not be larger, but shall not be smaller, than the relief valve inlet.

407.3 Marking of Relief Devices and Fusible Plugs

407.3.1 All pressure relief valves for refrigerant containing components shall be set and sealed by the manufacturer or an assembler as defined in paragraph UG-136(c)(4) of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code. Each pressure relief valve shall be marked by the manufacturer or assembler with the data required in Paragraph UG-129(a) of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code.

EXCEPTION: relief valves for systems with design pressures of 15 psig (103.4 kPa gage) or less may be marked by the manufacturer with pressure-setting capacity.

407.3.2 Each rupture member for refrigerant pressure vessels shall be marked with the data required in Paragraph UG-129(e) of Section VIII Division 1, of the ASME Boiler and Pressure Vessel Code.

407.4 Pressure Vessel Protection

407.4.1 Pressure vessel shall be provided with pressure relief protection in accordance with rules in Paragraphs UG-125 to UG-136 inclusive, of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code, with such additional modifications as are necessary for control of refrigerants.

407.4.2 Pressure vessels over 3 ft^3 (0.085 m^3) internal gross volume, containing liquid refrigerant, except as specified in 407.4.4, which may be shut off by valves from other parts of a refrigerating system shall be protected by a pressure relief device sized per 407.2 to prevent the pressure in the pressure vessel from rising more than 10% above the setting of the pressure relief device.

407.4.2.1 Pressure vessels over 3 ft^3 (0.085 m^3) but less than 10 ft^3 (0.285 m^3) internal gross volume, under conditions specified in 407.4.2, may use a single pressure relief device.

407.4.2.2 Pressure vessels of 10 ft^3 (0.285 m^3) internal gross volume or more, under conditions specified in 407.4.2, using a pressure relief valve shall have a second pressure relief valve, in parallel, as described in 407.1.6. Each pressure relief valve shall have sufficient capacity to prevent the pressure in the pressure vessel from rising more than 10% above the setting of the pressure-relief valve.
Pressure-relief valves discharging into lowside of the system. Under the conditions permitted in 407.4.8.1, except as specified in 407.4.8.6, a single relief (not rupture member) of the required relieving capacity may be used on vessels of 10 ft^3 (0.283 m^3) or more.

407.4.3 Pressure vessels with internal gross volume of 3 ft^3 or less containing liquid refrigerant, except as specified in 404.4.4, which may be shut off by valves from all other parts of a refrigerant system, shall be protected by a pressure relief device or fusible plug. Pressure vessels of less than 3 in (76.1 mm) inside diameter are exempt from the requirements.

407.4.4 Pressure vessels having internal diameter greater than 6 in (152 mm), used as, or part of, an evaporator, insulated or installed in insulated space, which may be shut off by valves from all other parts of a refrigerating system shall be protected by a pressure-relief device except a second parallel pressure relief valve is not required. Pressure vessels used as evaporators, which have internal diameters of 6 in (152 mm) or less, are exempt from pressure-relief device requirements.

407.4.5 The required discharge capacity of the pressure relief device or fusible plug for each pressure vessel shall be determined by the following:

$$C = fDL$$

where:

C = minimum required discharge capacity of the relief device in lb of air per minute (Kg/s)

D = outside diameter of vessel in feet (m)

L = length of vessel in feet (m)

f = factor dependent upon type of refrigerant

Refrigerant	Value of f
When used on the lowside of a limited charge cascade system	
R-170, R-744, R-1150	1.0(0.082)
R-13, R-13B1, R-503	2.0(0.163)
R-14	2.5(0.203)
Other Applications	
R-717	0.5(0.041)
R-11, R-40, R-113, R-123, R-142b, R-152a, R-290, R-600, R-600a, R-611, R-764	1.0(0.082)
R-12, R-22, R-114, R-134a, R-C318,	1.6(0.163)
R-500, R-1270	25(0.203)

When pressure relief device or fusible plug is used to protect more than one pressure vessel, the required capacity shall be the sum of the capacities required for each pressure vessel.

407.4.6 The rated discharge capacity of a pressure-relief device expressed in pounds of air per minute (kilograms of air per minute), shall be determined in accordance with paragraph UG-131, Section VIII, Division of the ASME Boiler and Pressure Vessel Code. All pipe and fittings between the pressure relief valve and the parts of the system it protects shall have at least the area of the pressure relief valve inlet.

407.4.7 The rated discharge capacity of a rupture member or fusible plug discharging to atmosphere under critical flow conditions in pounds of air per minute (kg/s) shall be determined by the following formulas:

$$C = 0.8P_1d^2 \qquad (C = 1.36 \times 10^6\ P_1\ d^2)$$

$$d = 1.12\ (C/P_1)^{0.5} \qquad (d = 857.5(C/P_1)^{0.5})$$

where:

C = rated discharge capacity in pounds of air per minute (kg/s)

d = smallest of the internal diameter of the inlet pipe, retaining flanges, fusible plug, and rupture member in inches (millimeters)

where:

for rupture members,

$P1$ = (rated pressure psig kPa gage x 1.10) + 14.7 (101.33)

for fusible plugs,

P_1 = absolute saturation pressure, corresponding to the stamped temperature melting point of the fusible plug, or the critical pressure, of the refrigerant used, whichever is smaller, psia (kPa).

407.4.8 Pressure relief devices and fusible plugs on any system containing a Group A3 or B3 refrigerant, or any system containing more than 6.6 lb (3 kg) of Group A2, B1, or B2 refrigerant, and on any system containing more than 110 lb (50 kg) of Group A1 refrigerant shall discharge to the atmosphere at a location not less than 15 ft (4.57 m) above the adjoining ground level and not less than 20 ft (6.1 m) from any window, ventilation opening, or exit in any building. The discharge termination shall be fashioned in such a manner to prevent direct spray of discharged refrigerant on personnel in the vicinity and foreign material or debris from entering the discharge piping. Discharge piping connected to the discharge side of a fusible plug or rupture member shall have provisions to prevent plugging the pipe in the vent the fusible plug or rupture member functions.

407.4.8.1 Pressure relief valves may discharge into the lowside of the system provided the pressure relief devices are not a type affected by back pressure and provided the lowside of the system is equipped with pressure relief devices. The relief device on the lowside of the system shall have sufficient capacity to protect the pressure vessels that are relieved into the lowside of the system, or to protect all pressure vessels on the lowside of the system whichever relieving capacity is the largest, as computed by the formula in Section 407. Such a lowside pressure relief device shall be set in accordance with 10.2.1 and vented to the outside of the building.

407.4.8.2 Optional Ammonia Discharge. Where ammonia is used, the preferred discharge is to atmosphere. An optional discharge may be used into a tank of water that shall be used for no other purpose except ammonia absorption. At least one gallon of fresh water shall be provided for each pound (1 m^3 for each 120 kg) of ammonia in the system. The water used shall be prevented from freezing without the use of salt or chemicals. The tank shall be substantially constructed of not less than 1/8 in (3.2 mm) or No. 11 U.S. gage iron or steel. No horizontal dimension of the tank shall be greater than one half the height. The tank shall have a hinged cover, or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank near the bottom.

EXCEPTION: An indirect ammonia water absorption unit system installed outdoors adjacent to single-family residence is not required to comply with 407.4.8 provided the discharge is shielded and dispersed.

