2012 FUEL GAS CODE CHANGES
CHAPTER 1 - SCOPE AND ADMINISTRATION

101.1 Title. These regulations shall be known as the North Carolina Fuel Gas Code as adopted by the North Carolina Building Code Council on September 14, 2010, to be effective September 1, 2011. References to the International Codes shall mean the North Carolina Codes. The North Carolina amendments to the International Codes are underlined.

101.2 Scope. This code shall apply to the installation of fuel gas piping systems, fuel gas appliances, gaseous hydrogen systems and related accessories in accordance with Sections 101.2.1 through 101.2.5. Exception: Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories high with separate means of egress and their accessory structures shall comply with the International Residential Code.

101.2.2 Piping systems. These regulations cover piping systems for natural gas with an operating pressure of 125 pounds per square inch gauge (psig) (862 kPa gauge) or less, and for LP-gas with an operating pressure of 20 psig (140 kPa gauge) or less, except as provided in Section 402.6. Coverage shall extend from the point of delivery to the outlet of the appliance shutoff valves. Piping system requirements shall include design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance.

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

102.1 General. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern. Where, in a specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

102.10 Other laws. The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

102.11 Application of references. Reference to chapter section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

105.1 Modifications. Whenever there are practical difficulties involved in carrying out the provisions of this code, the code official shall have the authority to grant modifications for individual cases, upon application of the owner or owner’s representative, provided that the code official shall first find that special individual reason makes the strict letter of this code impractical and that such modification is in compliance with the intent and purpose of this code and does not lessen health, life and fire safety requirements. The details of action granting modifications shall be recorded and entered in the files of the Department of Inspection.
105.2.1 Research reports. Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

105.4 Material and Equipment reuse changed to 105.4 Used material, appliances and equipment.
105.4 Used material, appliances and equipment. The use of used materials which meet the requirements of this code for new materials is permitted. Used appliances, equipment and devices shall not be reused unless such elements have been reconditioned, tested and placed in good and proper working condition, and approved by the code official.

105.5 Approved materials and equipment. Materials, equipment and devices approved by the code official shall be constructed and installed in accordance with such approval.

106.1 Where required.
Exception: Where appliance and equipment replacements and repairs are required to be performed in an emergency situation, the permit application shall be submitted within the next working business day of the Department of Inspection.

106.2 Permits not required.
2. Replacement of any minor component of appliance or equipment that does not alter approval of such appliance or equipment or make such appliance or equipment unsafe.

110.1 General. The code official is authorized to issue a permit for temporary equipment, systems and uses. Such permits shall be limited as to time of service, but shall not be permitted for more than 180 days. The code official is authorized to grant extensions for demonstrated cause.

110.2 Conformance. Temporary equipment, systems and uses shall conform to the structural strength, fire safety, and means of egress, accessibility, light, ventilation and sanitary requirements of this code as necessary to ensure the public health, safety and general welfare.

110.3 Temporary utilities. The code official is authorized to give permission to temporarily supply utilities before an installation has been fully completed and the final certificate of completion has been issued. The part covered by the temporary certificate shall comply with the requirements specified for temporary lighting, heat or power in the code.

110.4 Termination of approval. The code official is authorized to terminate such permit for a temporary structure or use and to order the temporary structure or use to be discontinued.

CHAPTER 2 – DEFINITIONS

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

BAROMETRIC DRAFT REGULATOR. A balanced damper device attached to a chimney, vent connector, breeching or flue gas manifold to protect combustion appliances by controlling chimney draft. A double-acting barometric draft regulator is one whose balancing damper is free to move in either direction to protect combustion appliances from both excessive draft and backdraft.
BONDING JUMPER. A conductor installed to electrically connect metallic gas piping to the grounding electrode system

CONCEALED LOCATION. A location that cannot be accessed without damaging permanent parts of the building structure or finish surface. Spaces above, below or behind readily removable panels or doors shall not be considered as concealed. Buried underground piping shall not be considered as concealed.

COUNTER APPLIANCES. Appliances such as coffee brewers and coffee urns and any appurtenant water-heating appliances, food and dish warmers, hot plates, griddles, waffle bakers and other appliances designed for installation on or in a counter

DRAFT. The pressure difference existing between the appliance or any component part and the atmosphere, that causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere

EXTERIOR MASONRY CHIMNEYS. Masonry chimneys exposed to the outdoors on one or more sides below the roof line.

FUEL GAS UTILIZATION EQUIPMENT. See “Appliance”.

LABELED. Appliances, equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark (included in a list published by-deleted) 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 whose labeling indicates either that the appliance, equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose. (Laboratories, agencies or organizations that have been identified by approval and accreditation bodies, such as ANSI, IAS, ICC or OSHA, are acceptable.)

LISTED. Appliances, equipment, materials, products or services included in a list published by an organization acceptable to the code official and (nationally recognized testing laboratory-deleted) concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the appliance, equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose. (The means for identifying listed equipment, appliances or materials may vary for each testing laboratory, inspection agency or other organization concerned with product evaluation, some of which do not recognize equipment, appliances or materials as listed unless they are also labeled. The authority having jurisdiction shall utilize the system employed by the listing organization to identify a listed product-deleted).

OUTLET. The point at which a gas-fired appliance connects to the gas piping system.

PIPING SYSTEM. All fuel piping, valves and fittings from the outlet of the point of delivery to the outlets of the appliance (equipment-deleted) shutoff valves.

POINT OF DELIVERY. For natural gas systems, the point of delivery is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a valve is provided at the outlet of the service meter assembly, such valve shall be considered to be
downstream of the *point of delivery*. For undiluted liquefied petroleum gas systems, the *point of delivery* shall be considered to be the outlet of the first regulator that reduces pressure. *(to 2 psig (13.8 kPag) or less-Deleted)*.

**REGULATOR, GAS APPLIANCE.** A pressure regulator for controlling pressure to the manifold of the *appliance (equipment-Deleted)*. Types of appliance regulators are as follows:

**VALVE.**
*Appliance shutoff.* A valve located in the piping system, used to isolate individual appliances for purposes such as service or replacement.

**CHAPTER 3 - GENERAL REGULATIONS**

301.8 **Vibration isolation.** Where means for isolation of vibration of an appliance is installed, an approved means for support and restraint of that appliance shall be provided.

301.14.1 **Foundation and exterior wall sealing.** Annular spaces around pipes, electric cables, conduits or other openings in the walls shall be protected against the passage of rodents by closing such opening with cement mortar, concrete masonry, silicone caulking or non-corrosive metal.

303.6 **Outdoor locations.** *Appliances (Equipment-Deleted)* installed in outdoor locations shall be either listed for outdoor installation or provided with protection from outdoor environmental factors that influence the operability, durability and safety of the *appliances (equipment-Deleted)*.

303.7 **Pit locations.** Appliances installed in pits or excavations shall not come in direct contact with the surrounding soil. The sides of the pit or excavation shall be held back a minimum of 12 inches (305 mm) from the *appliance*. Where the depth exceeds 12 inches (305 mm) below adjoining grade, the walls of the pit or excavation shall be lined with concrete or masonry, such concrete or masonry shall extend a minimum of 4 inches (102 mm) above adjoining grade and shall have sufficient lateral load-bearing capacity to resist collapse. *(The appliance shall be protected from flooding in an approved manner-Deleted)*.

304.4 **Makeup air provisions.** Where exhaust fans, clothes dryers and kitchen ventilation systems interfere with the operation of appliances and fireplaces, makeup air shall be provided.

305.3.1 **Parking Garages**

305.3.1 **(IFGS) Installation in residential garage.** In residential garages where appliances are installed in a separate, enclosed space having access only from outside of the garage, such appliances shall be permitted to be installed at floor level, provided that the required combustion air is taken from the exterior of the garage.

305.3.2 **Parking Garages**

**Exceptions:**
*(2. This section shall not apply to one-and two-family dwellings-Deleted)*
305.7.3 Crawl space supports. A support shall be provided at each corner of the unit not less than 8 x 8 inches. The unit shall be supported a minimum of 2 inches above grade. When constructed of brick, the bricks shall be mortared together. All units stacked shall be mortared together. Fabricated units, formed concrete, or other approved materials shall be permitted.

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

305.9 (IFGS) Parking structures. Appliances installed in enclosed, basement and underground parking structures shall be installed in accordance with NFPA 88A.

