

PREFACE

History

The State of Florida first mandated statewide building codes during the 1970s at the beginning of the modern construction boom. The first law required all municipalities and counties to adopt and enforce one of the four state-recognized model codes known as the “state minimum building codes.” During the early 1990s a series of natural disasters, together with the increasing complexity of building construction regulation in vastly changed markets, led to a comprehensive review of the state building code system. The study revealed that building code adoption and enforcement was inconsistent throughout the state and those local codes thought to be the strongest proved inadequate when tested by major hurricane events. The consequences of the building codes system failure were devastation to lives and economies and a statewide property insurance crisis. The response was a reform of the state building construction regulatory system that placed emphasis on uniformity and accountability.

The 1998 Florida Legislature amended Chapter 553, *Florida Statutes* (FS), Building Construction Standards, to create a single state building code that is enforced by local governments. As of March 1, 2002, the *Florida Building Code*, which is developed and maintained by the Florida Building Commission, supersedes all local building codes. The Florida Building Code is updated every three years and may be amended annually to incorporate interpretations and clarifications.

Scope

The *Florida Building Code* is based on national model building codes and national consensus standards which are amended where necessary for Florida’s specific needs. The code incorporates all building construction-related regulations for public and private buildings in the State of Florida other than those specifically exempted by Section 553.73, Florida Statutes. It has been harmonized with the *Florida Fire Prevention Code*, which is developed and maintained by the Department of Financial Services, Office of the State Fire Marshal, to establish unified and consistent standards.

The base codes for the 2007 edition of the *Florida Building Code* include: the *International Building Code*®, 2006 edition; the *International Plumbing Code*®, 2006 edition; the *International Mechanical Code*®, 2006 edition; the *International Fuel Gas Code*®, 2006 edition; the *International Residential Code*®, 2006 edition; the *International Existing Building Code*®, 2006 edition; †† the *National Electrical Code*, 2008 edition; the U. S. Department of Housing and Urban Development, *Fair Housing Guidelines*, and; substantive criteria from the American Society of Heating, Refrigerating and Air-conditioning Engineers’ (ASHRAE) Standard 90.1-2004. State and local codes adopted and incorporated into the code include the *Florida Energy Efficiency Code for Building Construction*, the *Florida Accessibility Code for Building Construction* and special hurricane protection standards for the high-velocity hurricane zone.

The code is composed of seven main volumes: the *Florida Building Code, Building*, which also includes Chapter 13 (energy efficiency) and Chapter 11 (accessibility) as well as state regulations for licensed facilities; the *Florida Building Code, Plumbing*; the *Florida Building Code, Mechanical*; the *Florida Building Code, Fuel Gas*; the *Florida Existing Building Code*; the *Florida Building Code, Residential*; and the *Florida Building Code, Test Protocols for High-Velocity Hurricane Zones*. Chapter 27 of the *Florida Building Code, Building*, adopts the *National Electrical Code*, NFPA 70, by reference. ††

Under certain strictly defined conditions, local governments may amend requirements to be more stringent than the code. All local amendments to the *Florida Building Code* must be adopted by local ordinance and reported to the Florida Building Commission then posted on www.floridabuilding.org in Legislative format for a month before being enforced. Local amendments to the *Florida Building Code* and the *Florida Fire Prevention Code* may be obtained from the Florida Building Commission web site, or from the Florida Department of Community Affairs or the Florida Department of Financial Services, Office of the State Fire Marshal, respectively.

Adoption and Maintenance

The *Florida Building Code* is adopted and updated with new editions triennially by the Florida Building Commission. It is amended annually to incorporate interpretations, clarifications and to update standards. Minimum requirements for permitting, plans review and inspections are established by the code, and local jurisdictions may adopt additional administrative requirements that are more stringent. Local technical amendments are subject to strict criteria established by Section 553.73, F.S. They are subject to commission review and adoption into the code or repeal when the code is updated triennially and are subject to appeal to the Commission according to the procedures established by Section 553.73, F.S.

Ten Technical Advisory Committees (TACs), which are constituted consistent with American National Standards Institute (ANSI) Guidelines, review proposed code changes and clarifications of the code and make recommendations to the Commission. These TACs whose membership is constituted consistent with American National Standards Institute (ANSI) Guidelines include: Accessibility; Joint Building Fire (a joint committee of the Commission and the State Fire Marshal); Building Structural; Code Administration/ Enforcement; Electrical; Energy; Mechanical; Plumbing and Fuel Gas; Roofing; and Special Occupancy (state agency construction and facility licensing regulations).

The Commission may only issue official code clarifications using procedures of Chapter 120, Florida Statutes. To obtain such a clarification, a request for a Declaratory Statement (DEC) must be made to the Florida Building Commission in a manner that establishes a clear set of facts and circumstances and identifies the section of the code in question. Requests are analyzed by staff, reviewed by the appropriate Technical Advisory Committee, and sent to the Florida Building Commission for a first action. Draft Declaratory Statements are subject to public comment and are finalized by the Commission at its next meeting. These interpretations establish precedents for situations having similar facts and circumstances and are typically incorporated into the code in the next code amendment cycle. Non-binding opinions are available from the Building Officials Association of Florida's web site (www.BOAF.net) and a Binding Opinion process is available online at www.floridabuilding.org.

Letter Designations in Front of Section Numbers

* In each code development cycle, proposed changes to the code are considered at the Code Development Hearings by the ICC Mechanical Code Development Committee, whose action constitutes a recommendation to the voting membership for final action on the proposed change. Proposed changes to a code section that has a number beginning with a letter in brackets are considered by a different code development committee. For example, proposed changes to code sections that have [B] in front of them (e.g. [B] 601.2) are considered by the International Building Code Development Committee at the code development hearings.

The content of sections in this code that begin with a letter designation are maintained by another code development committee in accordance with the following:

- [B] = International Building Code Development Committee;
- [EC] = International Energy Conservation Code Development Committee;
- [F] = International Fire Code Development Committee;
- [FG] = International Fuel Gas Code Development Committee.

Marginal Markings

* Vertical lines in the margins within the body of the code indicate a change from the requirements of the base codes to the 2007 *Florida Building Code* effective March 1, 2009.

* An * inserted in the margin indicates a change from the 2007 *Florida Building Code* to the 2009 *Florida Building Code* revisions, effective March 1, 2009.

Sections deleted from the base code are designated "Reserved."

** An ** inserted in the margin indicates a change from the 2007 *Florida Building Code* to the 2009 *Florida Building Code* revisions, effective October 1, 2009.

Acknowledgments

The *Florida Building Code* is produced through the efforts and contributions of building designers, contractors, product manufacturers, regulators and other interested parties who participate in the Florida Building Commission's consensus processes, Commission staff and the participants in the national model code development processes.

TABLE OF CONTENTS

<p>CHAPTER 1 ADMINISTRATION 1.1</p> <p>Section</p> <p>101 General 1.1</p> <p>102 - 109 Reserved 1.1</p> <p>CHAPTER 2 DEFINITIONS 2.1</p> <p>Section</p> <p>201 General 2.1</p> <p>202 General Definitions 2.1</p> <p>CHAPTER 3 GENERAL REGULATIONS 3.1</p> <p>Section</p> <p>301 General 3.1</p> <p>302 Protection of Structure 3.2</p> <p>303 Equipment and Appliance Location 3.3</p> <p>304 Installation 3.3</p> <p>305 Piping Support 3.5</p> <p>306 Access and Service Space 3.5</p> <p>307 Condensate Disposal 3.7</p> <p>308 Clearance Reduction 3.8</p> <p>309 Temperature Control 3.9</p> <p>310 Explosion Control 3.9</p> <p>311 Smoke and Heat Vents 3.9</p> <p>312 Heating and Cooling Load Calculations 3.9</p> <p>CHAPTER 4 VENTILATION..... 4.1</p> <p>Section</p> <p>401 General 4.1</p> <p>402 Natural Ventilation 4.1</p> <p>403 Mechanical Ventilation 4.2</p> <p>404 Enclosed Parking Garages 4.4</p> <p>405 Systems Control 4.4</p> <p>406 Reserved 4.5</p> <p>407 Return Air Intake 4.5</p> <p>CHAPTER 5 EXHAUST SYSTEMS 5.1</p> <p>Section</p> <p>501 General 5.1</p> <p>502 Required Systems 5.1</p> <p>503 Motors and Fans 5.7</p> <p>504 Clothes Dryer Exhaust 5.8</p> <p>505 Domestic Kitchen Exhaust Equipment 5.8</p>	<p>506 Commercial Kitchen Hood Ventilation System Ducts And Exhaust Equipment .. 5.9</p> <p>507 Commercial Kitchen Hoods 5.12</p> <p>508 Commercial Kitchen Makeup Air 5.15</p> <p>509 Fire Suppression Systems 5.15</p> <p>510 Hazardous Exhaust Systems 5.15</p> <p>511 Dust, Stock and Refuse Conveying Systems 5.17</p> <p>512 Subslab Soil Exhaust Systems 5.19</p> <p>513 Smoke and Carbon Monoxide Control Systems 5.19</p> <p>514 Energy Recovery Ventilation Systems 5.22</p> <p>515 Mausoleum Relief Vent 5.23</p> <p>CHAPTER 6 DUCT SYSTEMS 6.1</p> <p>Section</p> <p>601 General 6.1</p> <p>602 Plenums 6.2</p> <p>603 Duct Construction and Installation 6.3</p> <p>604 Insulation 6.7</p> <p>605 Air Filters 6.8</p> <p>606 Smoke Detection Systems Control 6.8</p> <p>607 Duct and Transfer Openings 6.9</p> <p>CHAPTER 7 COMBUSTION AIR 7.1</p> <p>Section</p> <p>701 General 7.1</p> <p>702 Indoor Air 7.1</p> <p>703 Outdoor Air 7.1</p> <p>704 Combined Use of Indoor and Outdoor Air (Condition 1) 7.2</p> <p>705 Combined Use of Indoor and Outdoor Air (Condition 2) 7.2</p> <p>706 Forced Combustion Air Supply 7.2</p> <p>707 Direct Connection 7.2</p> <p>708 Combustion Air Ducts 7.3</p> <p>709 Opening Obstructions 7.3</p> <p>710 Opening Location and Protection 7.3</p> <p>CHAPTER 8 CHIMNEYS AND VENTS 8.1</p> <p>Section</p> <p>801 General 8.1</p> <p>802 Vents 8.2</p> <p>803 Connectors 8.3</p>
---	---