407.4.8.3 Optional Sulphur Dioxide Discharge. Where sulphur dioxide is used, the discharge may be into a tank of absorptive solution that shall be used for no other purpose except sulphur dioxide absorption. There shall be one gallon of standard dichromate solution (2.5 lb sodium dichromate per gallon of water or 300 kg per m^3 for each pound (1 m^3 for each 120 kg) of sulphur dioxide in the system. Solutions made with caustic soda or soda ash may be used in place of sodium dichromate provided the quantity and strength have the equivalent sulphur dioxide absorbing power. The tank shall be substantially constructed of not less than 1/8 in (3.2 mm) or No. 11 U.S. gage iron or steel. The tank shall have a hinged cover or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure relief valve shall discharge the sulphur dioxide in the center of the tank near the bottom.

407.4.8.4 The size of the discharge pipe from the pressure relief device or fusible plug shall not be less than the outlet size of the pressure relief device or fusible plug. If the discharge from more than one relief device or fusible plug is connected into a common header, the size and maximum equivalent length of the discharge header shall be determine by the sum of the rated discharge capacities of all relief valves discharging into the header, at the lowest pressure setting of any of the relief valves discharging into the header.

407.4.8.5 The maximum length of the discharge piping permitted to be installed on the outlet of a pressure relief device or fusible plug shall be determined as follows:

$$L = P^2 d^5/16C^2 \quad [L = 7 \times 10^{-13} P^2 d^5/36C^2]$$

where:

C = minimum required discharge capacity in pounds of air per minute (kg/s)
d = internal diameter of pipe in inches (mm)
L = length of discharge pipe in feet (m).

For relief valves and ruptures discs:

P = (Rated pressure x 1.1) + 14.7 [101.33].

For fusible plugs:

P = pressure as defined in 407.4.7..

See Table 4-4 for the results of computations using the relief valve formula.

407.4.8.6 Positive Displacement Compressor

When required to be equipped with a stop valve in the discharge connection, every Group A1 refrigerant positive displacement compressor operating above 15 psig (103.4 kPa) and every other refrigerant group having a positive displacement compressor shall be equipped by the manufacturer with a pressure relief device of adequate size and pressure setting to prevent rupture of the compressor or any other component located between the compressor and the stop valve on the discharge side. The pressure relief device shall discharge into the low pressure side of the system or in accordance with 407.4.8.

408 INSTALLATION REQUIREMENTS

408.1 Foundations

Foundations and supports for condensing units or compressor units shall be of substantial and noncombustible construction when more than 6 in (152 mm) high.

408.2 Refrigerant Parts in Air Duct

Joints and all refrigerant containing parts of a refrigerating system located in an air duct carrying conditioned air to and from an occupied space shall be constructed to withstand a temperature of 700°F (353.3°C) without leakage into the airstream.

408.3 Refrigerant Pipe Joint Inspection

Refrigerant pipe joints erected on the premises shall be exposed to view for visual inspection prior to being covered or enclosed.

408.4 Location of Refrigerant Piping

408.4.1 Refrigerant piping crossing an open space that affords passageway in any building shall be not less than 7.25 ft (2.2 m) above the floor.

408.4.2 Exits and exit access corridors shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter, or other shaft containing a moving object or in any shaft that has openings to living quarters or to main exits. Refrigerant piping shall not be placed in exits, lobbies or stairways, except that such refrigerant piping may pass across an exit if there are no joints in the section in the exit and provided nonferrous tubing of 1.12 in. (28.6 mm) outside diameter and smaller be contained in a rigid metal pipe.

408.4.3 Refrigerant piping may be installed vertically through floors from one story to another only as follows:

(1) It may be installed from the basement to the first floor, from the top floor to machinery penthouse or to the roof, or between adjacent floors served by the refrigerating system.

(2) The piping may be carried in an approved, rigid and tight, continuous fire resisting pipe duct or having no openings into floors not served by the refrigerating system, or it may be carried on the outer wall of the building, provided it is not located in an air shaft, closed court, or in similar spaces enclosed with the outer walls of the building. The pipe duct or shaft shall be vented to the outside or to the space served by the system.

(3) Piping of a direct system containing Group A1 refrigerant need not be enclosed where it passes through space served by that system.

408.4.3.1 Piping penetrations must be protected in accordance with Chapter 10 of the Standard Building Code.

408.4.4 Refrigerant piping may be installed horizontally in closed floors or in open joist spaces. Piping installed in concrete floors shall be encased in pipe duct.

408.5 Machinery Room, General Requirements

408.5.1 When a refrigerating system is located indoors, a machinery room shall be provided when required by 404.4. Machinery rooms serve for accommodating refrigerating machinery but may also house other mechanical equipment. A machinery room shall be so dimensioned that all parts are easily accessible with adequate space for proper service, maintenance and operations. There shall be clear head room of not less than 7.25 ft (2.2 m) below equipment situated over passageways. Access to the machinery room shall be restricted to authorized personnel.

408.5.2 Each refrigerating machinery room shall have a tight-fitting door or doors opening outward, self-closing if they open into the building, and adequate in number to ensure freedom for persons to escape in an emergency. There shall be no opening that will permit passage of escaping refrigerant to other parts of the building.

408.5.2.1 For Group A1 refrigerants, machinery rooms shall be equipped with an oxygen sensor to warn of oxygen levels below 19.5 volume percent since there is insufficient odor warning. The sensor shall be located in an area where refrigerant from a leak is likely to concentrate, and shall actuate an alarm.

408.5.2.2 For all other refrigerants, a refrigerant vapor detector shall be located in an area where refrigerant from a leak is likely to concentrate and an alarm shall be employed. The alarm shall be actuated at a value not greater than the corresponding TLV (or toxicity measure consistent therewith).

EXCEPTION: For ammonia refer to 408.6.7.

408.5.2.3 Periodic tests of the detector(s), alarm(s), and the mechanical ventilating system shall be performed.

408.5.3 Machinery rooms shall be vented to the outdoors utilizing ventilation in accordance with paragraphs 408.5.4.

408.5.4 Mechanical ventilation referred to in paragraph 408.5.3 shall be by one or more power driven fans capable of exhausting air from the machinery room at least in the amount given in the formula in paragraph 408.5.7. To obtain a reduced airflow for normal ventilation, multispeed fans may be used. The air inlets shall be near the machinery and suitably guarded. The discharge of the air shall be to the outdoors in such a manner as not to cause inconvenience or danger. Openings for inlet air shall be positioned to avoid intake of discharged air. Provision shall be made for inlet air to replace that being exhausted. Air supply and exhaust ducts to the machinery room shall serve no other area.

408.5.5 No open flame or apparatus to produce an open flame shall be installed in a machinery room where any refrigerant other than carbon dioxide is used. The use of matches, lighters, halide leak detectors, and similar devices shall not be considered a violation of this part.

408.5.6 Access to the machinery room shall be restricted to authorized personnel.

408.5.7 The minimum ventilation required to exhaust a potential accumulation of refrigerant due to leaks or a rupture of the system shall be capable of removing air from the machinery room in the following quantity:

$$Q = 100 \times G^{0.5} \qquad (Q = 70 \times G^{0.5})$$

where:

Q = the airflow in cu ft per minute (liters per second)

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

A sufficient part of the mechanical ventilation shall be operated to provide normal volumes equal to the larger of the following:

(1) 0.5 cfm per sq ft (2.54 L/s per sq meter) of machinery room area.