305.10 (IFGS) Repair garages. Appliances installed in repair garages shall be installed in a detached building or room, separated from repair areas by walls or partitions, floors or floor-ceiling assemblies that are constructed so as to prohibit the transmission of vapors and having a fire-resistance rating of not less than 1 hour, and that have no openings in the wall separating the repair area within 8 feet (2438 mm) of the floor. Wall penetrations shall be fire stopped. Air for combustion purposes shall be obtained from the outdoors. The appliance room shall not be used for the storage of combustible materials.

Exceptions:
1. Overhead heaters where installed not less than 8 feet (2438 mm) above the floor shall be permitted.
2. Heating appliances for vehicle repair areas where there is no dispensing or transferring of Class I or II flammable or combustible liquids or liquefied petroleum gas shall be installed in accordance with NFPA30A.

305.11 (IFGS) Installation in aircraft hangars. Heaters in aircraft hangars shall be installed in accordance with NFPA 409.

305.12 (IFGS) Avoid strain on gas piping. Appliances shall be supported and connected to the piping so as not to exert undue strain on the connections.

[M] 306.1 Access (Clearances-Deleted) for maintenance and replacement. Appliances shall be accessible for inspection, service, repair and replacement without disabling the function of a fire-resistance-rated assembly or removing permanent construction, other appliances, or any other piping or ducts not connected to the appliance being inspected, serviced, repaired or replaced. A level working space at least 30 inches deep and 30 inches wide (762 mm by 762 mm) shall be provided in front of the control side to service an appliance.

[M] 306.3 Appliances in attics. Attics containing appliances (requiring access-Deleted) shall be provided with an opening and unobstructed passageway large enough to allow removal of the largest (component of the-Deleted) appliance. The passageway shall not be less than 30 inches (762 mm) high and 22 inches (559 mm) wide and not more than 20 feet (6096 mm) in length when measured along the centerline of the passageway from the opening to the equipment. The passageway shall have continuous solid flooring not less than 24 inches (610 mm) wide. A level service space not less than 30 inches (762 mm)deep and 30 inches (762 mm) wide shall be present at the front or service side of the appliance (equipment-Deleted). The clear access opening dimensions shall be a minimum of 20 inches by 30 inches (508 mm by 762 mm), where such dimensions are large enough to allow removal of the largest (component of the-Deleted) appliance.
**M 306.4 Appliances under floors.** Under floor spaces containing appliances shall be provided with an access opening and unobstructed passageway large enough to remove the largest *component of the Deleted* appliance. The passageway shall not be less than 22 inches (559 mm) high and 36 inches (914 mm) wide, nor more than 20 feet (6096 mm) in length measured along the centerline of the passageway from the opening to the *appliance (equipment-Deleted)*. A level service space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be present at the front or service side of the appliance. If the depth of the passageway or the service space exceeds 12 inches (305 mm) below the adjoining grade, the walls of the passageway shall be lined with concrete or masonry. Such concrete or masonry shall extend a minimum of 4 inches (102 mm) above the adjoining grade and shall have sufficient lateral-bearing capacity to resist collapse. The clear access opening dimensions shall be a minimum of 22 inches *high* by 30 inches *wide* (559 mm by 762 mm), and large enough to allow removal of the largest *component of the Deleted* appliance.

**M 306.5 Appliances on roofs or elevated structures.** Where *equipment* and appliances requiring *periodic maintenance* are installed on roofs or elevated structures at a height exceeding 16 feet (4877 mm), such access shall be provided by a permanent *approved* means of access, the extent of which shall be from grade or floor level to the *equipment* and appliances' level service space. Such access shall not require climbing over obstructions greater than 30 inches (762 mm) high or walking on roofs having a slope greater than four units vertical in 12 units horizontal (33-percent slope). *Where access involves climbing over parapet walls, the height shall be measured to the top of the parapet wall.* Permanent ladders installed to provide the required access shall comply with the following minimum design criteria:

6. Ladders over 30 feet (9144 mm) in height shall be provided with offset sections and landings capable of withstanding 100 pounds per square foot (488.2 kg/m2). *Landing dimensions shall be not less than 18 inches (457 mm) and not less than the width of the ladder served.* A *guard rail shall be provided on all open sides of the landing.*

**M 306.5.1 Sloped roofs.** Where appliances, *equipment, fans or other components that require periodic maintenance* are installed on a roof having a slope of three units vertical in 12 units horizontal (25-percent slope) or greater and having an edge more than 30 inches (762 mm) above grade at such edge, a level platform shall be provided on each side of the *appliance or equipment* to which access is required for service, repair or maintenance. The platform shall be not less than 30 inches (762 mm) in any dimension and shall be provided with guards. The guards shall extend not less than 42 inches (1067 mm) above the platform, shall be constructed so as to prevent the passage of a 21-inch diameter (533 mm) sphere and shall comply with the loading requirements for guards specified in the *International Building Code*. *Access shall not require walking on roofs having a slope greater than four units vertical in 12 units horizontal (33-percent slope). Where access involves obstructions greater than 30 inches (762 mm) in height, such obstructions shall be provided with ladders installed in accordance with Section 306.5 or stairs installed in accordance with the requirements specified in the International Building Code in the path of travel to and from appliances, fans or equipment requiring service.*

**307.5 Auxiliary drain pan.**

*Exception: An auxiliary drain pan shall not be required for appliances that automatically shut down operation in the event of a stoppage in the condensate drainage system.*

**309.2 Connections.** Electrical connections between appliances and the building wiring, including the grounding of the appliances, shall conform to *NFPA 70*.

**310.1 Gas pipe bonding** changed to **310.1 Pipe and tubing other than CSST.**
310.1 *Pipe and tubing other than CSST.* Each above-ground portion of a gas *piping system other than corrugated stainless steel tubing (CSST)* that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping *other than CSST* shall be considered to be bonded where it is connected to appliances that are connected to the *equipment* grounding conductor of the circuit supplying that appliance.

310.1.1 *CSST.* **Corrugated stainless steel tubing (CSST) gas piping systems shall be bonded to the electrical service grounding electrode system at the point where the gas service enters the building. The bonding jumper shall be not smaller than 6 AWG copper wire or equivalent.**

Chapter 4 – GAS PIPING INSTALLATIONS

401.2 *Liquefied petroleum gas storage.* The enforcement of the location of undiluted liquefied petroleum gas containers shall be the responsibility of the North Carolina Department of Agriculture and Consumer Services in accordance with Article 5 of Chapter 119 of the General Statutes.

401.5 *Identification. Exceptions:*  
2. *Black steel piping, .5 psi or less, located at dwelling units shall not be required to be labeled*

402.1 *General considerations.* Piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance.

402.4 *Sizing tables and equations.* Where Tables 402.4(1) through 402.4(35) are used to size piping or tubing, the pipe length shall be determined in accordance with Section 402.4.1, 402.4.2 or 402.4.3.

TABLE 402.4(25)  
**SCHEDULE 40 METALLIC PIPE**  
*Pipe sizing between 2 psig service and the line pressure regulator*

TABLE 402.4(26)  
**SCHEDULE 40 METALLIC PIPE**  
*Pipe sizing between single- or second stage (low pressure) regulator and appliance*

TABLE 402.4(29)  
**SEMIRIGID COPPER TUBING**  
*Tubing sizing between 2 psig service and line pressure regulator*

TABLE 402.4(30)  
**CORRUGATED STAINLESS STEEL TUBING (CSST)**  
*INTENDED USE: SIZING BETWEEN SINGLE OR SECOND (low pressure) REGULATOR AND THE APPLIANCE SHUTOFF VALVE*

TABLE 402.4(31)  
**CORRUGATED STAINLESS STEEL TUBING (CSST)**  
*INTENDED USE: SIZING BETWEEN 2 PSI SERVICE and THE LINE PRESSURE REGULATOR*
TABLE 402.4(32)
CORRUGATED STAINLESS STEEL TUBING (CSST)

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For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 inch water column = 0.2488 kPa,
1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m³/h, 1 degree = 0.01745 rad.

Notes:
1. Table does not include effect of pressure drop across line regulator. Where regulator loss exceeds 1 psi, DO NOT USE THIS TABLE. Consult with the regulator manufacturer for pressure drops and capacity factors. Pressure drop across regulator may vary with the flow rate.
2. CAUTION: Capacities shown in the table might exceed maximum capacity of selected regulator. Consult with the tubing manufacturer for guidance.
3. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: L = 1.3ℓ where ℓ is additional length (feet) of tubing and n is the number of additional fittings and/or bends.
4. EHD — Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
5. All table entries have been rounded to three significant digits.