804	Direct-Vent, Integral Vent and Mechanical Draft Systems	8.4
805	Factory-built Chimneys	8.5
806	Metal Chimneys	8.6

CHAPTER 9 SPECIFIC APPLIANCES, FIREPLACES AND SOLID FUEL-BURNING EQUIPMENT 9.1

Section		
901	General	9.1
902	Masonry Fireplaces	9.1
903	Factory-built Fireplaces	9.1
904	Pellet Fuel-Burning Appliances	9.1
905	Fireplace Stoves and Room Heaters	9.1
906	Factory-built Barbecue Appliances	9.1
907	Incinerators and Crematories	9.1
908	Cooling Towers, Evaporative Condensers and Fluid Coolers	9.1
909	Vented Wall Furnaces	9.2
910	Floor Furnaces	9.2
911	Duct Furnaces	9.2
912	Infrared Radiant Heaters	9.2
913	Clothes Dryers	9.2
914	Sauna Heaters	9.3
915	Engine and Gas Turbine-Powered Equipment and Appliances	9.3
916	Pool and Spa Heaters	9.3
917	Cooking Appliances	9.3
918	Forced-air Warm-air Furnaces	9.3
919	Conversion Burners	9.4
920	Unit Heaters	9.4
921	Vented Room Heaters	9.4
922	Kerosene and Oil-fired Stoves	9.5
923	Small Ceramic Kilns	9.5
924	Stationary Fuel Cell Power Systems	9.5
925	Masonry Heaters	9.5
926	Residential Radiant Heating Systems	9.5
927	Residential Electric Duct Heaters	9.5
928	Vented Residential Floor Furnaces	9.5
929	Vented Residential Wall Furnaces	9.6
930	Vented Residential Room Heaters	9.6
931	Gaseous Hydrogen Systems	9.6

CHAPTER 10 BOILERS, WATER HEATERS AND PRESSURE VESSELS 10.1

Section		
1001	General	10.1
1002	Water Heaters	10.1
1003	Pressure Vessels	10.1
1004	Boilers	10.1
1005	Boiler Connections	10.2
1006	Safety and Pressure Relief Valves and Controls	10.2
1007	Boiler Low-water Cutoff	10.2
1008	Steam Blowoff Valve	10.3
1009	Hot Water Boiler Expansion Tank	10.3
1010	Gauges	10.3
1011	Tests	10.3

CHAPTER 11 REFRIGERATION 11.1

Section		
1101	General	11.1
1102	System Requirements	11.1
1103	Refrigeration System Classification	11.2
1104	System Application Requirements	11.2
1105	Machinery Room, General Requirements	11.7
1106	Machinery Room, Special Requirements	11.8
1107	Refrigerant Piping	11.8
1108	Field Test	11.9
1109	Periodic Testing	11.10

CHAPTER 12 HYDRONIC PIPING 12.1

Section		
1201	General	12.1
1202	Material	12.1
1203	Joints and Connections	12.2
1204	Pipe Insulation	12.3
1205	Valves	12.3
1206	Piping Installation	12.3
1207	Transfer Fluid	12.4
1208	Tests	12.4
1209	Embedded Piping	12.4

CHAPTER 13 FUEL OIL PIPING AND STORAGE 13.1

Section		
1301	General	13.1
1302	Material	13.1

CHAPTER 2

DEFINITIONS

SECTION 201 GENERAL

201.1 Scope. Unless otherwise expressly stated, the following words and terms shall, for the purposes of this code, have the meanings indicated in this chapter.

201.2 Interchangeability. Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

201.3 Terms defined in other codes. Where terms are not defined in this code and are defined in the *Florida Building Code, Building*, Chapter 27 of the *Florida Building Code, Building*, *Florida Fire Prevention Code*, *Florida Building Code, Fuel Gas* or the *Florida Building Code, Plumbing*, such terms shall have meanings ascribed to them as in those codes.

201.4 Terms not defined. Where terms are not defined through the methods authorized by this section, such terms shall have the meanings as defined in Webster's *Third New International Dictionary of the English Language Unabridged*.

SECTION 202 GENERAL DEFINITIONS

ABRASIVE MATERIALS. Moderately abrasive particulate in high concentrations, and highly abrasive particulate in moderate and high concentrations, such as alumina, bauxite, iron silicate, sand and slag.

ABSORPTION SYSTEM. A refrigerating system in which refrigerant is pressurized by pumping a chemical solution of refrigerant in absorbent, and then separated by the addition of heat in a generator, condensed (to reject heat), expanded, evaporated (to provide refrigeration), and reabsorbed in an absorber to repeat the cycle; the system may be single or multiple effect, the latter using multiple stages or internally cascaded use of heat to improve efficiency.

ACCESS (TO). That which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction [see also "Ready access (to)"].

ADDITION. An extension or increase in conditioned floor area or height of a building or structure. (Reference Chapter 13, Section 13-101.1.2 and Section 13-101.2.2, of the *Florida Building Code, Building*).

AIR. All air supplied to mechanical equipment and appliances for combustion, ventilation, cooling, etc. Standard air is air at standard temperature and pressure, namely, 70°F (21°C) and 29.92 inches of mercury (101.3 kPa).

AIR BARRIER. Relating to air distribution systems, a material object(s) which impedes or restricts the free movement of air under specified conditions. For fibrous glass duct, the air

barrier is its foil cladding; for flexible nonmetal duct, the air barrier is the nonporous core; and for sheet metal duct and air handling units, the air barrier is the metal in contact with the air stream. For mechanical closets, the air barrier may be a uniform panelized material such as gypsum wall board which meets ASTM C 36, or it may be a membrane which alone acts as an air barrier which is attached to a panel, such as the foil cladding of fibrous glass duct board.

Relating to the building envelope, air barriers comprise the planes of primary resistance to air flow between the interior spaces of a building and the outdoors and the planes of primary air flow resistance between adjacent air zones of a building, including planes between adjacent conditioned and unconditioned air spaces of a building. To be classed as an air barrier, a building plane must be substantially leak free; that is, it shall have an air leakage rate not greater than 0.5 cfm/ft² when subjected to an air pressure gradient of 25 pascal. In general, air barriers are made of durable, nonporous materials and are sealed to adjoining wall, ceiling or floor surfaces with a suitable long-life mastic. House wraps and taped and sealed dry-wall may constitute an air barrier but dropped acoustical tile ceilings (T-bar ceilings) may not. Batt insulation facings and asphalt-impregnated fiberboard and felt paper are not considered air barriers.

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

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

AIR DILUTION. The air that enters the relief opening of a draft hood or draft diverter, or the air that enters another opening in an appliance flue or venting system.

AIR DISTRIBUTION SYSTEM. Includes all building elements (duct systems, air handling units, cavities of the building structure and mechanical closets) through which air is delivered to or from the conditioned spaces.

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

AIR-HANDLING UNIT. The fan unit of a furnace and the fan-coil unit of a split-system, packaged air conditioner or heat pump.

AIR, MAKEUP. Air that is provided to replace air being exhausted.

AIR POROSITY. The ability to transmit air through minute openings in a substance or material.

ALTERATION. A change in a mechanical system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

DEFINITIONS

APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

APPLIANCE, EXISTING. Any appliance regulated by this code which was legally installed prior to the effective date of this code, or for which a permit to install has been issued.

APPLIANCE TYPE.

High-heat appliance. Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature greater than 2,000°F (1093°C).

Low-heat appliance (residential appliance). Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature of 1,000°F (538°C) or less.

Medium-heat appliance. Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature of more than 1,000°F (538°C), but not greater than 2,000°F (1093°C).

APPLIANCE, VENTED. An appliance designed and installed in such a manner that all of the products of combustion are conveyed directly from the appliance to the outdoor atmosphere through an approved chimney or vent system.

APPROVED. Acceptable to the code official or other authority having jurisdiction.

APPROVED AGENCY. An established and recognized agency that is approved by the code official and regularly engaged in conducting tests or furnishing inspection services.

ATTIC. An enclosed unconditioned space located immediately below an uninsulated roof and immediately above the ceiling of a building. For the roof to be considered insulated, roof insulation shall be at least the *R*-value required to meet Section 13-404.ABC.1 or Section 13-604.ABC.1 of Chapter 13 of the *Florida Building Code, Building*.