(2) Volume required to maintain a minimum temperature rise above ambient of 18°F (10°C) based on all of the heat producing machinery in the room.

When a refrigerating system is located outdoors more than 20 ft (6.1 m) from any building opening and is enclosed by a penthouse, lean-to, or other open structure, natural ventilation may be employed as an alternative to mechanical ventilation. The requirements for such natural ventilation are as follows:

The free aperture cross section for the ventilation of the machinery room shall amount to at least:

$$F = G^{0.5} \quad (F = 0.138G^{0.5})$$

where:

F = the free opening area in square feet (square meter)

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

Locations of the opening shall be with due regard for the relative density of the refrigerant to air.

408.6 Machinery Room, Special Requirements

In cases specified in Table 4-2, the machinery room shall meet the following special requirements in addition to those in 408.5

408.6.1 There shall be no flame producing device or hot surface over 800°F (427°C) permanently installed in the room.

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

408.6.3 Walls, floors, and ceiling shall be tight and of not less than one hour fire resistive construction.

408.6.4 It shall have an exit door that opens directly to the outer air or through a vestibule equipped with self-closing, tight-fitting doors.

408.6.5 Exterior openings, if present, shall not be under any fire escape or any open stairway.

408.6.6 All pipes piercing the interior walls, ceiling, or floor of such a room shall be tightly sealed to the walls, ceiling, or floor through which they pass.

408.6.7 Ventilation in ammonia machinery rooms shall be either (1) run continuously or (2) equipped with a vapor detector that will automatically start the ventilating system and actuate an alarm at the lowest practical detection levels not exceeding 4% by volume, or (3) the machinery room shall conform to Class 1, Division 2, of NFiPA 70.

408.6.8 When refrigerants of Groups A2, A3, B2 other than ammonia, and B3 are used, the machinery room shall conform to Class 1, Division 2, of NFiPA 70.

408.6.9 Remote pilot control of the mechanical equipment in the machinery room shall be provided immediately outside the machinery room solely for the purpose of shutting down the equipment in an emergency.

408.7 Purge Discharge

The discharge of purge systems shall be governed by the same rules as pressure relief devices and fusible plugs and may be piped in conjunction with these devices

409 FIELD TESTS

409.1 General

409.1.1 Every refrigerant-containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms, and systems that are factory tested, shall be tested and proved tight after complete installation and before operation.

The high and low sides of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or lowside of the system, respectively, except as noted in 409.1.2.

409.1.2 Systems erected on the premises using Group A1 refrigerant and with copper tubing not exceeding 0.62 in (16 mm) in outside diameter may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68°F (20°C) minimum.

409.2 Test Medium

Oxygen or any combustible gas or combustible mixture of gases shall not be used within the system for testing.

The means used to build up the test pressure shall have either a pressure limiting device or pressure reducing device with a pressure relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

409.3 Declaration

A dated declaration of test shall be provided for all systems containing 55 lb (25 kg) or more of refrigerant. The declaration shall give the name of the refrigerant and the field test pressure applied to the highside and the lowside of the system. The declaration of test shall be signed by the installer and, if an inspector is present at the tests, he should also sign the declaration. When requested copies of this declaration shall be furnished to the enforcing authority.

410 GENERAL REQUIREMENTS

410.1 Signs

410.1.1 Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds (kg) of refrigerant required in the system for normal operation, and the field pressure applied.

410.1.2 Metal sign for system containing more than 110 lb (50 kg) of refrigerant. System containing more than 110 lb (50 kg) of refrigerant shall be provided with metal signs having letters not less than 0.5 in (12.7 mm) in height designating the main shutoff valves to each vessel, main steam or electrical control, remote control switch, and pressure limiting device. On all exposed high-pressure and low-pressure piping in each room, where installed outside the machinery room, shall be signs, as specified above, with the name of the refrigerant and letter "HP" or "LP".

410.1.3 When the kind of refrigerant is changed as provided in 410.2 (substitution of refrigerant), there shall be a new sign, of the same type as specified in 410.1, indicated clearly that a substitution has been made and stating the same information for the new refrigerant as was stated for the original.

410.2 Changing Refrigerant
A change in the type of refrigerant in a system shall not be made without the permission of the approving authority, the user, and the makers of the original equipment and due observance of safety requirements.

410.3 Charging and Discharging of Refrigerant
When refrigerant is added to a system, except for a unit system requiring less than 6.6 lb (3 kg) of refrigerant, it shall be charged into the low-pressure side of the system. Any point of the downstream side of the main liquid line stop valve shall be considered as part of the low-pressure side when operating with said stop valve in the closed position. No service containers shall be left connected to a system except while charging or withdrawing refrigerant.

410.4 Withdrawing Refrigerant
Refrigerant withdrawn from refrigerating systems shall be transferred to approved containers only. No refrigerant shall be discharged to sewer, river stream, or lake.

410.5 Containers
Containers used for refrigerants withdrawn from a refrigerating system shall be carefully weighed each time they are used for this purpose, and containers shall not be filled in excess of the permissible filling weight for such containers and such refrigerants as are prescribed in the pertinent regulations of the Department of Transportation.

410.6 Storing Refrigerant
Refrigerant stores in a machinery room shall not be more than 330 lb (150 kg) in addition to the charge in the system and the refrigerant stored in a permanently attached receiver and then only in approved storage containers.

410.7 Respirator
At least one approved respirator (self-contained breathing apparatus) shall be provided at a location convenient to the machinery room.

410.8 Maintenance
All refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and shall be kept readily accessible at all times.

410.9 Responsibility for Operation
It shall be the duty of the person in charge of the premises on which a refrigerating system containing more than 55 lb (25 kg) of refrigerant is installed to place a card conspicuously as near as is practicable to the refrigerant compressor giving directions for the operation of the system, including precautions to be observed in case of a breakdown or leak as follows:

1. instructions for shutting down the system in case of emergency,
2. the name, address, and day and night telephone numbers for obtaining service, and
3. the name, address, and telephone number of the municipal inspection department having jurisdiction and instructions to notify said department immediately in cases of emergency.

410.10 Calibration of Pressure Gages

Pressure gages should be checked for accuracy prior to test and immediately after every occasion of unusually high pressure, equal to full-scale reading, either by comparison with master gages or by setting pointers as determined by a dead-weight gage tester.

CHAPTER 5
DUCTS AND DUCT SYSTEMS

501 SCOPE

501.1 General

All duct systems used for the movement of air or material in air conditioning, heating, ventilating, environmental exhaust and conveying systems shall conform with the provisions of this chapter. See 307 and 308 for ventilating and exhaust systems for the removal of dust, smoke, fumes, gases, vapors, odors or other hazardous, noxious or injurious impurities.

501.2 Limitations

When referred to in this section, commercial duct applies to all systems serving spaces of over 25,000 cu ft and residential duct applies to all systems serving one and two family dwellings and spaces 25,000 cu ft and less.