TABLE 402.4(33)
POLYETHYLENE PLASTIC PIPE

PE pipe sizing between integral two stage regulator at tank or second stage (low pressure regulator) and building

TABLE 402.4(34)
POLYETHYLENE PLASTIC PIPE

PE pipe sizing between 2 psig regulator and line pressure regulator

TABLE 402.4(35)
POLYETHYLENE PLASTIC PIPE

PE pipe sizing between integral two stage regulator at tank or second stage (low pressure regulator) and building
402.6 Maximum design operating pressure
5. The piping serves appliances or equipment used for agricultural purposes.
6. The piping system is an LP-gas piping system with a design operating pressure greater than 20 psi (137.9 kPa) and complies with NFPA 58.

402.6.1 Liquefied petroleum gas systems. LP-gas systems designed to operate below -5°F (-21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-gas or prevent LP-gas vapor from condensing into a liquid. (Exception-Deleted)

403.4.2 Steel. Steel and wrought-iron pipe shall be at least of standard weight (Schedule 40) and shall comply with one of the following standards:
2. ASTM A 53/A53M; or

403.5.1 Steel tubing. Steel tubing shall comply with ASTM A 254. (ASTM A 539-Deleted)

403.5.2 Copper and brass tubing. Copper tubing shall comply with Standard Type K or L of ASTM B 88 or ASTM B 280. Copper and brass tubing shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas (0.7 milligrams per 100 liters).

403.10.2 Tubing joints. Tubing joints shall be made with approved gas tubing fittings, brazed with a material having a melting point in excess of 1,000°F (538°C) or made with press-connect fittings complying with ANSI LC-4. Brazing alloys shall not contain more than 0.05-percent phosphorus.

404.1 Prohibited locations. Piping shall not be installed in or through a ducted supply, return or exhaust, or a clothes chute, chimney or gas vent, dumbwaiter or elevator shaft. Piping installed downstream of the point of delivery shall not extend through any townhouse unit other than the unit served by such piping.

404.4 Piping through foundation wall. Underground piping, where installed below grade through the outer foundation or basement wall of a building, shall be encased in a protective pipe sleeve or shall be protected by an approved device or method. The annular space between the gas piping and the sleeve and between the sleeve and the wall shall be sealed.

404.5 Protection against physical damage. In concealed locations, where piping other than black or galvanized steel is installed through holes or notches in wood studs, joists, rafters or similar members less than 11/2 inches (38 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

404.6 Piping in solid floors. Piping in solid floors shall be laid in channels in the floor and covered in a manner that will allow access to the piping with a minimum amount of damage to the building. Where such piping is subject to exposure to excessive moisture or corrosive substances, the piping shall be protected in an approved manner. As an alternative to installation in channels, the piping shall be installed in a conduit of Schedule 40 steel, wrought iron, PVC or ABS pipe in accordance with Section 404.6.1 or 404.6.2. (with tightly sealed ends and joints. Both ends of such conduit shall extend not less than 2 inches beyond the point where the pipe emerges from the floor. The conduit shall be vented above grade to the outdoors and shall be installed so as to prevent the entry of water and insects-Deleted).
404.6.1 Conduit with one end terminating outdoors. The conduit shall extend into an occupiable portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor. If the end sealing is capable of withstanding the full pressure of the gas pipe, the conduit shall be designed for the same pressure as the pipe. Such conduit shall extend not less than 4 inches (102 mm) outside the building, shall be vented above grade to the outdoors and shall be installed so as prevent the entrance of water and insects.

404.6.2 Conduit with both ends terminating indoors. Where the conduit originates and terminates within the same building, the conduit shall originate and terminate in an accessible portion of the building and shall not be sealed. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor.

404.7 Above-ground outdoor piping. All piping installed outdoors shall be elevated not less than 3 1/2 inches (152 mm) above ground and where installed across roof surfaces, shall be elevated not less than 3 1/2 inches (152 mm) above the roof surface. Piping installed above ground, outdoors, and installed across the surface of roofs shall be securely supported and located where it will be protected from physical damage. Where passing through an outside wall, the piping shall also be protected against corrosion by coating or wrapping with an inert material. Where piping is encased in a protective pipe sleeve, the annular space between the piping and the sleeve shall be sealed. Ferrous metal exposed in exterior locations shall be protected from corrosion with one coat of exterior paint. Zinc coatings (galvanized) shall be deemed adequate protection for gas piping above-ground.

404.8 Protection against corrosion underground moved to 404.9 Protection against corrosion underground.

404.8 Isolation. Metallic piping and metallic tubing that conveys fuel gas from an LP-gas storage container shall be provided with an approved dielectric fitting to electrically isolate the underground portion of the pipe or tube from the above ground portion that enters a building. Such dielectric fitting shall be installed above ground, outdoors.

404.9 Protection against corrosion underground. Metallic pipe or tubing exposed to corrosive action, such as soil condition or moisture, shall be protected in an approved manner. Zinc coatings (galvanizing) shall not be deemed adequate protection for gas piping underground. (Ferrous metal exposed in exterior locations shall be protected from corrosion-Deleted). Where dissimilar metals are joined underground, an insulating coupling or fitting shall be used. Piping shall not be laid in contact with cinders.

404.9.2 Protective coatings and wrapping. Pipe protective coatings and wrappings shall be approved for the application and shall be factory applied.

Exception: Where installed in accordance with the manufacturer's installation instructions, field application of coatings and wrappings shall be permitted. (for pipe nipples, fittings and locations where the factory coating or wrapping has been damaged or necessarily removed at joints-Deleted).

404.11 Piping underground beneath buildings moved to 404.12 Piping underground beneath buildings
404.12 Piping underground beneath buildings. Piping installed underground beneath buildings is prohibited except where the piping is encased in a conduit of wrought iron, plastic pipe, steel pipe or other approved conduit material designed to withstand the superimposed loads. The conduit shall be protected from corrosion in accordance with Section 404.9 and shall be installed in accordance with Section 404.12.1 or 404.12.2.

404.12.1 Conduit with one end terminating outdoors. The conduit shall extend into an occupiable portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor. Where the end sealing is capable of withstanding the full pressure of the gas pipe, the conduit shall be designed for the same pressure as the pipe. Such conduit shall extend not less than 4 inches (102 mm) outside of the building, shall be vented above grade to the outdoors and shall be installed so as to prevent the entrance of water and insects.

404.12.2 Conduit with both ends terminating indoors. Where the conduit originates and terminates within the same building, the conduit shall originate and terminate in an accessible portion of the building and shall not be sealed. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor.

404.15 Limitations

Exception 3. Plastic pipe shall be permitted under outdoor patio, walkway and driveway slabs provided that the burial depth complies with Section 404.10.

404.15.2 Connections. Connections made outdoors and underground between metallic and plastic piping shall be made only with transition fittings conforming with ASTM D 2513 Category I or ASTM F 1973.

404.15.3 Tracer. A yellow insulated copper tracer wire or other approved conductor shall be installed adjacent to underground nonmetallic piping. Access shall be provided to the tracer wire or the tracer wire shall terminate above ground at each end of the nonmetallic piping. The tracer wire size shall not be less than 18 AWG and the insulation type shall be suitable for direct burial.

406.4.1 Test pressure. The test pressure to be used shall be no less than 1 1/2 times the proposed maximum working pressure, but not less than 3 psig (20 kPa gauge), irrespective of design pressure. Where the test pressure exceeds 125 psig (862 kPa gauge), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe.

406.4.2 Test duration. Test duration shall be not less than 1/2 hour for each 500 cubic feet (14 m³) of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet (0.28 m³) or a system in a single-family dwelling, the test duration shall be not less than 10 minutes. The duration of the test shall not be required to exceed 24 hours.

406.6.2 Before turning gas on. During the process of turning gas on into a system of new gas piping, the entire system shall be inspected to determine that there are no open fittings or ends and that all valves at unused outlets are closed and plugged or capped.