AUTOMATIC BOILER. Any class of boiler that is equipped with the controls and limit devices specified in Chapter 10.

BATHROOM. A room containing a bathtub, shower, spa or similar bathing fixture.

BOILER. A closed heating appliance intended to supply hot water or steam for space heating, processing or power purposes. Low-pressure boilers operate at pressures less than or equal to 15 pounds per square inch (psi) (103 kPa) for steam and 160 psi (1103 kPa) for water. High-pressure boilers operate at pressures exceeding those pressures.

BOILER, HOT WATER SUPPLY. Any vessel used for generating hot water to be used external to the vessel, which exceeds any of the following limitations:

1. A heat input capacity of 400,000 Btu/h (117.2 kW).
2. A water temperature of 210°F (98°C).
3. A nominal water capacity of 120 gal (454 L).

BOILER ROOM. A room primarily utilized for the installation of a boiler.

BRAZED JOINT. A gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at a temperature above 1,000°F (538°C), but lower than the melting temperature of the parts to be joined.

BRAZING. A metal joining process wherein coalescence is produced by the use of a nonferrous filler metal having a melting point above 1,000°F (538°C), but lower than that of the base metal being joined. The filler material is distributed between the closely fitted surfaces of the joint by capillary attraction.

BTU. Abbreviation for British thermal unit, which is the quantity of heat required to raise the temperature of 1 pound (454 g) of water 1°F (0.56°C) (1 Btu = 1055 J).

BUILDING. Any structure that includes provision for any of the following or any combination of the following: a space heating system, a space cooling system or a service water heating system. For the purpose of this code each portion of a building separated from other portions by a rated fire wall shall be considered as a separate building. The term “building” shall be construed as if followed by the words “or part thereof.”

CHIMNEY. A primarily vertical structure containing one or more flues, for the purpose of carrying gaseous products of combustion and air from a fuel-burning appliance to the outdoor atmosphere.

Factory-built chimney. A listed and labeled chimney composed of factory-made components, assembled in the field in accordance with manufacturer’s instructions and the conditions of the listing.

Masonry chimney. A field-constructed chimney composed of solid masonry units, bricks, stones or concrete.

Metal chimney. A field-constructed chimney of metal.

CHIMNEY CONNECTOR. A pipe that connects a fuel-burning appliance to a chimney.

CLEARANCE. The minimum distance through air measured between the heat-producing surface of the mechanical appliance, device or equipment and the surface of the combustible material or assembly.

CLOSED COMBUSTION SOLID-FUEL-BURNING APPLIANCE. A heat-producing appliance that employs a combustion chamber that has no openings other than the flue collar, fuel charging door and adjustable openings provided to control the amount of combustion air that enters the combustion chamber.

CLOTHES DRYER. An appliance used to dry wet laundry by means of heat. Dryer classifications are as follows:

Type 1. Factory-built package, multiple production. Primarily used in family living environment. Usually the smallest unit physically and in function output.

Type 2. Factory-built package, multiple production. Used in business with direct intercourse of the function with the public. Not designed for use in individual family living environment.

CODE. These regulations, subsequent amendments thereto, or any emergency rule or regulation that the administrative authority having jurisdiction has lawfully adopted.

CODE OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

COMBUSTIBLE ASSEMBLY. Wall, floor, ceiling or other assembly constructed of one or more component materials that are not defined as noncombustible.

COMBUSTIBLE LIQUIDS. Any liquids having a flash point at or above 100°F (38°C), and that are divided into the following classifications:

Class II. Liquids having flash points at or above 100°F (38°C) and below 140°F (60°C).

Class IIIA. Liquids having flash points at or above 140°F (60°C) and below 200°F (93°C).

Class IIIB. Liquids having flash points at or above 200°F (93°C).

COMBUSTIBLE MATERIAL. Any material not defined as noncombustible.

COMBUSTION. In the context of this code, refers to the rapid oxidation of fuel accompanied by the production of heat or heat and light.

COMBUSTION AIR. Air necessary for complete combustion of a fuel, including theoretical air and excess air.

COMBUSTION CHAMBER. The portion of an appliance within which combustion occurs.

COMBUSTION PRODUCTS. Constituents resulting from the combustion of a fuel with the oxygen of the air, including the inert gases, but excluding excess air.

COMMERCIAL COOKING RECIRCULATING SYSTEM. Self-contained system consisting of the exhaust hood, the cooking equipment, the filters, and the fire suppression system. The system is designed to capture cooking vapors and residues generated from commercial cooking equipment. The system removes contaminants from the exhaust air and recirculates the air to the space from which it was withdrawn.

COMMERCIAL COOKING APPLIANCES. Appliances used in a commercial food service establishment for heating or cooking food and which produce grease vapors, steam, fumes, smoke or odors that are required to be removed through a local exhaust ventilation system. Such appliances include deep fat fryers; upright broilers; griddles; broilers; steam-jacketed kettles; hot-top ranges; under-fired broilers (charbroilers); ovens; barbecues; rotisseries; and similar appliances. For the purpose of this definition, a food service establishment shall include any building or a portion thereof used for the preparation and serving of food.

COMMERCIAL KITCHEN HOODS.

Backshelf hood. A backshelf hood is also referred to as a low-proximity hood, or as a sidewall hood where wall mounted. Its front lower lip is low over the appliance(s) and is “set back” from the front of the appliance(s). It is always closed to the rear of the appliances by a panel where free-standing, or by a panel or wall where wall mounted, and its height above the cooking surface varies. (This style of hood can be constructed with partial end panels to increase its effectiveness in capturing the effluent generated by the cooking operation).

Double island canopy hood. A double island canopy hood is placed over back-to-back appliances or appliance lines. It is open on all sides and overhangs both fronts and the sides of the appliance(s). It could have a wall panel between the backs of the appliances. (The fact that exhaust air is drawn from both sides of the double canopy to meet in the center causes each side of this hood to emulate a wall canopy hood, and thus it functions much the same with or without an actual wall panel between the backs of the appliances).

Eyebrow hood. An eyebrow hood is mounted directly to the face of an appliance, such as an oven and dishwasher, above the opening(s) or door(s) from which effluent is emitted, extending past the sides and overhanging the front of the opening to capture the effluent.

Pass-over hood. A pass-over hood is a free-standing form of a backshelf hood constructed low enough to pass food over the top.

Single island canopy hood. A single island canopy hood is placed over a single appliance or appliance line. It is open on all sides and overhangs the front, rear, and sides of the appliance(s). A single island canopy is more susceptible to cross drafts and requires a greater exhaust air flow than an equivalent sized wall-mounted canopy to capture and contain effluent generated by the cooking operation(s).

Wall canopy hood. A wall canopy exhaust hood is mounted against a wall above a single appliance or line of appliance(s), or it could be free-standing with a back panel from the rear of the appliances to the hood. It overhangs the front and sides of the appliance(s) on all open sides.

The wall acts as a back panel, forcing the makeup air to be drawn across the front of the cooking equipment, thus increasing the effectiveness of the hood to capture and contain effluent generated by the cooking operation(s).

COMPENSATING HOODS. Compensating hoods are those having integral (built-in) makeup air supply. The makeup air supply for such hoods is generally supplied from: short-circuit flow from inside the hood, air curtain flow from the bottom of the front face, and front face discharge from the outside front wall of the hood. The compensating makeup airflow can also be supplied from the rear or side of the hood, or the rear, front, or sides of the cooking equipment. The makeup airflow can be one or a combination of methods.

COMPRESSOR. A specific machine, with or without accessories, for compressing a gas.

COMPRESSOR, POSITIVE DISPLACEMENT. A compressor in which increase in pressure is attained by changing the internal volume of the compression chamber.

COMPRESSOR UNIT. A compressor with its prime mover and accessories.

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.

CONDENSATE. The liquid that condenses from a gas (including flue gas) caused by a reduction in temperature.

DEFINITIONS

CONDENSER. A heat exchanger designed to liquefy refrigerant vapor by removal of heat.

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.

CONDITIONED SPACE. That volume of a structure which is either mechanically heated, cooled or both heated and cooled by direct means. Spaces within the thermal envelope that are not directly conditioned shall be considered buffered unconditioned space. Such spaces may include, but are not limited to, mechanical rooms, stairwells and unducted spaces beneath roofs and between floors. Air leakage into dropped ceiling cavities does not constitute conditioned space. For residential energy purposes; see "SPACE (a) conditioned space," Chapter 11 Section N1100.7.3 of the *Florida Building Code, Residential*.

CONFINED SPACES. A space having a volume less than 50 cubic feet per 1,000 British thermal units per hour (Btu/h) (4.8 m³/kW) of the aggregate input rating of all appliances installed in that space.

CONSTRUCTION DOCUMENTS. All of the written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of the project necessary for obtaining a building permit. The construction drawings shall be drawn to an appropriate scale.

CONTROL. A manual or automatic device designed to regulate the gas, air, water or electrical supply to, or operation of, a mechanical system.

CONVERSION BURNER. A burner designed to supply gaseous fuel to an appliance originally designed to utilize another fuel.

COOKING APPLIANCE. See "Commercial cooking appliances."

DAMPER. A manually or automatically controlled device to regulate draft or the rate of flow of air or combustion gases.

Volume damper. A device that, when installed, will restrict, retard or direct the flow of air in a duct, or the products of combustion in a heat-producing appliance, its vent connector, vent or chimney therefrom.