502 STANDARDS

Ducts shall be constructed, braced, reinforced and installed to provide structural strength and durability. Ducts and duct systems complying with the requirements of the following standards shall be deemed as meeting the intent of this Code:

1. SMACNA HVAC Duct Construction Standards, Metal and Flexible and SMACNA Fibrous Glass Duct Construction Standard.
2. The Equipment Volume of the Handbook published by the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
3. UL 181.

503 DUCT MATERIALS

503.1 Allowable Materials

All ducts shall be constructed of iron, steel, aluminum or other approved material.

503.2 Commercial Duct Systems

503.2.1 Flexible and rigid Class 0 and Class 1 duct materials may be used when installed in accordance with the conditions of their listing, provided they are not used for vertical risers serving more than two stories and they are used on duct systems having a maximum air temperature of 250°F. Listed air duct material is not limited in length.

503.2.2 When approved by the Mechanical Official, part of the building structure may be used as a duct when installed in accordance with one of the following:

1. Ductwall construction consisting of not less than 3/4-inch cement or gypsum plaster on metal lath applied to suitable supports.
2. Duct walls of masonry construction of proper strength and design.
3. Properly constructed and lined passages of gypsum wallboard may be used for ductwalls for return air and heating ducts in which no condensation is to be encountered.

503.3 Residential Duct Systems

503.3.1 All ducts shall be constructed of metal having a minimum thickness as shown in the following table:

	Diam. or Width (in)	Nominal Thickness (in)	Equiv. Galvanized Sheet Gage No.	Aluminum Thickness (in)
Round Ducts:				
	14 or less	.0127	30	.0183
	Over 14	.0157	28	.023
Exposed Rectangular Ducts:				
	14 or less	.0157	28	.023
	Over 14	.0187	26	.032

503.3.2 Nonmetallic ducts and duct materials may be used for duct systems serving listed automatic-fired heating equipment having a 250°F temperature limit control when installed in accordance with the conditions of their listing and the following:

1. The entire system including plenums may be Class 0 or Class 1 materials.
2. Class 2 materials may be used in single-family dwellings only and shall not be used for ducts located within the first 3 ft of the bonnet, plenum or casing of the heating unit.

503.3.3 Return ducts, except those portions directly above the heating surface or closer than 2 ft from the heating unit casing, may be constructed of materials having a flame spread rating not higher than 200.

504 DUCT CONSTRUCTION AND INSTALLATION

504.1 Joints, Seams And Connections

504.1.1 Joints and seams shall be securely fastened and made substantially air tight. Where tape is used for sealing joints, it shall not be more combustible than flameproof fabric. All slip joints shall have at least a 1-inch lap which is mechanically fastened.

504.1.2 Vibration isolation connectors between ducts and mechanical systems shall be of an approved flame retardant fabric, and shall be 10 inches or less in length. On commercial systems, a sleeve joint packed with an approved material having a maximum flamespread rating of 25 and maximum smoke developed rating of 50 may be used.

504.1.3 Branches of the duct system shall be connected by one of the following:

1. factory take-off fittings, or
2. dovetail fittings constructed using alternating 3/4 x 3/4 inch tabs with joints sealed with caulking and tape.

504.1.4 Joints in all round pipe shall be secured with three or more sheet metal screws.

504.2 Protection

Ducts shall be suitably protected when placed in locations where they may be subject to damage, rupture or corrosion.

504.3 Support
Metal ducts shall be securely supported, hung or suspended by metal hangers, straps, rods, lugs or brackets complying with the duct construction standards referenced in 502. Approved nonmetallic ducts and approved duct systems shall be installed and supported in accordance with the terms of their listing. When approved by the Mechanical Official, heavy gage galvanized wire may be used for supports. When duct static pressure exceeds 2-inch water gage, any piercing of the duct wall to attach the duct to a supporting structure shall be sealed.

504.4 Location
Ducts shall not be installed in or within 4 inches of the ground unless the provisions of 507 are met.

504.5 Exposed Ducts
Vertical supply ducts in residential systems which are exposed in closet or rooms shall be covered or lined with a minimum of 1/4-inch thick approved fire resistant material.

504.6 Protection Of Openings
Exposed openings in fan housing shall be protected with screens or gratings to prevent accidents or the entry of foreign material.

504.7 Safety
All mechanical equipment shall be provided with guards or protectors over rotating parts to prevent accidents.

504.8 Lighting
Lights or lighting installed within the enclosure of any duct system shall be enclosed fixtures of the marine (vapor-tight) type. Germicidal lamps are not included.

504.9 Weather Protection
All ducts including linings, coverings and vibration isolation connectors installed on the exterior of the building shall be adequately protected against the elements.

505 FLEXIBLE AIR DUCT CONNECTORS

505.1 General
Flexible air connectors for use between air ducts and air outlets or air outlet units which do not pass through floors of buildings need not conform to the requirements of 503 for ducts if they conform to the following provisions:

1. Air duct connectors up to 8-inch diameter shall be minimum Class 2 materials.
2. Air duct connectors exceeding 8-inch diameter shall be minimum Class 1 materials.
3. Flexible air duct connectors shall not exceed 14 ft in length.
4. Flexible air duct connectors shall not pass through a fire wall or partition having a required fire resistance rating of 1 hour or more.

506 INSULATION

506.1 Materials

506.1.1 Coverings and linings, including adhesives when used, shall have a flame-spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating not over 50.

506.1.2 Duct coverings and linings shall not flame, flow, smolder, or smoke when tested in accordance with ASTM C 411 at the temperature to which it is exposed in service. In no case shall the test temperature be below 250°F.

506.1.3 Linings shall be interrupted at the area of operation of a fire damper or fire door.

506.1.4 Linings shall be interrupted for a minimum of 18 inches upstream and 30 inches downstream from electric resistance and fuel burning heaters in a duct system. (See 506.2.)

506.1.5 Listed equipment internally lined shall be considered as meeting the requirements of 506.1.

506.1.6 Duct coverings shall not penetrate a wall or floor required to have a fire resistance rating or required to be firestopped.

506.1.7 Service openings shall not be concealed by duct coverings unless the exact location of the opening is properly labeled.

506.1.8 Foam plastic shall conform to 717 of the Standard Building Code.

506.1.9 External duct work insulation and factory insulated flexible duct work shall be legibly printed or labeled at intervals not greater than 36 inches with the name of the manufacturer, the nominal thickness and density of the insulation or R-value and the flamespread and smoke developed ratings of the composite materials.

506.2 Installation

506.2.1 All ductwork installed in an attic shall be insulated. All metal supply ductwork installed in a ventilated crawl space or other nonconditioned area shall be insulated. Insulation shall be a minimum 2 inches thick, 3/4 pound density blanket or 1 inch thick, 1 1/2 lb density liner. When ducts used for cooling are externally insulated, the insulation shall be covered with a vapor barrier having a maximum permeance of 0.05 perms or aluminum foil having a minimum thickness of 2 mils. When nonmetallic ducts or other approved insulating or lining materials are used, the maximum thermal conductance value of the material shall be 0.23 at 75°F. All exterior ducts insulated shall be properly protected with an approved weatherproof vapor barrier.

506.2.2 Where duct liner has been interrupted, a duct covering of equal thermal performance shall be installed.

506.2.3 All ducts which operate at temperatures in excess of 120°F shall have sufficient thermal insulation to limit the exposed surface temperature to 120°F (vapor barrier not required).