406.7 Purging. Purging of 2 1/2- inch (63.5 mm) nominal pipe size or larger shall comply with Sections 406.7.1 through 406.7.4.
406.7.1 Removal from service. Where gas piping is to be opened for servicing, addition or modification, the section to be worked on shall be turned off from the gas supply at the nearest convenient point, and the line pressure vented to the outdoors, or to ventilated areas of sufficient size to prevent accumulation of flammable mixtures. The remaining gas in this section of pipe shall be displaced with an inert gas as required by Table 406.7.1.

**Exception:** If the line pressure cannot be vented to the outdoors: the building an all affected spaces shall be evacuated of personnel not involved with purging the gas lines, quantities of flammable gas shall not exceed 25 percent of the lower explosive limit (1.0-percent fuel/air mixture for natural gas or 0.6-percent fuel/air mixture for LP-gas) as measured by a combustible gas detector, all ignition sources shall be eliminated, and adequate ventilation to prevent accumulation of flammable gases shall be provided.

**TABLE 406.7.1**
SIZE AND LENGTH OF PIPING REQUIRING PURGING WITH INERT GAS FOR SERVICING OR MODIFICATION

**TABLE 406.7.2**
SIZE AND LENGTH OF PIPING REQUIRING PURGING WITH INERT GAS BEFORE PLACING IN OPERATION

406.7.3 Discharge of purged gases. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner (by ventilation of the space, control of purge rate, and elimination of all hazardous conditions). All potential sources of ignition shall be identified and eliminated or controlled. Precautions shall be taken to maintain the concentration of the flammable gas below 25-percent of the lower explosive limits (1.0-percent fuel/air mixture for natural gas or 0.6-percent fuel/air mixture for LP gas) such as adequate ventilation and control of purging rate. The point of discharge shall not be left unattended during purging.

406.7.5 Personnel training. Personnel performing purging operation shall be trained according to the hazards associated with purging and shall not rely on odor when monitoring the concentration of combustible gas.

407.2 Design and installation. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and shall not be supported by other piping.

408.4 Sediment trap. Where a sediment trap is not incorporated as part of the appliance (gas utilization equipment), a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical. The sediment trap shall be either a tee fitting having a capped nipple of any length installed vertically in the bottommost opening of the tee or other device approved as an effective sediment trap. Illuminating appliances, ranges, clothes dryers, gas logs, log lighters and outdoor grills need not be so equipped.

409.5 **Appliance** (Equipment) shutoff valve. Each appliance shall be provided with a shutoff valve in accordance with Section 409.5.1 409.5.2 or 409.5.3.
409.5.1 Located within same room. The shutoff valve shall be located in the same room as the appliance. The shutoff valve shall be within 6 feet (1829 mm) of the appliance, and shall be installed upstream of the union, connector or quick disconnect device it serves. Such shutoff valves shall be provided with access. Appliance shutoff valves located in the firebox of a fireplace shall be installed in accordance with the appliance manufacturer's instructions. This section shall not prohibit the use or the installation of gas shutoff valves in the firebox of fireplaces serving listed gas appliances.

409.5.2 Vented decorative appliances and room heaters. Shutoff valves for vented decorative appliances, room heaters and decorative appliances for installation in vented fireplaces shall be permitted to be installed in an area remote from the appliances where such valves are provided with ready access. Such valves shall be permanently identified and shall serve no other appliance. The piping from the shutoff valve to within 6 feet (1829 mm) of the appliance shall be designed, sized and installed in accordance with Sections 401 through 408.

409.6 Shutoff valve for laboratories. Where provided with two or more fuel gas outlets, including table-, bench- and hood-mounted outlets, each laboratory space in educational, research, commercial and industrial occupancies shall be provided with a single dedicated shutoff valve through which all such gas outlets shall be supplied. The dedicated shutoff valve shall be readily accessible, located within the laboratory space served, located adjacent to an egress door from the space and shall be identified by approved signage stating “Gas Shutoff.”

410.3.1 Vent piping. Vent piping for relief vents and breather vents shall be constructed of materials allowed for gas piping in accordance with Section 403. Vent piping shall be not smaller than the vent connection on the pressure regulating device. Vent piping serving relief vents and combination relief and breather vents shall be run independently to the outdoors and shall serve only a single device vent. Vent piping serving only breather vents is permitted to be connected in a manifold arrangement where sized in accordance with an approved design that minimizes back pressure in the event of diaphragm rupture. Regulator vent piping shall not exceed the length specified in the regulator manufacturer’s installation instructions.

411.1 Connecting appliances.

7. Listed and labeled appliance connectors complying with ANSI Z21.69 and listed for use with food service equipment having casters, or that is otherwise subject to movement for cleaning, and other large movable equipment-Deleted.

411.1.1 Commercial cooking appliances. Commercial cooking appliances installed on casters and appliances that are moved for cleaning and sanitation purposes shall be connected to the piping system with an appliance connector listed as complying with ANSI Z21.69 or in accordance with Item 1, 3 or 5 of Section 411.1.

411.1.3.1 Maximum length. Connectors shall have an overall length not to exceed 6 feet (1829 mm). Measurement shall be made along the centerline of the connector. Only one connector shall be used for each appliance.

Exception: Rigid metallic piping used to connect an appliance to the piping system shall be permitted to have a total length greater than 6 feet (1829 mm), provided that the connecting pipe is sized as part of the piping system in accordance with Section 402 and the location of the appliance shutoff valve complies with Section 409.5.
411.1.3.3 Prohibited locations and penetrations. Connectors shall not be concealed within, or extended through, walls, floors, partitions, ceilings or appliance housings.

Exceptions:
1. Connectors constructed of materials allowed for piping systems in accordance with Section 403 shall be permitted to pass through walls, floors, partitions and ceilings where installed in accordance with Section 409.5.2.
2. Rigid steel pipe connectors shall be permitted to extend through openings in appliance housings.
3. Fireplace inserts that are factory equipped with grommets, sleeves or other means of protection in accordance with the listing of the appliance.
4. Semi rigid tubing and listed connectors shall be permitted to extend through an opening in an appliance housing, cabinet or casing where the tubing or connector is protected against damage.

411.1.5 (IFGS) Connection of gas engine-powered air conditioners. Internal combustion engines shall not be rigidly connected to the gas supply piping.

411.1.6 Unions. A union fitting shall be provided for appliances connected by rigid metallic pipe. Such unions shall be accessible and located within 6 feet (1829 mm) of the appliance.

411.3 Suspended low-intensity infrared tube heaters. Suspended low-intensity infrared tube heaters shall be connected to the building piping system with a connector listed for the application complying with ANSI Z21.24/CGA 6.10. The connector shall be installed as specified by the tube heater manufacturer’s instructions.

413.9.2.4 Grounding and bonding. The structure or appurtenance used for supporting the cylinder shall be grounded in accordance with NFPA 70. The cylinder valve shall be bonded prior to the commencement of venting operations.

CHAPTER 5 – CHIMNEYS AND VENTS

501.4 Minimum size of chimney or vent. Chimneys and vents shall be sized in accordance with Sections 503 and 504.

501.8 Appliances (Equipment-Deleted) not required to be vented. The following appliances shall not be required to be vented. Where the appliances (and equipment-Deleted) listed in Items 5 through 11 above are installed so that the aggregate input rating exceeds 20 British thermal units (Btu) per hour per cubic feet (207 watts per m³) of volume of the room or space in which such appliances (and equipment-Deleted) are installed, one or more shall be provided with venting systems or other approved means for conveying the vent gases to the outdoor atmosphere so that the aggregate input rating of the remaining un-vented appliances (and equipment-Deleted) does not exceed 20 Btu per hour per cubic foot (207 watts per m³). Where the room or space in which the appliance (equipment-Deleted) is installed is directly connected to another room or space by a doorway, archway or other opening of comparable size that cannot be closed, the volume of such adjacent room or space shall be permitted to be included in the calculations.

501.15.4 Clearances. Chimneys and vents shall have airspace clearance to combustibles in accordance with the International Building Code and the chimney or vent manufacturer’s installation instructions. (Noncombustible firestopping or fireblocking shall be provided in accordance with the International Building Code-Deleted).
Exception: Masonry chimneys **without the required air-space clearances shall be permitted to be used if lined or relined with a chimney lining system listed for use in chimneys with reduced clearances in accordance with UL 1777. The chimney clearance shall be not less than permitted by the terms of the chimney liner listing and the manufacturer’s instructions.**

501.15.4.1 **Fireblocking.** Noncombustible fireblocking shall be provided in accordance with the International Building Code.