DESIGN FLOOD ELEVATION. Reserved.

DESIGN WORKING PRESSURE. The maximum allowable working pressure for which a specific part of a system is designed.

DIRECT REFRIGERATION SYSTEM. A system 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.

DIRECT-VENT APPLIANCES. Appliances that are constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outdoor atmosphere.

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.

Induced draft. The pressure difference created by the action of a fan, blower or ejector, that is located between the appliance and the chimney or vent termination.

Natural draft. The pressure difference created by a vent or chimney because of its height, and the temperature difference between the flue gases and the atmosphere.

DRAWBAND. A fastener which surrounds and fastens a duct fitting with either the inner lining or the outer jacket of flexible ducts. Tension ties, clinch bands, draw ties and straps are considered drawbands.

DRIP. The container placed at a low point in a system of piping to collect condensate and from which the condensate is removable.

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 (38°C).

Type II. Those systems using Class II combustible liquid solvents having a flash point at or above 100°F (38°C) and below 140°F (60°C).

Type III. Those systems using Class III combustible liquid solvents having a flash point at or above 140°F (60°C).

Types IV and V. Those systems using Class IV nonflammable liquid solvents.

DUCT. A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

DUCT FITTING. Couplings that join sections of ducting together or to other air distribution system components. When used to join sections of flexible nonmetal duct, duct fittings are typically metal or other rigid material and have a raised bead or indented groove against which the drawband is secured. Terminal fittings join ducting to supply outlets and return inlets at the end of the distribution system and include register and return boots and register and return boxes. Intermediate fittings join flexible nonmetal duct to other sections of flexible nonmetal duct, to sections of other types of ducting and to mechanical equipment and include collars, take-offs, tap-ins, sleeves and the supply and return ends of air handlers and furnaces. (See "INTEGRAL FLANGE DUCT COLLAR FITTING")

DUCT FURNACE. A warm-air furnace normally installed in an air distribution duct to supply warm air for heating. This definition shall apply only to a warm-air heating appliance that, for air circulation, depends on a blower not furnished as part of the furnace.

DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

DWELLING. A building or portion thereof that contains not more than two dwelling units.

DWELLING UNIT. A single unit providing complete, independent living facilities for one or more persons, including per-

altered in any way without written concurrence and approval of a registered design professional. Alterations resulting in the addition of loads to any member (e.g., HVAC equipment, water heaters) shall not be permitted without verification that the truss is capable of supporting such additional loading.

[B] 302.5 Cutting, notching and boring in steel framing. The cutting, notching and boring of steel framing members shall comply with Sections 302.5.1 through 302.5.3.

[B] 302.5.1 Cutting, notching and boring holes in structural steel framing. The cutting, notching and boring of holes in structural steel framing members shall be as prescribed by the registered design professional.

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

[B] 302.5.3 Cutting, notching and boring holes in nonstructural cold-formed steel wall framing. Flanges and lips of nonstructural cold-formed steel wall studs shall not be cut or notched. Holes in webs of nonstructural cold-formed steel wall studs shall be permitted along the center-line of the web of the framing member, shall not exceed 1.5 inches (38 mm) in width or 4 inches (102 mm) in length, and shall not be spaced less than 24 inches (610 mm) center to center from another hole or less than 10 inches (254 mm) from the bearing end.

SECTION 303 EQUIPMENT AND APPLIANCE LOCATION

303.1 General. Equipment and appliances shall be located as required by this section, specific requirements elsewhere in this code and the conditions of the equipment and appliance listing.

303.2 Hazardous locations. Appliances shall not be located in a hazardous location unless listed and approved for the specific installation.

303.3 Prohibited locations. Fuel-fired appliances shall not be located in, or obtain combustion air from, any of the following rooms or spaces:

1. Sleeping rooms.
2. Bathrooms.
3. Toilet rooms.
4. Storage closets.
5. Surgical rooms.

Exception: This section shall not apply to the following appliances:

1. Direct-vent appliances that obtain all combustion air directly from the outdoors.
2. Solid fuel-fired appliances, provided that the room is not a confined space and the building is not of unusually tight construction.
3. Appliances installed in a dedicated enclosure in which all combustion air is taken directly from the outdoors, in accordance with Section 703. Access to such enclosure shall be through a solid door, weather-stripped in accordance with the exterior door air leakage requirements of the Chapter 13 of the *Florida Building Code, Building* and equipped with an approved self-closing device.

303.4 Protection from damage. Appliances shall not be installed in a location where subject to mechanical damage unless protected by approved barriers.

303.5 Indoor locations. Fuel-fired furnaces and boilers installed in closets and alcoves shall be listed for such installation. For purposes of this section, a closet or alcove shall be defined as a room or space having a volume less than 12 times the total volume of fuel-fired appliances other than boilers and less than 16 times the total volume of boilers. Room volume shall be computed using the gross floor area and the actual ceiling height up to a maximum computation height of 8 feet (2438 mm).

303.6 Outdoor locations. Appliances installed in other than indoor locations shall be listed and labeled for outdoor installation.

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.

[B] 303.8 Elevator shafts. Mechanical systems shall not be located in an elevator shaft.

SECTION 304 INSTALLATION

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

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

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

304.3 Elevation of ignition source. Reserved.**[FG] 304.4 Hydrogen-generating and refueling operations.**

Ventilation shall be required in accordance with Section 304.4.1, 304.4.2 or 304.4.3 in public garages, private garages, repair garages, automotive service stations and parking garages that contain hydrogen-generating appliances or refueling systems. For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

[FG] 304.4.1 Natural ventilation. Indoor locations intended for hydrogen-generating or refueling operations shall be limited to a maximum floor area of 850 square feet (79 m²) and shall communicate with the outdoors in accordance with Sections 304.4.1.1 through 304.4.1.2. The maximum rated output capacity of hydrogen generating appliances shall not exceed 4 standard cubic feet per minute (0.00189 m³/s) of hydrogen for each 250 square feet (23.2 m²) of floor area in such spaces. The minimum cross-sectional dimension of air openings shall be 3 inches (76 mm). Where ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. In such locations, equipment and appliances having an ignition source shall be located such that the source of ignition is not within 12 inches (305 mm) of the ceiling.

[FG] 304.4.1.1 Two openings. Two permanent openings shall be provided within the garage. The upper opening shall be located entirely within 12 inches (305 mm) of the ceiling of the garage. The lower opening shall be located entirely within 12 inches (305 mm) of the floor of the garage. Both openings shall be provided in the same exterior wall. The openings shall communicate directly with the outdoors and shall have a minimum free area of 1/2 square foot per 1,000 cubic feet (1 m²/610 m³) of garage volume.

[FG] 304.4.1.2 Louvers and grilles. In calculating free area required by Section 304.4.1, the required size of openings shall be based on the net free area of each opening. If the free area through a design of louver or grille is known, it shall be used in calculating the size opening required to provide the free area specified. If the design and free area are not known, it shall be assumed that wood louvers will have 25 percent free area and metal louvers and grilles will have 75 percent free area. Louvers and grilles shall be fixed in the open position.

[FG] 304.4.2 Mechanical ventilation. Indoor locations intended for hydrogen-generating or refueling operations shall be ventilated in accordance with Section 502.16. In such locations, equipment and appliances having an ignition source shall be located such that the source of ignition is below the mechanical ventilation outlet(s).

[FG] 304.4.3 Specially engineered installations. As an alternative to the provisions of Sections 304.4.1 and 304.4.2 the necessary supply of air for ventilation and dilution of flammable gases shall be provided by an approved engineered system.

304.5 Public garages. Appliances located in public garages, motor fueling dispensing facilities, repair garages or other areas frequented by motor vehicles, shall be installed a minimum of 8 feet (2438 mm) above the floor. Where motor vehicles exceed 6 feet (1829 mm) in height and are capable of passing under an appliance, appliances shall be installed a minimum of 2 feet (610 mm) higher above the floor than the height of the tallest vehicle.

Exception: The requirements of this section shall not apply where the appliances are protected from motor vehicle impact and installed in accordance with NFPA 30A. ¶

304.6 Private garages. Reserved. ||

304.7 Construction and protection. Boiler rooms and furnace rooms shall be protected as required by the *Florida Building Code, Building*.

304.8 Clearances to combustible construction. Heat-producing equipment and appliances shall be installed to maintain the required clearances to combustible construction as specified in the listing and manufacturer's instructions. Such clearances shall be reduced only in accordance with Section 308. Clearances to combustibles shall include such considerations as door swing, drawer pull, overhead projections or shelving and window swing, shutters, coverings and drapes. Devices such as doorstops or limits, closers, drapery ties or guards shall not be used to provide the required clearances.

304.9 Clearances from grade. Equipment and appliances installed at grade level shall be supported on a level minimum 3 1/2 inch concrete slab or other approved material extending a minimum of 2 inches above adjoining finished grade. Suspended equipment and appliances shall be installed a minimum of 6 inches (152 mm) above adjoining grade to provide support and protection from contact with soil or water.

Exception: On changeouts or new installations of existing buildings where equipment is replaced that has a support platform approved under a previous code.

[B] 304.10 Guards. Guards shall be provided where appliances, equipment, fans or other components that require service and roof hatch openings are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof or grade below. The guard shall extend not less than 30 inches (762 mm) beyond each end of such appliances, equipment, fans, components and roof hatch openings and the top of the guard shall be located not less than 42 inches (1067 mm) above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21-inch-diameter (533 mm) sphere and shall comply with the loading requirements for guards specified in the *Florida Building Code, Building*.