507 DUCTS IN CONCRETE SLABS

507.1 General

507.1.1 Ducts located in or under concrete shall be of metal of sufficient strength encased on all sides with not less than 2 inches of concrete or shall be of other approved material specifically designed for this service

509.2.2 Construction Practices

509.2.2.1 Framing shall comply with the requirements of the Standard Building Code.

509.2.2.2 Where required, preservatives for decay and termite protection shall be of approved water borne type.

509.2.2.3 Chemical soil treatment shall be applied to both sides of the foundation wall from the footing to the grade level. Approved chemicals shall be used. All excavations for plumbing and other services shall be completed at the time of the chemical soil treatment, or retreatment shall be necessary.

509.2.2.4 After the soil has been treated, a vapor barrier shall be provided within the foundation perimeter, from wall to wall, with joints lapped 4 inches but not sealed. The vapor barrier membrane shall be carefully fitted around pipes and drains and turned up at the foundation wall. The vapor barrier membrane shall be equal to or greater than polyethylene film of 4 mil thickness and a flamespread classification of 200 or less.

509.2.2.5 A noncombustible receptacle shall be placed below each floor register into the air chamber. Such receptacle shall conform to the following:

1. The receptacle shall be securely suspended from the floor members and shall not be more than 18 inches below the opening.
2. The size of the horizontal projected area of the receptacle shall extend 3 inches beyond the opening.
3. The perimeter of the receptacle shall have a vertical lip at least 1 inch high at the open sides if it is at the level of the bottom of the joints or 3 inches high if the receptacle is suspended.

509.2.2.6 The foundation wall shall be insulated along its inner face from the sill vertically to the underfloor plenum grade level and horizontally over the vapor barrier, a distance of 2 ft. The plenum system shall be insulated to provide a thermal resistance, excluding film resistance, of:

$$R = (\Delta t\ hr/15)\ (°\ F)(ft^2/Btu)$$

Where Δt = the design temperature between the air in the plenum floor system and the minimum outdoor design temperature.

509.2.2.7 Outlets from the plenum shall be provided by one of the following methods:

1. Approved air slots, floor registers or wall registers shall be provided.
2. Floor registers shall be designed for easy removal in order to give access for cleaning.
3. Wall registers shall be connected to the plenum space with a duct or boot complying with the requirements of this chapter.

510 FIRE PROTECTION OF DUCTS

510.1 Fire Door

Duct penetrations of fire walls having a fire resistance rating of 3 hours or more shall be protected by installing a listed fire door satisfactory for Class A openings on both sides of the walls.

510.2 Fire Dampers

510.2.1 Listed fire dampers shall be installed in accordance with the manufacturer's installation instructions in the following locations:

1. Ducts penetrating walls or partitions enclosing exits, boilers, and furnaces having a fire resistance rating of 1 or more hours.
2. Ducts penetrating shaft walls having a fire resistance rating of 1 or more hours (not sprinklered).
3. Ducts penetrating floors of buildings requiring the protection of vertical openings when the duct is not protected by shafts described in 510.5.
4. Transfer ducts and openings penetrating walls or partitions having a fire resistance rating of one or more hours.

510.2.2 Fire Dampers are not required under the following conditions unless required above:

1. In buildings which do not require protected floor openings.
2. In duct systems serving only one floor and used only for exhaust of air to the outside and not penetrating a wall or partition having a required fire resistance rating of 2 hours or more or passing entirely through the enclosure for a vertical shaft.
3. Where branch ducts connect to return risers in which the air flow is upward and subducts at least 22 inches long are carried up inside the riser at each inlet.
4. In openings in shaft walls in fully sprinklered buildings which are supervised.
5. Duct systems, of any duct material or combination thereof, penetrating 1-hour rated walls or partitions shall meet the following minimum requirements:
   1. The duct shall be of 0.0217 inch (26 ga) minimum steel.
   2. The duct shall continue with no duct openings for not less than 5 feet from the rated walls, and the duct secured in the opening by steel collars of a gauge equivalent to that of the duct and fastened to both the duct and the enclosure, or other approved method affording equivalent protection. When wall registers occur at the rated wall, a fire damper shall be provided.

510.3 Ceiling Penetration

Ducts penetrating the ceiling of a fire resistant roof/floor and ceiling assembly shall be protected by methods complying with the design of the assembly or by ceiling dampers specifically designed and listed for this type service.

510.4 Smoke Dampers

Unless the air system is designed to provide smoke control or pressurization functions during a fire emergency, smoke dampers with listed operators shall be installed at all duct penetrations of required smoke partitions.

510.5 Floor Penetration

In buildings more than one story in height, ducts extending through more than one floor shall be enclosed in a shaft constructed of noncombustible materials having a fire resistance rating of not less than 1 hour for buildings less than four stories in height and not less than 2 hours for buildings four stories and more in height. Ducts penetrating only one floor may be protected by installing a listed fire damper where the floor is pierced in lieu of the enclosure.

510.6 Means Of Access

An access door or other approved means of access shall be provided in ducts to permit the proper maintenance and resetting of each fire door, fire damper and smoke damper. For ducts located above the ceiling of a fire rated assembly, a service opening designed and installed so as not to reduce the fire rating of the assembly shall be provided.

510.7 Location And Installation Details

The specific location and installation details of each fire door, fire damper, ceiling damper and smoke damper shall be shown and properly identified on the building plans by the designer.

511 WEATHERPROOFING

All ducts installed outside buildings and exposed to the elements shall be properly weatherproofed in an approved manner. Ducts with internal insulation shall have all joints and seams soldered or otherwise sealed so as to be weathertight. Ducts externally insulated shall have this insulation protected with a covering of sheet metal, weatherproof membrane or a mastic coating, all of which shall be applied in an approved manner.

512 Moved to 509.1

513 AIR FILTERS

All heating and air conditioning systems of the central type shall be provided with approved type air filters. Low velocity type filters shall have a face area of not less than 1 sq in for each 2 1/2 cu ft per minute of air circulated by the unit. Filters shall be installed in the return air, upstream from any heat exchanger or coil, in an approved convenient location, and shall be easily accessible for cleaning or replacement. Filters shall be of a type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when attacked by flames. Liquid adhesive coatings used on filters shall have a flashpoint not lower than 325°F.

514 FRESH AIR INTAKES

Outdoor air intakes shall be protected against fire exposure by means of approved fire doors, dampers, or other suitable protection in accordance with the degree of exposure hazard and shall be screened with a corrosion-resistant material not larger than 1/2-inch mesh. Fresh air intakes shall not be taken from a location closer than 10 ft from any chimney or vent outlet, or sanitary sewer vent outlet, unless such vent outlet is not less than 24 inches above the fresh air inlet.

515 FAN SHUTDOWN CONTROLS

515.1 Scope

The provisions of this section shall apply to all HVAC systems except systems serving one and two family dwellings, individual apartments, condominiums, and townhouses.

515.2 Manual Controls

Each air distribution system shall be equipped with a manual control to stop supply and return fans in an emergency. The control device shall be mounted in a readily accessible location and identified.

EXCEPTION: An air handling unit serving a single space with no attached duct systems.