502.4 **Insulation shield.** Where vents pass through insulated assemblies, an insulation shield constructed of steel having a minimum thickness of 0.0187 inch (0.4712 mm) (No. 26 gage) shall be installed to provide clearance between the vent and the insulation material. The clearance shall not be less than the clearance to combustibles specified by the vent manufacturer's installation instructions. Where vents pass through attic space, the shield shall terminate not less than 2 inches (51 mm) above the insulation materials and shall be secured in place to prevent displacement. Insulation shields provided as part of a listed vent system shall be installed in accordance with the manufacturer’s installation instructions.

502.7 **Protection against physical damage.** In concealed locations, where a vent is installed through holes or notches in studs, joists, rafters or similar members less than 11/2 inches (38 mm) from the nearest edge of the member, the vent shall be protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) shall cover the area of the vent where the member is notched or bored and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

503.3 **Design and construction**

6. The exit terminals of mechanical draft systems shall be not less than 7 feet (2134 mm) above finished ground level (grade—Deleted) where located adjacent to public walk-ways and shall be located as specified in Section 503.8, Items 1 and 2.

503.3.4 **Ventilating hoods and exhaust systems.** Ventilating hoods and exhaust systems shall be permitted to be used to vent appliances installed in commercial applications. Where automatically operated appliances, other than commercial cooking appliances, are vented through a ventilating hood or exhaust system equipped with a damper or with a power means of exhaust, provisions shall be made to allow the flow of gas to the main burners only when the damper is open to a position to properly vent the appliance and when the power means of exhaust is in operation.

503.3.5 **(Circulating-Deleted) Air ducts and furnace plenums.** (No portion of a-Deleted) Venting systems shall not extend into or pass through any fabricated air duct or furnace plenum.

503.4.1.1 **Plastic vent joints.** Plastic pipe and fittings used to vent appliances shall be installed in accordance with the appliance manufacturer’s installation instructions. Where a primer is required, it shall be of a contrasting color.

503.5.6.1 **Chimney lining**

Exception: **Where an existing chimney complies with Sections 503.5.6 through 503.5.6.3 and its sizing is in accordance with Section 503.5.5, its continued use shall be allowed where the appliance vented by such chimney** is replaced by an appliance of similar type, input rating and efficiency.
503.6.13 Fastener penetrations. Screws, rivets and other fasteners shall not penetrate the inner wall of double-wall gas vents, except at the transition from an appliance draft hood outlet, a flue collar or a single-wall metal connector to a double-wall vent.

503.7 Single-wall metal pipe. Single-wall metal pipe vents shall comply with Sections 503.7.1 through 503.7.13.

503.7.6 Installation. Single-wall metal pipe shall not originate in any unoccupied attic or concealed space and shall not pass through any attic, inside wall, concealed space or floor. The installation of a single-wall metal pipe through an exterior combustible wall shall comply with Section 503.7.7. Single-wall metal pipe used for venting an incinerator shall be exposed and readily examinable for its full length and shall have suitable clearances maintained.

503.7.7 Single-wall penetrations of combustible walls. A single-wall metal pipe shall not pass through a combustible exterior wall unless guarded at the point of passage by a ventilated metal thimble not smaller than the following:

1. For listed appliances equipped with draft hoods and appliances listed for use with Type B gas vents, the thimble shall be not less than 4 inches (102 mm) larger in diameter than the metal pipe. Where there is a run of not less than 6 feet (1829 mm) of metal pipe in the open between the draft hood outlet and the thimble, the thimble shall be permitted to be not less than 2 inches (51 mm) larger in diameter than the metal pipe.
2. For unlisted appliances having draft hoods, the thimble shall be not less than 6 inches (152 mm) larger in diameter than the metal pipe.
3. For residential and low-heat appliances, the thimble shall be not less than 12 inches (305 mm) larger in diameter than the metal pipe.

Exception: In lieu of thimble protection, all combustible material in the wall shall be removed a sufficient distance from the metal pipe to provide the specified clearance from such metal pipe to combustible material. Any material used to close up such opening shall be non-combustible.

TABLE 503.7.7 CLEARANCES FOR CONNECTORS moved to TABLE 503.10.5 CLEARANCES FOR CONNECTORS

503.7.8 Clearances. Minimum clearances from single-wall metal pipe to combustible material shall be in accordance with Table 503.10.5. The clearance from single-wall metal pipe to combustible material shall be permitted to be reduced where the combustible material is protected as specified for vent connectors in Table 308.2.

503.8 Venting system termination location

2. A mechanical draft venting system, excluding direct-vent appliances, shall terminate at least 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 12 inches (305 mm) above finished ground level (grade –Deleted).

3. The vent terminal of a direct-vent appliance with an input of 10,000 Btu per hour (3 kW) or less shall be located at least 6 inches (152 mm) from any air opening into a building, and such an appliance with an input over 10,000 Btu per hour (3 kW) but not over 50,000 Btu per hour (14.7 kW) shall be installed with a 9-inch (230 mm) vent termination clearance, and an appliance with an input over 50,000 Btu/h (14.7 kW) shall have at least a 12-inch (305 mm) vent termination clearance. The bottom of the vent terminal and the air intake shall be located at least 12 inches (305 mm) finished ground level (grade –Deleted).

4. Through-the-wall vents for Category II and IV appliances and non-categorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a
nuisance or hazard or could be detrimental to the operation of regulators, relief valves or other equipment. Where local experience indicates that condensate is a problem with Category I and III appliances, this provision shall also apply. **Drains for condensate shall be installed in accordance with the manufacturer's installation instructions.**

503.10 Vent connectors for Category I appliances. Vent connectors for Category I appliances shall comply with Sections 503.10.1 through 503.10.15.

503.10.2.3 Residential-type appliance connectors. Exception: Listed insulated vent connectors shall be installed **in accordance with the manufacturer's installation instructions.**

503.10.4.1 Two or more openings. Where two or more openings are provided into one chimney flue or vent, the openings shall be at different levels, or the connectors shall be attached to the vertical portion of the chimney or vent at an angle of 45 degrees (0.79 rad) or less relative to the vertical.

503.10.5 Clearance. Minimum clearances from vent connectors to combustible material shall be in accordance with Table 503.10.5.

503.10.9 Length of vent connector. A vent connector shall be as short as practical and the appliance located as close as practical to the chimney or vent. The maximum horizontal length of a single-wall connector shall be 75 percent of the height of the chimney or vent except for engineered systems. The maximum horizontal length of a Type B double-wall connector shall be 100 percent of the height of the chimney or vent except for engineered systems. **(For a chimney or vent system serving multiple appliances, the maximum length of an individual connector, from the appliance outlet to the junction with the common vent or another connector, shall be 100 percent of the height of the chimney or vent-Deleted)**

503.10.14 Passage through ceilings, floors or walls. Single-wall metal pipe connectors shall not pass through any wall, floor or ceiling except as permitted by Section 503.7.4. **(and 503.10.15.-Deleted)**

503.10.15 **(Single-wall connector penetrations of combustible walls-Deleted)**

503.10.16 Medium-heat connectors moved to 503.10.15

503.16 Outside wall penetrations. Where vents, including those for direct-vent appliances, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using approved materials to prevent entry of combustion products into the building.

504.2.3 Vent offsets. Single-appliance venting configurations with zero (0) lateral lengths in Tables 504.2(1), 504.2(2) and 504.2(5) shall not have elbows in the venting system. Single-appliance venting configurations with lateral lengths include two 90-degree (1.57 rad) elbows. For each additional elbow up to and including 45 degrees (0.79 rad), the maximum capacity listed in the venting tables shall be reduced by 5 percent. For each additional elbow greater than 45 degrees (0.79 rad) up to and including 90 degrees (1.57 rad), the maximum capacity listed in the venting tables shall be reduced by 10 percent. **Where multiple off-sets occur in a vent, the total lateral length of all offsets combined shall not exceed that specified in Tables 504.2(1) through 504.2(5).**
504.2.9 Chimney and vent locations. Tables 504.2(1), 504.2(2), 504.2(3), 504.2(4) and 504.2(5) shall be used only for chimneys and vents not exposed to the outdoors below the roof line. A Type B vent or listed chimney lining system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors. A Type B vent shall not be considered to be exposed to the outdoors where it passes through an unventilated enclosure or chase insulated to a value of not less than R8. Table 504.2(3) in combination with Table 504.2(6) shall be used for clay-tile-lined exterior masonry chimneys, provided that all of the following are met:
1. Vent connector is a Type B double wall.
2. Vent connector length is limited to 11/2 feet for each inch (18 mm per mm) of vent connector diameter.
3. The appliance is draft hood equipped.
4. The input rating is less than the maximum capacity given by Table 504.2(3).
5. For a water heater, the outdoor design temperature is not less than 5°F (-15°C).
6. For a space-heating appliance, the input rating is greater than the minimum capacity given by Table 504.2(6).