304.11 Area served. Appliances serving different areas of a building other than where they are installed shall be permanently marked in an approved manner that uniquely identifies the appliance and the area it serves.

CHAPTER 4

VENTILATION

SECTION 401 GENERAL

401.1 Scope. This chapter shall govern the ventilation of spaces within a building intended to be occupied. This chapter does not govern the requirements for smoke control systems.

401.2 Ventilation required. Every occupied space shall be ventilated by natural means in accordance with Section 402 or by mechanical means in accordance with Section 403.

401.3 When required. Ventilation shall be provided during the periods that the room or space is occupied.

401.4 Opening location. Outdoor air exhaust and intake openings shall be located a minimum of 10 feet (3048 mm) from lot lines or buildings on the same lot. Where openings front on a street or public way, the distance shall be measured to the centerline of the street or public way.

Exceptions:

1. Group R-3.
2. Exhaust outlets for environmental air exhaust openings shall be located not less than 3 feet (914 mm) from property lines and not less than 3 feet (914 mm) from openings into the building.

401.4.1 Intake openings. Mechanical and gravity outdoor air intake openings shall be located a minimum of 10 feet (3048 mm) horizontally from any hazardous or noxious contaminant source, such as vents, chimneys, plumbing vents, streets, alleys, parking lots and loading docks, except as otherwise specified in this code. Fresh air intakes shall not be located closer than 10 feet (3048 mm) from any chimney or vent outlet, or sanitary sewer vent outlet.

The exhaust from a bathroom or kitchen in a residential dwelling shall not be considered to be a hazardous or noxious contaminant.

401.4.2 Exhaust openings. Outdoor exhaust openings shall be located so as not to create a nuisance. Exhaust air shall not be directed onto walkways.

[B] 401.4.3 Flood hazard. See Section 301.13.

401.5 Outdoor opening protection. Air exhaust and intake openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles. Openings in louvers, grilles and screens shall be sized in accordance with Table 401.5, and shall be protected against local weather conditions. Outdoor air exhaust and intake openings located in exterior walls shall meet the provisions for exterior wall opening protectives in accordance with the *Florida Building Code, Building*.

**TABLE 401.5
OPENING SIZES IN LOUVERS, GRILLES AND
SCREENS PROTECTING OUTDOOR EXHAUST AND
AIR INTAKE OPENINGS**

OUTDOOR OPENING TYPE	MINIMUM AND MAXIMUM OPENING SIZES IN LOUVERS, GRILLES AND SCREENS MEASURED IN ANY DIRECTION
Exhaust openings	Not < 1/4 inch and not > 1/2 inch
Intake openings in residential occupancies	Not < 1/4 inch and not > 1/2 inch
Intake openings in other than residential occupancies	> 1/4 inch and not > 1 inch

For SI: 1 inch = 25.4 mm.

401.6 Contaminant sources. Stationary local sources producing air-borne particulates, heat, odors, fumes, spray, vapors, smoke or gases in such quantities as to be irritating or injurious to health shall be provided with an exhaust system in accordance with Chapter 5 or a means of collection and removal of the contaminants. Such exhaust shall discharge directly to an approved location at the exterior of the building.

[B] SECTION 402 NATURAL VENTILATION

402.1 Natural ventilation. Natural ventilation of an occupied space shall be through windows, doors, louvers or other openings to the outdoors. The operating mechanism for such openings shall be provided with ready access so that the openings are readily controllable by the building occupants.

402.2 Ventilation area required. The minimum openable area to the outdoors shall be 4 percent of the floor area being ventilated.

402.3 Adjoining spaces. Where rooms and spaces without openings to the outdoors are ventilated through an adjoining room, the opening to the adjoining rooms shall be unobstructed and shall have an area not less than 8 percent of the floor area of the interior room or space, but not less than 25 square feet (2.3 m²). The minimum openable area to the outdoors shall be based on the total floor area being ventilated.

Exception: Exterior openings required for ventilation shall be permitted to open into a thermally isolated sunroom addition or patio cover, provided that the openable area between the sunroom addition or patio cover and the interior room has an area of not less than 8 percent of the floor area of the interior room or space, but not less than 20 square feet (1.86 m²). The minimum openable area to the outdoors shall be based on the total floor area being ventilated.

402.3.1 Bathrooms. Rooms containing bathtubs, showers, spas and similar bathing fixtures shall be mechanically ventilated in accordance with Section 403.

Exception: Residential bathrooms with windows having no less than 3 square feet of open space.

403.4 Openings below grade. Where openings below grade provide required natural ventilation, the outside horizontal clear space measured perpendicular to the opening shall be one and one-half times the depth of the opening. The depth of the opening shall be measured from the average adjoining ground level to the bottom of the opening.

SECTION 403 MECHANICAL VENTILATION

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return or exhaust air. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey ventilation air shall be designed and installed in accordance with Chapter 6. See also Section 13-409.AB.2 of the *Florida Building Code, Building*.

Ventilation supply systems shall be designed to deliver the required rate of supply air to the occupied zone within an occupied space. The occupied zone shall have boundaries measured at 3 inches (76 mm) and 72 inches (1829 mm) above the floor and 24 inches (610 mm) from the enclosing walls.

403.2 Outdoor air required. The minimum ventilation rate of outdoor air shall be determined in accordance with Section 403.3.

Exception: Where the registered design professional demonstrates that an engineered ventilation system design will prevent the maximum concentration of contaminants from exceeding that obtainable by the rate of outdoor air ventilation determined in accordance with Section 403.3, the minimum required rate of outdoor air shall be reduced in accordance with such engineered system design.

403.2.1 Recirculation of air. The air required by Section 403.3 shall not be recirculated. Air in excess of that required by Section 403.3 shall not be prohibited from being recirculated as a component of supply air to building spaces, except that:

1. Ventilation air shall not be recirculated from one dwelling to another or to dissimilar occupancies.
2. Supply air to a swimming pool and associated deck areas shall not be recirculated unless such air is dehumidified to maintain the relative humidity of the area at 60 percent or less. Air from this area shall not be recirculated to other spaces where 10 percent or more of the resulting supply airstream consists of air recirculated from these spaces.
3. Where mechanical exhaust is required by Note b in Table 403.3, recirculation of air from such spaces shall be prohibited. All air supplied to such spaces shall be exhausted, including any air in excess of that required by Table 403.3.
4. Where mechanical exhaust is required by Note h in Table 403.3, mechanical exhaust is required and recirculation is prohibited where 10 percent or more

of the resulting supply airstream consists of air recirculated from these spaces.

403.2.2 Transfer air. Except where recirculation from such spaces is prohibited by Table 403.3, air transferred from occupied spaces is not prohibited from serving as make-up air for required exhaust systems in such spaces as kitchens, baths, toilet rooms, elevators and smoking lounges. The amount of transfer air and exhaust air shall be sufficient to provide the flow rates as specified in Sections 403.3 and 403.3.1. The required outdoor air rates specified in Table 403.3 shall be introduced directly into such spaces or into the occupied spaces from which air is transferred or a combination of both.

403.3 Ventilation rate. Ventilation systems for other than Group R-3 (one- and two-family dwellings), shall be designed to have the capacity to supply the minimum outdoor airflow rate determined in accordance with Table 403.3 based on the occupancy of the space and the occupant load or other parameter as stated therein. The occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3. Ventilation rates for occupancies not represented in Table 403.3 shall be determined by an approved engineering analysis. The ventilation system shall be designed to supply the required rate of ventilation air continuously during the period the building is occupied, except as otherwise stated in other provisions of the code.

Exception: The occupant load is not required to be determined, based on the estimated maximum occupant load rate indicated in Table 403.3 where approved statistical data document the accuracy of an alternate anticipated occupant density.

403.3.1 System operation. The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3 and the actual number of occupants present.

403.3.2 Common ventilation system. Where spaces having different ventilation rate requirements are served by a common ventilation system, the ratio of outdoor air to total supply air for the system shall be determined based on the space having the largest outdoor air requirement or shall be determined in accordance with the following formula:

$$Y = \frac{X}{(1 + X - Z)} \quad \text{(Equation 4-1)}$$

where

$Y = V_{ot}/V_{st}$ = Corrected fraction of outdoor air in system supply.

$X = V_{on}/V_{st}$ = Uncorrected fraction of outdoor air in system supply.

$Z = V_{oc}/V_{sc}$ = Fraction of outdoor air in critical space. The critical space is that space with the greatest

*
||
||

**SECTION 406
RESERVED**

||
||

**SECTION 407
RETURN AIR INTAKE**

407.1 General. It shall be prohibited to place a return air intake in the following locations: public bathrooms and nondedicated kitchen HVAC systems.

[F] 502.12 Organic coating processes. Enclosed structures involving organic coating processes in which Class I liquids are processed or handled shall be ventilated at a rate of not less than 1 cfm/ft² [0.00508 m³/(s · m²)] of solid floor area. Ventilation shall be accomplished by exhaust fans that intake at floor levels and discharge to a safe location outside the structure. Noncontaminated intake air shall be introduced in such a manner that all portions of solid floor areas are provided with continuous uniformly distributed air movement.

502.13 Public garages. Mechanical exhaust systems for public garages, as required in Chapter 4, shall operate continuously or in accordance with Section 404.