515.3 Automatic Shutdown

Recirculating air systems serving more than one room or compartment shall be automatically shut down on detection of smoke by duct type smoke detector(s) in the return duct ahead of make-up air connection when:

1. An air handling unit serves sleeping or patient care areas in Institutional (I) or Residential (R) occupancies or required exit corridors in all occupancies regardless sof CFM capacity, or
2. An air handling unit has a rated capacity exceeding 2000 CFM.

515.4 An air handling unit serving more than one floor shall be automatically shut down on detection of smoke by a duct type detector in the return duct from each floor level located upstream from connection to the common return.

515.5 Exceptions to Sections 515.3 and 515.4.

1. Duct detectors may be omitted and air handling unit may be shut down by area smoke detector system provided full area coverage is provided as per NFiPA 72E.
2. Automatic shutdown is not required when an automatic smoke evacuation (smoke control) system, designed by a professional engineer, is installed.

515.6 An air handling unit exceeding 15,000 CFM shall automatically shut down on detection of smoke by a duct type detector located downstream of the filters. This detector is in addition to the detector required in return air of units serving more than one space as required by 515.3.

EXCEPTION: An air handling unit serving a single space with no attached duct systems.

515.7 Where a building smoke detection system is provided, each smoke or duct type detector required for control of recirculating air system shall also be connected to activate the fire alarm system.

516 STAIRWELL ENCLOSURES

Ducts serving other areas shall not be located in or pass through exit enclosures.

517 RETURN AIR INTAKE FOR RESIDENCES (Non-Engineered Systems)

517.1 If only one central return air grille is installed, it shall be of proper size. The size shall be sufficient to return a volume of air compatible with the CFM requirements and temperature rise limitations specified by the equipment manufacturer. The face velocity of return air grilles shall not exceed 450 fpm. At least one separate return shall be installed on each level of a multilevel structure. For split-level and split-foyer structures one return may serve more than one level if located near the levels served and the total area of the levels does not exceed 1600 sq ft. Return air grilles shall not be located in bathrooms. The return air from one residential living unit shall not be mixed with return air from other living units.

517.2 In buildings with 1600 sq ft or less of conditioned area, a central return is permitted. When the building contains more than 1600 sq ft of conditioned area, additional returns shall be provided. Each return shall not serve more than 1600 sq ft of area and shall be located in the area it serves. Return air may travel through the living space to the return air intake if there are no restrictions, such as solid doors, to the air movement. When panned joists are used for return air, the structural integrity shall be maintained. Air capacity for joists, 16 inches on center shall be a maximum of 375 CFM for 8 inches joists and 525 CFM for 10 inches joists. Wiring located in spaces used for return air ducts shall comply with North Carolina State Building Code, Volume IV - Electrical.

CHAPTER 6 PIPING

601 GENERAL

The provisions of this chapter shall govern the construction, installation, alteration and repair of all heating, cooling and certain process piping for steam, chilled and hot water systems unless otherwise provided for in this Code.

602 STEAM AND HOT WATER PIPING

602.1 General Steam and hot water piping shall conform to Table 602.1. The system shall be designed to operate within specified pipe or tubing working pressure and temperature rating.

TABLE 602.1 MATERIAL STANDARDS

Materials	Standards	Remarks
Steel	ASTM A 120/A 53	Schedule 40
Copper Tube	ANSI/ASTM B 88	
Copper Pipe	ANSI/ASTM B 42	
Brass Pipe	ANSI/ASTM B 43	
Polybutylene	ANSI/ASME B31.9 and ASTM D 3309	Hot water piping only
Steel	ASTM A53/A 135	Schedule 5 for use with mechanical pressfitting system. Hot water only.

602.2 Reaming All pipe or tubing shall be reamed after cutting to not less than full internal dimensions.

602.3 Pipe Joining Polybutylene pipe and tubing shall be joined by fusion, insert fittings and crimp rings, or mechanical fittings. Steel piping shall be joined by welding or by the use of screw or flanged fittings, or mechanical fittings. Schedule 5 steel may be joined by self-restraining mechanically pressed fittings. Copper tubing shall be joined by brazing, soldering or approved compression fittings.

EXCEPTION: For joints in embedded construction, see 303.11.4.

602.4 Pipe

Support 602.4.1 Pipe and piping shall be properly hung and supported to permit expansion and contraction. U-bends, swing joints or expansion joints shall be installed so as to permit free expansion and contraction of the piping. Swing joints of U-bends shall be fabricated of equivalent pipe material, and shall be suitable for the pressures and temperatures at which the installation is designed to operate. Expansion joints of either the slip sleeve or corrugated copper type may be used where such joints meet the temperature and pressure requirements of the installation.

602.4.2 All piping shall be securely supported on substantial noncombustible supports or hangers. Such supports or hangers shall be securely fastened to an adequate support or structural member. The hangers or supports shall be so spaced that there shall be no undue stress or strain on the pipe, joints, fittings or valves and so sagging will not occur in the pipe between points of suspension under normal operating conditions.
602.4.3 The piping shall be securely fastened to proper type anchor foundations where necessary to prevent undue stress or strain on boilers or equipment due to weight of the pipe or expansion and contraction.

602.5 Piping Through Walls, Floors, Etc. Piping passing through walls, ceilings, floors, in or under concrete slabs, beams, or any portion of the building structure, shall be free to expand and contract and shall not be embedded in plaster, concrete or masonry. Such piping shall be provided with metal sleeves or thimbles when passing through concrete or masonry walls, ceilings, floors or beams, and such sleeves or thimbles shall be at least 3/8 inch larger than the outside diameter of the pipe or the pipe plus insulation. Openings through wooden floors, ceilings, walls and beams shall be at least 3/8 inch larger than the outside diameter of the pipe or the pipe plus insulation. Piping penetrating fire resistant assemblies shall not reduce the fire rating of the assembly. The Mechanical Official shall approve the type of sleeve and insulation to be used on piping carrying steam, water, or other fluids at temperatures in excess of 300^0 F.

EXCEPTION: Piping for panel heating systems may be embedded in accordance with 303.11.

602.5.1 Steam piping serving areas other than stair heating units shall not be located in or pass through exit enclosures.

602..6 Vertical Piping Secured Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents but in no case less than at every other story height.

602.7 Branch Main Stress Where the main stream supply or hot water supply piping or the main return piping of a system is divided into two or more branch mains or returns, such branches from themain piping shall be taken off with tees and elbows or "Y" branch fittings, so installed and connected that undue stresses or strains from pipe expansion or other causes shall not be placed on the pipe fittings or threads at the point or points of junction of the piping.

602.8 Bull-Heading Tees The use of bull-heading tee connections is prohibited where the side opening of a tee is connected to the main piping and where the two branch connections are taken off the run of the tee thereby forming a rigid connection.

604.1.1 Type K, L or M copper may be used on all underground or underslab copper lines and joined by a brazing filler metal.

604.1.2 Type 3003-0 aluminum tubing may be used for chilled water piping only.

604.1.3 All piping and fittings shall be marked to indicate type, weight, or pressure as applicable.

604.1.4 All plastic pipe shall be installed and supported in accordance with the manufacturer's recommendations and in such a manner as to give protection from physical damage to the piping and shall not be used as a connection material to heating devices, nor other equipment where temperature and/or vibration could affect the piping.