Exception: The installation of vents serving listed appliances shall be permitted to be in accordance with the appliance manufacturer’s installation instructions.

TABLE 504.2(3) MASONARY CHIMNEY

| Maximum Internal Area of Chimney (square inches) | Seven times the listed appliance categorized area, flue color area or draft hood outlet area. |

TABLE 504.2(4) MASONARY CHIMNEY

| Maximum Internal Area of Chimney (square inches) | Seven times the listed appliance categorized area, flue color area or draft hood outlet area. |

504.3.5 Common vertical vent offset. Where the common vertical vent is offset, the maximum capacity of the common vent shall be reduced in accordance with Section 504.3.6. The horizontal length of the common vent offset (Lo) shall not exceed 11/2 feet for each inch (18 mm per mm) of common vent diameter (D). Where multiple offsets occur in a common vent, the total horizontal length of all offsets combined shall not exceed 11/2 feet for each inch (18 mm per mm) of common vent diameter (D).

504.3.9.1 Tee and wye fittings. Tee and wye fittings connected to a common gas vent shall be considered as part of the common gas vent and shall be constructed of materials consistent with that of the common gas vent.

504.3.20 Chimney and vent location. Tables 504.3(1), 504.3(2), 504.3(3), 504.3(4) and 504.3(5) shall be used only for chimneys and vents not exposed to the outdoors below the roof line. A Type B vent or listed chimney lining system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors. A Type B vent shall not be considered to be exposed to the outdoors where it passes through an unventilated enclosure or chase insulated to a value of not less than R8. Tables 504.3(6a), 504.3(6b) and Tables 504.3(7a), 504.3(7b) shall be used for clay-tile-lined exterior masonry chimneys, provided that all of the following conditions are met:
1. Vent connector is Type B double wall.
2. At least one appliance is draft hood equipped.
3. The combined appliance input rating is less than the maximum capacity given by Table 504.3(6a) for NAT+NAT or Table 504.3(7a) for FAN+NAT.

4. The input rating of each space-heating appliance is greater than the minimum input rating given by Table 504.3(6b) for NAT+NAT or Table 504.3(7b) for FAN+NAT.

5. The vent connector sizing is in accordance with Table 504.3(3).

(When these conditions cannot be met, an alternative venting design shall be used, such as a chimney lining system-Deleted)

Exception: Vents serving listed appliances installed in accordance with the appliance manufacturer's installation instructions.

505.1.1 Commercial cooking appliances vented by exhaust hoods. Where commercial cooking appliances are vented by means of the Type I or II kitchen exhaust hood system that serves such appliances, the exhaust system shall be fan powered and the appliances shall be interlocked with the exhaust hood system to prevent appliance operation when the exhaust hood system is not operating. The method of interlock between the exhaust hood system and the appliances equipped with standing pilot burner ignition systems shall not cause such pilots to be extinguished. Where a solenoid valve is installed in the gas piping as part of an interlock system, gas piping shall not be installed to bypass such valve. Dampers shall not be installed in the exhaust system.

CHAPTER 6 – SPECIFIC APPLIANCES

[M] 614.5 Makeup air. Installations exhausting more than 200 cfm (0.09 m3/s) shall be provided with makeup air. Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (645 mm2) for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.

[M] 614.6 Domestic clothes dryer exhaust ducts. Exhaust ducts for domestic clothes dryers shall conform to the requirements of Sections 614.6.1 through 614.6.7

[M] 614.6.1 Material and size. Exhaust ducts shall have a smooth interior finish and shall be constructed of metal a minimum 0.016 inch (0.4 mm) thick. With the exception of the transition duct, flexible ducts are prohibited. The exhaust duct size shall be 4 inches (102 mm) nominal in diameter.

[M] 614.6.2 Duct installation. Exhaust ducts shall be supported at 4-foot (1219 mm) intervals and secured in place and shall terminate not less than 12 inches (305 mm) above finished grade. The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow. Ducts shall not be joined with screws or similar fasteners that protrude into the inside of the duct.

Exception: Where the duct termination is less than 12 inches (305 mm) above finished grade an areaway shall be provided with a cross-sectional area not less than 200 square feet (18.6 m2). The bottom of the duct termination shall be no less than 12 inches (305 mm) above the areaway bottom.

[M] 614.6.4 Transition ducts. Transition ducts used to connect the dryer to the exhaust duct system shall be a single length that is listed and labeled in accordance with UL 2158A. Transition ducts shall be a maximum of 8 feet (2438 mm) in length, shall not be concealed within construction, and must remain entirely within the room in which the appliance is installed.

[M] 614.6.5 Duct length. The maximum allowable exhaust duct length shall be determined by one of the methods specified in Section 614.6.5.1 or 614.6.5.2.
614.6.5.1 Specified length. The maximum length of the exhaust duct shall be 35 feet (10,668 mm) from the connection to the transition duct from the dryer to the outlet terminal. Where fittings are utilized, the maximum length of the exhaust duct shall be reduced in accordance with Table 614.6.5.1.

614.6.5.2 Manufacturer’s instructions. The maximum length of the exhaust duct shall be determined by the dryer manufacturer’s installation instructions. The code official shall be provided with a copy of the installation instructions for the make and model of the dryer. Where the exhaust duct is to be concealed, the installation instructions shall be provided to the code official prior to the concealment inspection. In the absence of fitting equivalent length calculations from the clothes dryer manufacturer, Table 614.6.5.1 shall be utilized.

614.6.6 Length identification. The equivalent length of the exhaust duct shall be identified on a permanent label or tag. The label or tag shall be located within 6 feet (1829 mm) of the exhaust duct connection.

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

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

![Table 614.6.5.1](image)

<table>
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<tr>
<th>DRYER EXHAUST DUCT FITTING TYPE</th>
<th>EQUIVALENT LENGTH</th>
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<td>4 inch radius mitered 90-degree elbow</td>
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<tr>
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<tr>
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<td>9 inches</td>
</tr>
<tr>
<td>10 inch radius smooth 90-degree elbow</td>
<td>1 foot, 6 inches</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.

614.8 Common exhaust systems for clothes dryers located in multistory structures. Where a common multistory duct system is designed and installed to convey exhaust from multiple clothes dryers, the construction of such system shall be in accordance with all of the following:

1. The shaft in which the duct is installed shall be constructed and fire-resistant rated as required by the International Building Code.
2. Dampers shall be prohibited in the exhaust duct. Penetrations of the shaft and ductwork shall be protected in accordance with Section 607.5.5, Exception 2, of the International Mechanical Code.
3. Rigid metal ductwork shall be installed within the shaft to convey the exhaust. The ductwork shall be constructed of sheet steel having a minimum thickness of 0.0187 inch (0.471 mm) (No. 26 gage) and in accordance with SMACNA Duct Construction Standards.
4. The ductwork within the shaft shall be designed and installed without offsets.
5. The exhaust fan motor design shall be in accordance with Section 503.2 of the International Mechanical Code.
6. **The exhaust fan motor shall be located outside of the air stream.**
7. **The exhaust fan shall run continuously, and shall be connected to a standby power source.**
8. **The exhaust fan operation shall be monitored in an approved location and shall initiate an audible or visual signal when the fan is not in operation.**
9. **Makeup air shall be provided for the exhaust system.**
10. **A cleanout opening shall be located at the base of the shaft to provide access to the duct to allow for cleaning and inspection. The finished opening shall be not less than 12 inches by 12 inches (305 mm by 305 mm).**
11. **Screens shall not be installed at the termination.**

616.1 **Powered equipment.** Permanently installed equipment powered by internal combustion engines and turbines shall be installed in accordance with the manufacturer’s installation instructions and NFPA 37. Stationary engine generator assemblies shall meet the requirements of UL 2200.