502.14 Motor vehicle operation. In areas where motor vehicles operate, mechanical ventilation shall be provided in accordance with Section 403. Additionally, areas in which stationary motor vehicles are operated shall be provided with a source capture system that connects directly to the motor vehicle exhaust systems.

Exceptions:

1. This section shall not apply where the motor vehicles being operated or repaired are electrically powered.
2. This section shall not apply to one- and two-family dwellings.
3. This section shall not apply to motor vehicle service areas where engines are operated inside the building only for the duration necessary to move the motor vehicles in and out of the building.

[F] 502.15 Repair garages. Where Class I liquids or LP-gas are stored or used within a building having a basement or pit wherein flammable vapors could accumulate, the basement or pit shall be provided with ventilation designed to prevent the accumulation of flammable vapors therein.

[F] 502.16 Repair garages for natural gas- and hydrogen-fueled vehicles. Repair garages used for the repair of natural gas- or hydrogen-fueled vehicles shall be provided with an approved mechanical ventilation system. The mechanical ventilation system shall be in accordance with Sections 502.16.1 and 502.16.2.

Exception: Where approved by the code official, natural ventilation shall be permitted in lieu of mechanical ventilation.

[F] 502.16.1 Design. Indoor locations shall be ventilated utilizing air supply inlets and exhaust outlets arranged to provide uniform air movement to the extent practical. Inlets shall be uniformly arranged on exterior walls near floor level. Outlets shall be located at the high point of the room in exterior walls or the roof.

Ventilation shall be by a continuous mechanical ventilation system or by a mechanical ventilation system activated by a continuously monitoring natural gas detection system, or for hydrogen, a continuously monitoring flammable gas detection system, each activating at a gas concentration of 25 percent of the lower flammable limit (LFL). In all cases, the system shall shut down the fueling system in the event of failure of the ventilation system.

The ventilation rate shall be at least 1 cubic foot per minute per 12 cubic feet [0.00138 m³/(s · m³)] of room volume.

[F] 502.16.2 Operation. The mechanical ventilation system shall operate continuously.

Exceptions:

1. Mechanical ventilation systems that are interlocked with a gas detection system designed in accordance with the *Florida Fire Prevention Code*.
2. Mechanical ventilation systems in garages that are used only for the repair of vehicles fueled by liquid fuels or odorized gases, such as CNG, where the ventilation system is electrically interlocked with the lighting circuit.

502.17 Tire rebuilding or recapping. Each room where rubber cement is used or mixed, or where flammable or combustible solvents are applied, shall be ventilated in accordance with the applicable provisions of NFPA 91.

502.17.1 Buffing machines. Each buffing machine shall be connected to a dust-collecting system that prevents the accumulation of the dust produced by the buffing process.

502.18 Specific rooms. Specific rooms, including bathrooms, locker rooms, smoking lounges and toilet rooms, shall be exhausted in accordance with the ventilation requirements of Chapter 4.

502.19 Indoor firing ranges. Ventilation shall be provided in an approved manner in areas utilized as indoor firing ranges. Ventilation shall be designed to protect employees and the public in accordance with OSHA 29 CFR 1910.1025 where applicable.

SECTION 503 MOTORS AND FANS

503.1 General. Motors and fans shall be sized to provide the required air movement. Motors in areas that contain flammable vapors or dusts shall be of a type approved for such environments. A manually operated remote control installed at an approved location shall be provided to shut off fans or blowers in flammable vapor or dust systems. Electrical equipment and appliances used in operations that generate explosive or flammable vapors, fumes or dusts shall be interlocked with the ventilation system so that the equipment and appliances cannot be operated unless the ventilation fans are in operation. Motors for fans used to convey flammable vapors or dusts shall be located outside the duct or shall be protected with approved shields and dustproofing. Motors and fans shall be provided with a means of access for servicing and maintenance.

503.2 Fans. Parts of fans in contact with explosive or flammable vapors, fumes or dusts shall be of nonferrous or nonsparking materials, or their casing shall be lined or constructed of such material. When the size and hardness of materials passing through a fan are capable of producing a spark, both the fan and the casing shall be of nonsparking materials. When fans are required to be spark resistant, their bearings shall not be within the airstream, and all parts of the fan shall be grounded. Fans in systems-handling materials that are capable

of clogging the blades, and fans in buffing or woodworking exhaust systems, shall be of the radial-blade or tube-axial type.

503.3 Equipment and appliances identification plate. Equipment and appliances used to exhaust explosive or flammable vapors, fumes or dusts shall bear an identification plate stating the ventilation rate for which the system was designed.

503.4 Corrosion-resistant fans. Fans located in systems conveying corrosives shall be of materials that are resistant to the corrosive or shall be coated with corrosion-resistant materials.

**SECTION 504
CLOTHES DRYER EXHAUST**

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

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

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

504.3 Cleanout. Each vertical riser shall be provided with a means for cleanout. Such means may include the exhaust duct connection to an individual dryer outlet if it is accessible and readily disassembled.

504.4 Exhaust installation. Dryer exhaust ducts for clothes dryers shall terminate on the outside of the building and shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums.

504.5 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 (0.0645 m²) shall be provided in the closet enclosure.

* **504.6 Domestic clothes dryer ducts.** Exhaust ducts for domestic clothes dryers shall be constructed of metal and shall have a smooth interior finish. The exhaust duct shall be a minimum nominal size of 4 inches (102 mm) in diameter. The entire exhaust system shall be supported and secured in place.

The male end of the duct at overlapped duct joints shall extend in the direction of airflow. Clothes dryer transition ducts used to connect the appliance to the exhaust duct system shall be limited to single lengths not to exceed 8 feet (2348 mm) and shall be listed and labeled for the application. Transition ducts shall not be concealed within construction.

504.6.1 Maximum length. The maximum length of a clothes dryer exhaust duct shall not exceed 25 feet (7620 mm) from the dryer location to the outlet terminal. The maximum length of the duct shall be reduced 2½ feet (762 mm) for each 45-degree (0.79 rad) bend and 5 feet (1524 mm) for each 90-degree (1.6 rad) bend. The maximum length of the exhaust duct does not include the transition duct.

Exceptions:

1. Where the make and model of the clothes dryer to be installed is known and the manufacturer’s installation instructions for such dryer are provided to the code official, the maximum length of the exhaust duct, including any transition duct, shall be permitted to be in accordance with the dryer manufacturer’s installation instructions.
2. Where a clothes dryer booster fan is installed and listed and labeled for the application, the maximum length of the exhaust duct, including any transition duct, shall be permitted to be in accordance with the booster fan manufacturer’s installation instructions. Where a clothes dryer booster fan is installed and not readily accessible from the room in which the dryer is located, a permanent identifying label shall be placed adjacent to where the exhaust duct enters the wall. The label shall bear the words: “This dryer exhaust system is equipped with a remotely located booster fan.”

504.6.2 Rough-in required. Where a compartment or space for a domestic clothes dryer is provided, an exhaust duct system shall be installed in accordance with Sections 504.6 and 504.6.1.

504.7 Commercial clothes dryers. The installation of dryer exhaust ducts serving Type 2 clothes dryers shall comply with the appliance manufacturer’s installation instructions. Exhaust fan motors installed in exhaust systems shall be located outside of the airstream. In multiple installations, the fan shall operate continuously or be interlocked to operate when any individual unit is operating. Ducts shall have a minimum clearance of 6 inches (152 mm) to combustible materials. Clothes dryer transition ducts used to connect the appliance to the exhaust duct system shall be limited to single lengths not to exceed 8 feet (2438 mm) in length and shall be listed and labeled for the application. Transition ducts shall not be concealed within construction.

**SECTION 505
DOMESTIC KITCHEN EXHAUST EQUIPMENT**

505.1 Domestic systems. Where domestic range hoods and domestic appliances equipped with downdraft exhaust are

located within dwelling units, such hoods and appliances shall discharge to the outdoors through sheet metal ducts constructed of galvanized steel, stainless steel, aluminum or copper. Such ducts shall have smooth inner walls and shall be air tight and equipped with a backdraft damper.

Exceptions:

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

505.2 Installation of microwave ovens over a cooking appliance. The installation of a listed and labeled cooking appliance or microwave oven over a listed and labeled cooking appliance shall conform to the terms of the upper appliance's listing and label and the manufacturer's installation instructions.

505.3 Overhead exhaust hoods, general. Domestic open-top broiler units shall be provided with a metal exhaust hood, not less than 28 gage, with a clearance of not less than 0.25 inch (6.4 mm) between the hood and the underside of combustible material or cabinets. A clearance of at least 24 inches (610 mm) shall be maintained between the cooking surface and the combustible material or cabinet. The hood shall be at least as wide as the broiler unit and shall extend over the entire unit. Such exhaust hood shall discharge to the outdoors and shall be equipped with a back draft damper or other means to control infiltration/exfiltration when not in operation. Broiler units incorporating an integral exhaust system, and listed and labeled for use without an exhaust hood, need not be provided with an exhaust hood.

SECTION 506 COMMERCIAL KITCHEN HOOD VENTILATION SYSTEM DUCTS AND EXHAUST EQUIPMENT

506.1 General. Commercial kitchen grease ducts and exhaust equipment shall comply with the requirements of this section.

Commercial kitchen grease ducts shall be designed for the type of cooking appliance and hood served. Unless otherwise specified in this chapter, grease hoods and grease hood duct systems shall conform to NFPA 96.