605 CONDENSER WATER PIPING

605.1 General

Condenser water piping shall be of the same quality and installed in the same manner as required in 604.

605.2 Bleed-Off

All cooling tower bleed-off lines shall be extended to a sanitary sewer drain or storm sewer drain. Such drain shall not in any case be allowed to drain into yards, street or alleys, or on the roof of a building which drains into such an area.

605.3 Installation

Cooling towers shall be provided with a direct connection to a water supply through an individual float control valve. The control valve shall terminate not less than 3 inches above the highest possible water level in the cooling tower pan. A convenient means shall be provided, either a gate valve or a capped nipple, for draining or flushing the tower.

606 MAKE-UP WATER PIPING

606.1 General

From an approved back-flow preventer installed as required by the Standard Plumbing Code, to the inlet on a boiler, chiller, or other water-using device covered by this Code, the piping shall be as hereinbefore specified for hot and chilled water piping, except on boilers operating above 250°F or 100 psi, the make-up water line shall be black iron or wrought-iron pipe conforming to Schedule 80 of ANSI B36.10 and extra-heavy malleable iron fittings. Make-up water piping to chillers or water towers shall be either galvanized steel or copper pipe.

606.2 Cross-Connections

A direct cross connection shall not be permitted between the potable water supply and any other circulating water system except as approved in 921.1.4 of the Standard Plumbing Code.

TABLE 604
CHILLED WATER PIPE SPECIFICATIONS

Materials	Standards	Max. Type	Max. Pressure @ (psi)	Temp. (˚F)	Max. Size (in)	Type Joint
PE Sch. 40	ASTM D 2104 ASTM D 2239	II	75	73.4	—	Mechanical
PE (SDR-PR)	ANSI B72.1	II	75	73.4	—	Mechanical
PVC Sch. 40I		Normal Impact	50	100	6	Solvent
PVC Sch. 40	ASTM D 1785	II High Impact	50	100	3	Solvent
PVC Sch. 80		I Normal Impact	50	100	12	Solvent
PVC Sch. 80	ANSI B72.2	II High Impact	50	100	6	Solvent
PVC Sch. 80		I Normal Impact	50	100	6	Threaded
PVC Sch. 80		II High Impact	50	100	1 1/4	Threaded
Steel	ASTM A 53	Schedule 40	125	—	—	Threaded, Welded, or Mechanical Grooved Couplings/ Fittings
	ASTM A 53 ASTM A 135	Schedule 5	300		2	Self-restraining Mechanically Pressed Fittings
Copper	ASTM B 88	K,L and M	200 non-shock	310	—	Joined by brazing filler metal

CHAPTER 9
REFERENCE STANDARDS

901 REFERENCED STANDARDS

STANDARD DESIGNATION	SECTION
ACCA Manual J: Load Calculation for Residential Winter and Summer Air Conditioning, 1986	B102
ACCA Manual N: Load Calculation for Commercial Summer and Winter Air Conditioning, 1982	B102
ANSI B 2.1-1960, Pipe Threads	602.12.1
ANSI B 9.1-1971, Safety Code for Mechanical Refrigeration	302.4, 405, 406.2.2
ANSI B 36.10-1975, Welded and Seamless Wrought Steel Pipe	606.1 607.3.1.2
ANSI B 50.11-1965, Synchronous Motors	302.6.2
ANSI B 72.1-1967	Table 604
ANSI B 72.2-1967	Table 604
ANSI B 23.1-1971, Centrifugal Pump for Process Use	302.6.1
ANSI Z21.13, Gas Fired Low-Pressure Steam and Hot Water Heating Boilers	304.2
ANSI Z21.59, Gas Fire High Pressure Steam and Hot Water Boilers	304.2
ASHRAE Applications Handbook, Chapter 57, Solar Energy Utilization for Heating and Cooling, 1982	309.1.6
ASHRAE Handbook of Fundamentals, 1993	608.1.1, B102
ASHRAE Handbook & Product Directory Equipment, 1980	302.4, 502
ASHRAE Handbook & Product Directory-Systems 1980	302.4
ASME Boiler and Pressure Vessel Code: Section I, Power Boilers Section IV, Heating Boilers Section IX, Welding and Brazing Qualifications	304.2, 304.4.2, Table 602.1
ASTM A 53-87b, Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless	Table 602.1 Table 604
ASTM A 120-84, Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses	Table 602.1, Table 604
ASTM B 42-88, Specification for Seamless Copper Pipe, Standard Sizes	Table 602.1, 608.2.3

ASTM B 43-88, Specification for Seamless Red Brass Pipe, Standard Sizes	Table 602.1 608.2.3
ASTM B 88-88a, Specification for Seamless Copper Water Tube	Table 602.1, Table 604, 608.2.4
ASTM B 280-88, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service	608.2.5
ASTM C 411-82(1987), Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation	309.6.5, 506.1.2
ASTM D 1785-86, Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120	Table 604
ASTM D 2104-85, Specification for Polyethylene (PE) Plastic Pipe, Schedule 40	Table 604
ASTM D 2239-85, Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter	Table 604
ASTM D 2662-83, Specification for Polybutylene (PB) Plastic Tubing	Table 604
ASTM D 2666-83, Specification for Polybutylene (PB) Plastic Tubing	Table 604
ASTM D 3000-73(1981), Specification for Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter	Table 604
ASTM D 3309-85b, Specification for Polybutylene (PB) Plastic Hot-Water Distribution Systems	Table 602.1, Table 604
ASTM D 3667-85, Specification for Rubber Seals Used in Flat-Plate Solar Collectors	309.5.2
ASTM D 3771-85, Specification for Rubber Seals Used in Concentrating Solar Collectors	309.5.2
ASTM D 3832-79(1987), Specification for Rubber Seals Contacting Liquids in Solar Energy Systems	309.5.2
ASTM E 84-87, Test Method for Surface Burning Characteristics of Building Materials	202, 309.6.4, 309.7.3, 610.1
ASTM E 136-1982, Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C	202
HYDI C 30-1973, Cooling Load Calculation Guide	B102
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NFiPA 91-1992, Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying	308.10.1
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SBCCI Standard Gas Code, 1988 Edition/NC Amendments	201.2, 303.9.3, 306.15.10, 306.16.1, 404.1.6, 607.1, 607.2, 709.6

SBCCI Standard Plumbing Code, 1988 Edition/NC Amendments	201.2, 302.7.2, 309.11, 309.12, 309.13.1, 404.1.4, 602.11, 606.1, 606.2
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UL 910-85, Test Method for Fire and Smoke Characteristics of Cables	512.2
UL 1482-86, Room Heaters, Solid-Fuel Type	306.17.2

902 ORGANIZATIONS

The purpose of this reference index is to catalog by name and address those agencies, associations, institutions and others that are referred to in this Code by name, initials or symbols. Further there are those listed, for convenience, whose technical and other services are made available to the Mechanical Official.