616.2 **Gas supply connection.** Equipment powered by internal combustion engines and turbines shall not be rigidly connected to the gas supply piping.

618.5 **Prohibited sources.** Outside or return air for a forced-air heating system shall not be taken from the following locations:
1. Closer than 10 feet (3048 mm) from an appliance vent outlet, a vent opening from a plumbing drainage system or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside air inlet.
2. Where there is the presence of objectionable odors, fumes or flammable vapors; or where located less than 10 feet (3048 mm) above the surface of any abutting public way or driveway; or where located at grade level by a sidewalk, street, alley or driveway.
3. A hazardous or in-sanitary location or a refrigeration machinery room as defined in the International Mechanical Code.
4. A room or space, the volume of which is less than 25 percent of the entire volume served by such system. Where connected by a permanent opening having an area sized in accordance with Section 618.2, adjoining rooms or spaces shall be considered as a single room or space for the purpose of determining the volume of such rooms or spaces.
   **Exception:** The minimum volume requirement shall not apply where the amount of return air taken from a room or space is less than or equal to the amount of supply air delivered to such room or space.
5. A room or space containing a fuel-burning appliance or fireplace where such a room or space serves as a source of return air.
   **Exception:** This shall not apply where:
   1. The appliance is a direct-vent appliance or an appliance not requiring a vent in accordance with Section 501.8.
   2. The room or space complies with the following requirements:
      2.1. The return air shall be taken from a room or space having a volume exceeding 1 cubic foot for each 10 Btu/h (9.6 L/W) of combined input rating of all fuel-burning appliances therein.
      2.2. The volume of supply air discharged back into the same space shall be approximately equal to the volume of return air taken from the space.
      2.3. Return-air inlets shall not be located within 10 feet (3048 mm) of any appliance firebox or draft hood in the same room or space.
   3. Rooms or spaces containing solid fuel-burning appliances, provided that return-air inlets are located not less than 10 feet (3048 mm) from the firebox of such appliances.
   **(4. Rooms or spaces containing fireplaces provided that the return air inlets are located not less than 10 feet from the firebox of such fireplaces-Deleted)**
6. A closet, bathroom, toilet room, kitchen, garage, mechanical room, boiler room, furnace room or attic.

Exception: Where return air intakes are located not less than 10 feet (3048 mm) from cooking appliances and serve only the kitchen area, taking return air from a kitchen area shall not be prohibited.

7. A non-conditioned crawl space by means of direct connection to the return side of a forced air system.

618.8 Return air intake (nonengineered systems) changed to 618.8 (IFGS) Furnace plenums and air ducts

618.8 (IFGS) Furnace plenums and air ducts. Where a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside of the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside of the space containing the furnace.

618.9 Refrigeration coils in warm-air furnaces. When a cooling coil is located in the supply plenum of a warm-air furnace, the furnace blower shall be rated at not less than 0.5 inch water column (124 Pa) static pressure unless the furnace is listed and labeled for use with a cooling coil. Cooling coils shall not be located upstream from heat exchangers unless listed and labeled for such use. Conversion of existing furnaces for use with cooling coils shall be permitted provided the furnace will operate within the temperature rise specified for the furnace.

618.10 Return-air intake (non-engineered systems). 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 the temperature rise limitations specified by the equipment manufacturer. The face velocity of return air grilles shall not exceed 450 feet per minute (fpm) (2.3 m/s). At least one separate return shall be installed on each level of a multilevel structure. For split-level and split-foyer structures, one return may serve more than one level if located near the levels served and the total area of the levels does not exceed 1,600 square feet (148.6 m2). Return-air grilles shall not be located in bathrooms. The return air from one residential living unit shall not be mixed with the return air from other living units.

In dwellings with 1,600 square feet (148.6 m2) or less of conditioned area, a central return is permitted. When the dwelling contains more than 1,600 square feet (148.6 m2) of conditioned area, additional returns shall be provided. Each return shall serve not more than 1,600 square feet (148.6 m2) of area and shall be located in the area it serves. Return air may travel through the living space to the return-air intake if there are no restrictions, such as solid doors, to the air movement. When panned joists are used for return air, the structural integrity shall be maintained. Air capacity for joists 16 inches (406 mm) on center shall be a maximum of 375 cfm (0.177 m3/s) for 8-inch (203 mm) joists and 525 cfm (0.248 m3/s) for 10-inch (254 mm) joists. Wiring located in spaces used for return-air ducts shall comply with the North Carolina Electrical Code.

620.5 (IFGS) Installation in commercial garages and aircraft hangars. Unit heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be installed in accordance with Sections 305.9, 305.10 and 305.11.

621.5 Room or space volume. The aggregate input rating of all un-vented appliances installed in a room or space shall not exceed 20 Btu/h per cubic foot (207 W/m3) of volume of such room or space. Where the room or space in which the appliances (equipment—Deleted) are installed is directly connected to another room or space by a doorway, archway or other opening of comparable size that cannot be closed, the volume of such adjacent room or space shall be permitted to be included in the calculations.
623.7 (IFGS) Vertical clearance above cooking top. House hold cooking appliances shall have a vertical clearance above the cooking top of not less than 30 inches (760 mm) to combustible material and metal cabinets. A minimum clearance of 24 inches (610 mm) is permitted where one of the following is installed:

1. The underside of the combustible material or metal cabinet above the cooking top is protected with not less than

   1/4-inch (6 mm) insulating millboard covered with sheet metal not less than 0.0122 inch (0.3 mm) thick.

2. A metal ventilating hood constructed of sheet metal not less than 0.0122 inch (0.3 mm) thick is installed above the cooking top with a clearance of not less than 1/4 inch (6.4 mm) between the hood and the underside of the combustible material or metal cabinet. The hood shall have a width not less than the width of the appliance and shall be centered over the appliance.

3. A listed cooking appliance or microwave oven is installed over a listed cooking appliance and in compliance with the terms of the manufacturer’s installation instructions for the upper appliance.

627.1 General. Gas-fired air-conditioning appliances shall be tested in accordance with ANSI Z21.40.1 or ANSI Z21.40.2 and shall be installed in accordance with the manufacturer’s installation instructions.

627.2 Independent piping. Gas piping serving heating appliances shall be permitted to also serve cooling appliances where such heating and cooling appliances cannot be operated simultaneously (see Section 402).

627.4 Clearances for indoor installation. Air-conditioning appliances installed in rooms other than alcoves and closets shall be installed with clearances not less than those specified in Section 308.3 except that air-conditioning appliances listed for installation at lesser clearances than those specified in Section 308.3 shall be permitted to be installed in accordance with such listing and the manufacturer’s instructions and air-conditioning appliances listed for installation at greater clearances than those specified in Section 308.3 shall be installed in accordance with such listing and the manufacturer’s instructions.

Air-conditioning appliances installed in rooms other than alcoves and closets shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material is protected in accordance with Table 308.2.

627.5 Alcove and closet installation. Air-conditioning appliances installed in spaces such as alcoves and closets shall be specifically listed for such installation and installed in accordance with the terms of such listing. The installation clearances for air-conditioning appliances in alcoves and closets shall not be reduced by the protection methods described in Table 308.2.

627.6 Installation. Air-conditioning appliances shall be installed in accordance with the manufacturer’s instructions. Unless the appliances is listed for installation on a combustible surface such as a floor or roof, or unless the surface is protected in an approved manner, the appliances shall be installed on a surface of noncombustible construction with noncombustible material and surface finish and with no combustible material against the underside thereof.

627.7 Plenums and air ducts. A plenum supplied as a part of the air-conditioning appliances shall be installed in accordance with the manufacturer’s instructions. Where a plenum is not supplied with the appliances, such plenum shall be installed in accordance with the fabrication and installation instructions provided by the plenum and
appliances [equipment-Deleted] manufacturer. The method of connecting supply and return ducts shall facilitate proper circulation of air. Where the air-conditioning appliances [equipment-Deleted] is installed within a space separated from the spaces served by the appliance, the air circulated by the appliances [equipment-Deleted] shall be conveyed by ducts that are sealed to the casing of the appliances [equipment-Deleted] and that separate the circulating air from the combustion and ventilation air.

627.10 Switches in electrical supply line. Means for interrupting the electrical supply to the air-conditioning appliances [equipment-Deleted] and to its associated cooling tower (if supplied and installed in a location remote from the air conditioner) shall be provided within sight of and not over 50 feet (15240 mm) from the air conditioner and cooling tower.