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

506.3 Ducts serving Type I hoods. Type I exhaust ducts shall be independent of all other exhaust systems except as provided in Section 506.3.5. Commercial kitchen duct systems serving Type I hoods shall be designed, constructed and installed in accordance with Sections 506.3.1 through 506.3.12.3.

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

506.3.1.1 Grease duct materials. Grease ducts serving Type I hoods shall be constructed of steel not less than 0.055 inch (1.4 mm) (No. 16 Gage) in thickness or stainless steel not less than 0.044 inch (1.1 mm) (No. 18 Gage) in thickness.

Exception: Listed and labeled factory-built commercial kitchen grease ducts shall be installed in accordance with Section 304.1.

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

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

Exceptions:

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

506.3.2.1 Duct joint types. Duct joints shall be butt joints or overlapping duct joints of either the telescoping or bell type. Overlapping joints shall be installed to prevent ledges and obstructions from collecting grease or interfering with gravity drainage to the intended collection point. The difference between the inside cross-sectional dimensions of overlapping sections of duct shall not exceed 0.25 inch (6 mm). The length of overlap for overlapping duct joints shall not exceed 2 inches (51 mm).

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

Exceptions: This section shall not apply to:

1. A vertical duct-to-hood collar connection made in the top plane of the hood in accordance with all of the following:
 - 1.1. The hood duct opening shall have a 1-inch-deep (25 mm), full perimeter, welded flange turned down into the hood interior at an angle of 90 degrees from the plane of the opening.
 - 1.2. The duct shall have a 1-inch-deep (25 mm) flange made by a 1-inch by 1-inch (25 mm by 25 mm) angle iron welded to the full perimeter of the duct not less than 1 inch (25 mm) above the bottom end of the duct.
 - 1.3. A gasket rated for use at not less than 1,500°F (815°C) is installed between the duct flange and the top of the hood.
 - 1.4. The duct-to-hood joint shall be secured by stud bolts not less than 0.25 inch (6.4 mm) in diameter welded to the hood with a spacing not greater than 4 inches (102 mm) on center for the full perimeter of the opening. All bolts and nuts are to be secured with lockwashers.
2. Listed and labeled duct-to-hood collar connections installed in accordance with Section 304.1.

506.3.2.3 Duct-to-exhaust fan connections. Duct-to-exhaust fan connections shall be flanged and gasketed at the base of the fan for vertical discharge fans; shall be flanged, gasketed and bolted to the inlet of the fan for side-inlet utility fans; and shall be flanged, gasketed and bolted to the inlet and outlet of the fan for in-line fans.

506.3.2.4 Vibration isolation. A vibration isolation connector for connecting a duct to a fan shall consist of noncombustible packing in a metal sleeve joint of approved design or shall be a coated-fabric flexible duct connector listed and labeled for the application. Vibration isolation connectors shall be installed only at the connection of a duct to a fan inlet or outlet.

506.3.3 Grease duct supports. Grease duct bracing and supports shall be of noncombustible material securely attached to the structure and designed to carry gravity and seismic loads within the stress limitations of the *Florida Building Code, Building*. Bolts, screws, rivets and other mechanical fasteners shall not penetrate duct walls.

506.3.3.1 Grease duct test. Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed in the presence of the code official. Ducts shall be considered to be concealed where installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides. The permit

holder shall be responsible to provide the necessary equipment and perform the grease duct leakage test. A light test or an approved equivalent test method shall be performed to determine that all welded and brazed joints are liquid tight. A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of duct work to be tested. The lamp shall be open so as to emit light equally in all directions perpendicular to the duct walls.

A test shall be performed for the entire duct system, including the hood-to-duct connection. The ductwork shall be permitted to be tested in sections, provided that every joint is tested

506.3.4 Air velocity. Grease duct systems serving a Type I hood shall be designed and installed so as to provide an air velocity within the duct system of not less than 1,500 feet per minute (7.6 m/s) and not greater than 2,500 feet per minute (13 m/s).

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

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

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

506.3.6 Grease duct clearances. Grease duct systems and exhaust equipment serving a Type I hood shall have a clearance to combustible construction of not less than 18 inches (457 mm), and shall have a clearance to noncombustible construction and gypsum wallboard attached to noncombustible structures of not less than 3 inches (76 mm).

Exception: Listed and labeled factory-built commercial kitchen grease ducts and exhaust equipment installed in accordance with Section 304.1.

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

507.14 Noncanopy size and location. Noncanopy-type hoods shall be located a maximum of 3 feet (914 mm) above the cooking surface. The edge of the hood shall be set back a maximum of 1 foot (305 mm) from the edge of the cooking surface.

507.15 Exhaust outlets. Exhaust outlets located within the hood shall be located so as to optimize the capture of particulate matter. Each outlet shall serve not more than a 12-foot (3658 mm) section of hood.

507.16 Performance test. A performance test shall be conducted upon completion and before final approval of the installation of a ventilation system serving commercial cooking appliances. The test shall verify the rate of exhaust airflow required by Section 507.13, makeup airflow required by Section 508, and proper operation as specified in this chapter. The permit holder shall furnish the necessary test equipment and devices required to perform the tests.

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

SECTION 508 COMMERCIAL KITCHEN MAKEUP AIR

508.1 Makeup air. Makeup air shall be supplied during the operation of commercial kitchen exhaust systems that are provided for commercial cooking appliances. The amount of makeup air supplied shall be approximately equal to the amount of exhaust air. The makeup air shall not reduce the effectiveness of the exhaust system. Makeup air shall be provided by gravity or mechanical means or both. For mechanical makeup air systems, the exhaust and makeup air systems shall be electrically interlocked to insure that makeup air is provided whenever the exhaust system is in operation. Makeup air intake opening locations shall comply with Sections 401.4 and 401.4.1.

⌘ **508.1.1 Makeup air temperature. Reserved.**

508.2 Compensating hoods. Manufacturers of compensating hoods shall provide a label indicating minimum exhaust flow and/or maximum makeup airflow that provides capture and containment of the exhaust effluent.

SECTION 509 FIRE SUPPRESSION SYSTEMS

509.1 Where required. Commercial cooking appliances required by Section 507.2.1 to have a Type I hood shall be pro-

vided with an approved automatic fire suppression system complying with the *Florida Building Code, Building* and the *Florida Fire Prevention Code*.

SECTION 510 HAZARDOUS EXHAUST SYSTEMS

510.1 General. This section shall govern the design and construction of duct systems for hazardous exhaust and shall determine where such systems are required. Hazardous exhaust systems are systems designed to capture and control hazardous emissions generated from product handling or processes, and convey those emissions to the outdoors. Hazardous emissions include flammable vapors, gases, fumes, mists or dusts, and volatile or airborne materials posing a health hazard, such as toxic or corrosive materials. For the purposes of this section, the health hazard rating of materials shall be as specified in NFPA 704.

For the purposes of the provisions of Section 510, a laboratory shall be defined as a facility where the use of chemicals is related to testing, analysis, teaching, research or developmental activities. Chemicals are used or synthesized on a non-production basis, rather than in a manufacturing process.

510.2 Where required. A hazardous exhaust system shall be required wherever operations involving the handling or processing of hazardous materials, in the absence of such exhaust systems and under normal operating conditions, have the potential to create one of the following conditions:

1. A flammable vapor, gas, fume, mist or dust is present in concentrations exceeding 25 percent of the lower flammability limit of the substance for the expected room temperature.
2. A vapor, gas, fume, mist or dust with a health-hazard rating of 4 is present in any concentration.
3. A vapor, gas, fume, mist or dust with a health-hazard rating of 1, 2 or 3 is present in concentrations exceeding 1 percent of the median lethal concentration of the substance for acute inhalation toxicity.

Exception: Laboratories, as defined in Section 510.1, except where the concentrations listed in Item 1 are exceeded or a vapor, gas, fume, mist or dust with a health-hazard rating of 1, 2, 3 or 4 is present in concentrations exceeding 1 percent of the median lethal concentration of the substance for acute inhalation toxicity.

[F] 510.2.1 Lumber yards and woodworking facilities. Equipment or machinery located inside buildings at lumber yards and woodworking facilities which generates or emits combustible dust shall be provided with an approved dust-collection and exhaust system installed in conformance with this section and the *Florida Fire Prevention Code*. Equipment and systems that are used to collect, process or convey combustible dusts shall be provided with an approved explosion-control system.

[F] 510.2.2 Combustible fibers. Equipment or machinery within a building which generates or emits combustible fibers shall be provided with an approved dust-collecting and exhaust system. Such systems shall comply with this code and the *Florida Fire Prevention Code*.

510.3 Design and operation. The design and operation of the exhaust system shall be such that flammable contaminants are diluted in noncontaminated air to maintain concentrations in the exhaust flow below 25 percent of the contaminant's lower flammability limit.

510.4 Independent system. Hazardous exhaust systems shall be independent of other types of exhaust systems. Incompatible materials, as defined in the *Florida Fire Prevention Code*, shall not be exhausted through the same hazardous exhaust system. Hazardous exhaust systems shall not share common shafts with other duct systems, except where such systems are hazardous exhaust systems originating in the same fire area.