ACCA	Air Conditioning Contractors of America 1228 17 Street NW Washington, D.C. 20036
AGA	American Gas Association, Inc. 8501 East Pleasant Valley Road Cleveland, Ohio 44131
ANSI	American National Standards Institute, Inc. 1430 Broadway New York, New York 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, Georgia 30329

North Carolina State Building Code

Volume III – Mechanical

1995 REVISIONS TO THE 1991 EDITION

INSTRUCTIONS

Items needed for a complete 1995 North Carolina State Building Code, Volume III – Mechanical

1. 1991 North Carolina Volume III,
2. 1992 North Carolina Revisions,
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North Carolina
State Building Code

1995 Revisions
TO THE
1991 EDITION

Volume III – Mechanical
(Revisions Adopted Through September 13, 1994
Effective January 1, 1995)

North Carolina Building Code Council
and
North Carolina Department of Insurance
Post Office Box 26387
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an approved door closing device, has been designed exclusively for the central furnace and where all air for combustion and ventilation is supplied from outdoors.

303.4 Attic Installation

Every attic or furred space in which mechanical equipment is installed shall be accessible by an opening and passageway as large as the largest piece of the equipment and in no case less than 22 x 36 inches continuous from the opening to the equipment and its controls. The opening to the passageway shall be located not more than 20 ft from the equipment measured along the center line of such passageway. Every passageway shall be unobstructed and shall have solid continuous flooring not less than 24 inches wide from the entrance opening to the equipment. On the control side and other sides where access is necessary for servicing the equipment a level working platform extending a minimum of 30 inches from the edge of the equipment with a 36-inch high clear working space shall be provided. Top or bottom service equipment shall have a full clearance above or below the unit for component removal.

303.5 Under Floor Installations

303.5.1 All mechanical equipment installed in the underfloor area of any building shall comply with the following requirements:

1. An access opening and passageway of a height and width sufficient to permit removal of the mechanical equipment and in no case less than 36 wide x 22 high inches shall be provided to the working space in front of the mechanical equipment. The access opening to any such passageway shall be through an opening in an exterior wall of the building or through a trap door within the building.
2. In a crawl space, a minimum of 4 x 8 x 16 inch block or brick supports shall be installed under equipment. All stacked masonry units shall be held in place with mortar. Below grade installations shall be provided with a natural drain or an automatic lift or sump pump. Formed concrete or approved prefabricated steel units are acceptable. Equipment may be supported from floor joists with steel supports or with wood supports when the equipment is labeled for zero clearance to combustibles.
3. The lowest portion of mechanical equipment suspended from the building shall have a clearance of at least 6 inches from the ground.
4. Whenever it is necessary to excavate to install any such mechanical equipment, the excavation shall extend to a depth of 6 inches below the mechanical equipment and 12 inches on all sides of the mechanical equipment, except the control side, which shall have a clearance of 30 inches.
5. In floodplain areas, the entire crawl space grade or height shall be such that a 12-inch clearance will exist between the bottom of the mechanical equipment and the ground.

303.6 Roof Or Exterior Wall Installation

303.6.1 Mechanical equipment installations on roofs or exterior walls of buildings shall comply with the requirements for roof and wall structures as specified in the Standard Building Code, and shall be listed and approved for such use.

303.6.2 DELETED.

303.6.3 Every appliance located on a roof of a building shall be installed on a substantial level platform. Whenever the roof has a slope greater than 3:12, a level working platform not less than 30 inches deep shall be provided in front of the entire firebox and control sides of the appliance. Guard rails 42" high and of a type permitted in areas not accessible to the public or a 36" high parapet shall be provided when any side of a working platform is facing any portion of a roof edge below the platform or when any side of an appliance faces any portion of a roof edge which is 6 feet or less from the side. Required working platforms and railings may be omitted when access to the equipment is through a required roof scuttle and all of the following provisions are met:

1. The required scuttle is located immediately adjacent to the control side of the equipment unit.
2. All controls, filters, burners, fans and motors are accessible for service and repair within 2 ft of the edge of the equipment platform on the scuttle side.
3. The equipment platform is not more than 20 inches above the high side of the scuttle opening.
4. A substantial working platform not less than 30 inches by 30 inches shall be provided directly below the scuttle at a point not less than 30 inches or more than 32 inches below the high side of the scuttle opening.
5. Scuttles located on other than the roof incline side of the equipment unit shall have their lids or trap doors hinged on the low side of the scuttle.

303.6.4 Every appliance in or on an exterior wall of a building, which is so designed that the components are serviceable only from outside the building, shall be accessible. Every appliance located on the roof of any building shall be accessible.

EXCEPTION: When the roof is less than 20 ft above grade the use of portable means of access is acceptable.

303.7 Mounting

Heat producing appliances listed for mountings on combustible floors shall be installed strictly according to their listings, subject to the approval of the Mechanical Official.

308.6 Hoods

308.6.1 An exhaust hood shall be installed for all commercial, industrial, institutional and other food heat-processing equipment producing smoke or grease-laden air.

EXCEPTION: Residential ranges (4 burner) installed in dwelling units, churches, schools, day care centers, break areas and similar installations.

308.6.2 The hood shall be designed with a sufficient air volume to properly exhaust all grease and smoke vapor produced by the equipment which it serves. Unless the hood is designed and certified by a licensed architect or professional engineer or is an approved prefabricated hood tested and certified by the manufacturer the following requirements shall be met:

1. Canopy-type hoods shall be at least 2 ft deep from bottom edge to top edge of hood and shall overhang the equipment they serve at least 6 inches on all open sides.
2. The bottom edge of a canopy-type hood shall be a maximum of 7 ft above the floor.
3. Canopy hoods open on all sides shall have a minimum exhaust capacity of 150 cfm per square foot of hood area.
4. Canopy-type hoods open on three or less sides shall have a minimum exhaust capacity of 100 cfm per sq ft of hood area.
5. Backshelf-type hoods having an intake within 3 ft of vapor producing surface shall have a minimum exhaust capacity of 300 cfm per linear foot of cooking surface within a maximum distance of 1 ft from the face of the hood to the front edge of the equipment they are serving.
6. Provisions shall be made to admit air to the room where the hood is located at a rate not less than that which is exhausted by the hood. The make-up air restrictions of Section 3202.5.2 of Volume I do not apply to non-canopy type backshelf kitchen exhaust hoods.

308.6.3 All hoods shall be constructed and installed in accordance with the following:

1. Hoods shall be constructed of and supported by steel 0.0478-inch (18 ga) minimum thickness or stainless steel 0.0359-inch (20 ga) minimum thickness or of other material of equivalent strength, fire and corrosion resistance as approved by the Mechanical Official.
2. Hoods shall be securely supported by noncombustible supports.
3. All seams and joints shall be made liquid-tight with a continuous external weld.
4. Hoods shall be so designed and installed to provide for thorough cleaning of the entire hood.
5. When grease troughs or gutters are provided, they shall drain to a collecting receptacle designed, fabricated and installed to be readily accessible for cleaning.

308.6.4 Every portion of the hood shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than 3 inches provided the combustible material is protected with materials as approved for 1 hour fire resistance on the hood side.

EXCEPTION: Clearance may be reduced to 0 inches when the duct system is protected by material specifically listed for such use.

308.6.5 Each hood shall be equipped with a properly sized grease removal device of one of the following types:

1. Grease extractors specifically listed for this service and installed in accordance with the terms of its listing.

2. Grease filters or other grease removal devices specifically listed for use with commercial cooking equipment installed with the height of the lowest edge of the grease filter or other removal device located above the cooking or heating surface not less than the distances shown in Table 308.