630.3 (IFGS) Combustion and ventilation air. Where un-vented infrared heaters are installed, natural or mechanical means shall provide outdoor ventilation air at a rate of not less than 4 cfm per 1,000 Btu/h (0.38 m3/min/kW) of the aggregate input rating of all such heaters installed in the space. Exhaust openings for removing flue products shall be above the level of the heaters.

630.4 (IFGS) Installation in commercial garages and air- craft hangars. Overhead infrared heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be installed in accordance with Sections 305.9, 305.10 and 305.11

[F] 633.1 General. Stationary fuel-cell power systems having a power output not exceeding 10 MW shall be tested in accordance with ANSI CSA America FC 1 and shall be installed in accordance with the manufacturer’s installation instructions, NFPA 853, the International Building Code and the International Fire Code.

635.1 Installation. The installation of gaseous hydrogen systems shall be in accordance with the applicable requirements of this code, the International Fire Code and the International Building Code.

CHAPTER 7 – GASEOUS HYDROGEN SYSTEMS

[F] 703.6 Electrical wiring and equipment. Electrical wiring and equipment shall comply with NFPA 70.

704.1.2.3.5 Protection against physical damage. (In concealed locations-Deleted) Where piping other than stainless steel piping, stain- less steel tubing or black steel is installed through holes or notches in wood studs, joists, rafters or similar members less than 1 1/2 inches (38 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Shield plates shall be a mini- mum of 1/16-inch-thick (1.6 mm) steel, shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

[F] 706.2 Indoor gaseous hydrogen systems. Gaseous hydrogen systems shall be located in indoor rooms or areas in accordance with one of the following:
1. Inside a building in a hydrogen cutoff room designed and constructed in accordance with Section 421 of the International Building Code;
A.2.2 Low pressure natural gas tables. Capacities for gas at low pressure [less than 2.0 psig (13.8 kPa gauge)] in cubic feet per hour of 0.60 specific gravity gas for different sizes and lengths are shown in Tables 402.4(1) and 402.4(2) for iron pipe or equivalent rigid pipe; in Tables 402.4(6) through 402.4(9) for smooth wall semirigid tubing; and in Tables 402.4(13) through 402.4(15) for corrugated stainless steel tubing. Tables 402.4(1) and 402.4(6) are based upon a pressure drop of 0.3-inch w.c. (75 Pa), whereas Tables 402.4(2), 402.4(7) and 402.4(13) are based upon a pressure drop of 0.5-inch w.c. (125 Pa). Tables 402.4(8), 402.4(9), 402.4(14) and 402.4(15) are special low-pressure applications based upon pressure drops greater than 0.5-inch w.c. (125 Pa). In using these tables, an allowance (in equivalent length of pipe) should be considered for any piping run with four or more fittings (see Table A.2.2).

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continued
A.2.3 Undiluted liquefied petroleum tables. Capacities in thousands of Btu per hour of undiluted liquefied petroleum gases based on a pressure drop of 0.5-inch w.c. (125 Pa) for different sizes and lengths are shown in Table 402.4(26) for iron pipe or equivalent rigid pipe, in Table 402.4(28) for smooth wall semi-rigid tubing, in Table 402.4(30) for corrugated stainless steel tubing, and in Tables 402.4(33) and 402.4(35) for polyethylene plastic pipe and tubing. Tables 402.4(31) and 402.4(32) for corrugated stainless steel tubing and Table 402.4(34) for polyethylene plastic pipe are based on operating pressures greater than 11/2 pounds per square inch (psi) (3.5 kPa) and pressure drops greater than 0.5-inch w.c. (125 Pa). In using these tables, an allowance (in equivalent length of pipe) should be considered for any piping run with four or more fittings [see Table A.2.2].

![Table A.2.2—continued](image-url)

**TABLE A.2.2—continued**

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<tr>
<td>24</td>
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For SI: 1 foot = 305 mm, 1 degree = 0.01745 rad.

**Note:** Values for welded fittings are for conditions where bore is not obstructed by weld spatter or backing rings. If appreciably obstructed, use values for “Screwed Fittings.”

1. Flanged fittings have three-fourths the resistance of screwed elbows and tees.
2. Tabular figures give the extra resistance due to curvature alone to which should be added the full length of travel.
3. Small size socket-welding fittings are equivalent to miter elbows and miter tees.
4. Equivalent resistance in number of diameters of straight pipe computed for a value of (f - 0.0075) from the relation (n - k/4).
5. For condition of minimum resistance where the centerline length of each miter is between d and 21/2 d.
6. For pipe having other inside diameters, the equivalent resistance may be computed from the above n values.
The following procedure is intended as a guide to aid in determining that an appliance is properly installed and is in a safe condition for continuing use. This procedure is intended for central furnace and boiler installations and may not be applicable to all installations.

(a) This procedure should be performed prior to any attempt at modification of the appliance or of the installation.

(b) If it is determined that there is a condition that could result in unsafe operation, shut off the appliance and advise the owner of the unsafe condition. The following steps should be followed in making the safety inspection:

1. Conduct a check for gas leakage. (See Section 406.6)
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies that could cause an unsafe condition.
3. Shut off all gas to the appliance and shut off any other fuel-gas-burning appliance within the same room. Use the shutoff valve in the supply line to each appliance.
4. Inspect burners and crossovers for blockage and corrosion.
5. Furnace installations: Inspect the heat exchanger for cracks, openings or excessive corrosion.
7. Close all building doors and windows and all doors between the space in which the appliance is located and other spaces of the building that can be closed. Turn on any clothes dryers. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers. If, after completing Steps 8 through 13, it is believed sufficient combustion air is not available, refer to Section 304 of this code.
8. Place the appliance being inspected in operation. Follow the lighting instructions. Adjust the thermostat so appliance will operate continuously.
9. Determine that the pilot, where provided, is burning properly and that the main burner ignition is satisfactory by interrupting and reestablishing the electrical supply to the appliance in any convenient manner. If the appliance is equipped with a continuous pilot, test all pilot safety devices to determine if they are operating properly by extinguishing the pilot when the main burner is off and determining, after 3 minutes, that the main burner gas does not flow upon a call for heat. If the appliance is not provided with a pilot, test for proper operation of the ignition system in accordance with the appliance manufacturer’s lighting and operating instructions.
10. Visually determine that the main burner gas is burning properly (i.e., no floating, lifting or flashback). Adjust the primary air shutters as required. If the appliance is equipped with high and low flame controlling or flame modulation, check for proper main burner operation at low flame.
11. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle or smoke.
12. Turn on all other fuel-gas-burning appliances within the same room so they will operate at their full inputs. Follow lighting instructions for each appliance.
13. Repeat Steps 10 and 11 on the appliance being inspected.
14. Return doors, windows, exhaust fans, fireplace dampers and any other fuel-gas-burning appliance to their previous conditions of use.
15. Furnace installations: Check both the limit control and the fan control for proper operation. Limit control operation can be checked by blocking the circulating air inlet or temporarily disconnecting the electrical supply to the blower motor and determining that the limit control acts to shut off the main burner gas.
16. Boiler installations: Verify that the water pumps are in operating condition. Test low water cutoffs, automatic feed controls, pressure and temperature limit controls and relief valves in accordance with the manufacturer’s recommendations to determine that they are in operating condition.

PLEASE REFER TO CHAPTER 8 OF THE NEW N.C. 2012 FUEL GAS CODE FOR ALL APPLICABLE REFERENCES.

PLEASE REFER TO THE APPENDICES OF THE NEW N.C. 2012 FUEL GAS CODE FOR ALL APPLICABLE APPENDICES.

PLEASE REFER TO THE INDEX OF THE NEW N.C. 2012 FUEL GAS CODE FOR ALL APPLICABLE SEARCHES.

The preceding summarizations of the respective 2012 N.C. State Fuel Gas Code changes are for informational use only and are not intended as a substitute for the 2012 N.C. State Fuel Gas Code itself.

Also, it is important to understand that these informational summarizations are not intended to be all inclusive, only to highlight what we interpret to be the most relevant code changes based on our permitting and inspection processes.

If, upon review of these code change documents, you have any questions concerning their application or intent, please contact our Plumbing and Mechanical Inspection Division at (919) 469-4341 or e-mail at phil.rice@townofcary.org.