Exception: The provision of this section shall not apply to laboratory exhaust systems where all of the following conditions apply:

1. All of the hazardous exhaust ductwork and other laboratory exhaust within both the occupied space and the shafts is under negative pressure while in operation.
2. The hazardous exhaust ductwork manifolded together within the occupied space must originate within the same fire area.
3. Each control branch has a flow regulating device.
4. Perchloric acid hoods and connected exhaust shall be prohibited from manifolding.
5. Radioisotope hoods are equipped with filtration and/or carbon beds where required by the registered design professional.
6. Biological safety cabinets are filtered.
7. Provision is made for continuous maintenance of negative static pressure in the ductwork.

Contaminated air shall not be recirculated to occupied areas unless the contaminants have been removed. Air contaminated with explosive or flammable vapors, fumes or dusts; flammable, highly toxic or toxic gases; or radioactive material shall not be recirculated.

510.5 Design. Systems for removal of vapors, gases and smoke shall be designed by the constant velocity or equal friction methods. Systems conveying particulate matter shall be designed employing the constant velocity method.

510.5.1 Balancing. Systems conveying explosive or radioactive materials shall be prebalanced by duct sizing. Other systems shall be balanced by duct sizing with balancing devices, such as dampers. Dampers provided to balance air-flow shall be provided with securely fixed minimum-position blocking devices to prevent restricting flow below the required volume or velocity.

510.5.2 Emission control. The design of the system shall be such that the emissions are confined to the area in which they are generated by air currents, hoods or enclosures and

shall be exhausted by a duct system to a safe location or treated by removing contaminants.

510.5.3 Hoods required. Hoods or enclosures shall be used where contaminants originate in a limited area of a space. The design of the hood or enclosure shall be such that air currents created by the exhaust systems will capture the contaminants and transport them directly to the exhaust duct.

510.5.4 Contaminant capture and dilution. The velocity and circulation of air in work areas shall be such that contaminants are captured by an airstream at the area where the emissions are generated and conveyed into a product-conveying duct system. Contaminated air from work areas where hazardous contaminants are generated shall be diluted below the thresholds specified in Section 510.2 with air that does not contain other hazardous contaminants.

510.5.5 Makeup air. Makeup air shall be provided at a rate approximately equal to the rate that air is exhausted by the hazardous exhaust system. Makeup-air intakes shall be located so as to avoid recirculation of contaminated air.

510.5.6 Clearances. The minimum clearance between hoods and combustible construction shall be the clearance required by the duct system.

510.5.7 Ducts. Hazardous exhaust duct systems shall extend directly to the exterior of the building and shall not extend into or through ducts and plenums.

510.6 Penetrations. Penetrations of structural elements by a hazardous exhaust system shall conform to Sections 510.6.1 through 510.6.4.

Exception: Duct penetrations within H-5 occupancies as allowed by the *Florida Building Code, Building*.

510.6.1 Fire dampers. Fire dampers are prohibited in hazardous exhaust ducts.

510.6.2 Floors. Hazardous exhaust systems that penetrate a floor/ceiling assembly shall be enclosed in a fire-resistance-rated shaft constructed in accordance with the *Florida Building Code, Building*.

510.6.3 Wall assemblies. Hazardous exhaust duct systems that penetrate fire-resistance-rated wall assemblies shall be enclosed in fire-resistance-rated construction from the point of penetration to the outlet terminal, except where the interior of the duct is equipped with an approved automatic fire suppression system. Ducts shall be enclosed in accordance with the *Florida Building Code, Building* requirements for shaft construction and such enclosure shall have a minimum fire-resistance-rating of not less than the highest fire-resistance-rated wall assembly penetrated.

510.6.4 Fire walls. Ducts shall not penetrate a fire wall.

510.7 Suppression required. Ducts shall be protected with an approved automatic fire suppression system installed in accordance with the *Florida Building Code, Building*.

Exceptions:

1. An approved automatic fire suppression system shall not be required in ducts conveying materials, fumes, mists and vapors that are nonflammable and

noncombustible under all conditions and at any concentrations.

2. An approved automatic fire suppression system shall not be required in ducts where the largest cross-sectional diameter of the duct is less than 10 inches (254 mm).
3. For laboratories, as defined in Section 510.1, automatic fire protection systems shall not be required in laboratory hoods or exhaust systems.

510.8 Duct construction. Ducts utilized to convey hazardous exhaust shall be constructed of approved G90 galvanized sheet steel, with a minimum nominal thickness as specified in Table 510.8.

Nonmetallic ducts utilized in systems exhausting nonflammable corrosive fumes or vapors shall be listed and labeled. Nonmetallic duct shall have a flame spread index of 25 or less and a smoke-developed index of 50 or less, when tested in accordance with ASTM E 84. Ducts shall be approved for installation in such an exhaust system.

Where the products being exhausted are detrimental to the duct material, the ducts shall be constructed of alternative materials that are compatible with the exhaust.

**TABLE 510.8
MINIMUM DUCT THICKNESS**

DIAMETER OF DUCT OR MAXIMUM SIDE DIMENSION	MINIMUM NOMINAL THICKNESS		
	Nonabrasive materials	Nonabrasive/ Abrasive materials	Abrasive materials
0-8 inches	0.028 inch (No. 24 Gage)	0.034 inch (No. 22 Gage)	0.040 inch (No. 20 Gage)
9-18 inches	0.034 inch (No. 22 Gage)	0.040 inch (No. 20 Gage)	0.052 inch (No. 18 Gage)
19-30 inches	0.040 inch (No. 20 Gage)	0.052 inch (No. 18 Gage)	0.064 inch (No. 16 Gage)
Over 30 inches	0.052 inch (No. 18 Gage)	0.064 inch (No. 16 Gage)	0.079 inch (No. 14 Gage)

For SI: 1 inch = 25.4 mm.

510.8.1 Duct joints. Ducts shall be made tight with the male end of the duct overlapped a minimum of 1 inch (25 mm) with duct joints extending in the direction of airflow.

510.8.2 Clearance to combustibles. Ducts shall have a clearance to combustibles in accordance with Table 510.8.2. Exhaust gases having temperatures in excess of 600°F (316°C) shall be exhausted to a chimney in accordance with Section 511.2.

**TABLE 510.8.2
CLEARANCE TO COMBUSTIBLES**

TYPE OF EXHAUST OR TEMPERATURE OF EXHAUST (°F)	CLEARANCE TO COMBUSTIBLES (inches)
Less than 100	1
100-600	12
Flammable vapors	6

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

510.8.3 Explosion relief. Systems exhausting potentially explosive mixtures shall be protected with an approved

explosion relief system or by an approved explosion prevention system designed and installed in accordance with NFPA 69. An explosion relief system shall be designed to minimize the structural and mechanical damage resulting from an explosion or deflagration within the exhaust system. An explosion prevention system shall be designed to prevent an explosion or deflagration from occurring.

510.9 Supports. Ducts shall be supported at intervals not exceeding 10 feet (3048 mm). Supports shall be constructed of noncombustible material.

SECTION 511 DUST, STOCK AND REFUSE CONVEYING SYSTEMS

511.1 Dust, stock and refuse conveying systems. Dust, stock and refuse conveying systems shall comply with the provisions of Sections 511.1.1 through 511.2. Unless otherwise specified in this section, dust, stock and refuse conveying systems shall also comply with Section 510 and NFPA 91.

511.1.1 Collectors and separators. Collectors and separators involving such systems as centrifugal separators, bag filter systems and similar devices, and associated supports shall be constructed of noncombustible materials and shall be located on the exterior of the building or structure. A collector or separator shall not be located nearer than 10 feet (3048 mm) to combustible construction or to an unprotected wall or floor opening, unless the collector is provided with a metal vent pipe that extends above the highest part of any roof within a distance of 30 feet (9144 mm).

Exceptions:

1. Collectors such as “Point of Use” collectors, close extraction weld fume collectors, spray finishing booths, stationary grinding tables, sanding booths, and integrated or machine-mounted collectors shall be permitted to be installed indoors provided the installation is in accordance with the *Florida Fire Prevention Code* and Chapter 27 of the *Florida Building Code, Building*.
2. Collectors in independent exhaust systems handling combustible dusts shall be permitted to be installed indoors provided that such collectors are installed in compliance with the *Florida Fire Prevention Code* and Chapter 27 of the *Florida Building Code, Building*.

511.1.2 Discharge pipe. Discharge piping shall conform to the requirements for ducts, including clearances required for high-heat appliances, as contained in this code. A delivery pipe from a cyclone collector shall not convey refuse directly into the firebox of a boiler, furnace, dutch oven, refuse burner, incinerator or other appliance.

511.1.3 Conveying systems exhaust discharge. An exhaust system shall discharge to the outside of the building either directly by flue or indirectly through the bin or vault into which the system discharges except where the contaminants have been removed. Exhaust system discharge shall be permitted to be recirculated provided that the solid particulate has been removed at a minimum efficiency of 99.9

percent at 10 microns, vapor concentrations are less than 25 percent of the LFL, and approved equipment is used to monitor the vapor concentration.

511.1.4 Spark protection. The outlet of an open-air exhaust terminal shall be protected with an approved metal or other noncombustible screen to prevent the entry of sparks.

511.1.5 Explosion relief vents. A safety or explosion relief vent shall be provided on all systems that convey combustible refuse or stock of an explosive nature, in accordance with the requirements of the *Florida Building Code, Building*.

511.1.5.1 Screens. Where a screen is installed in a safety relief vent, the screen shall be attached so as to permit ready release under the explosion pressure.

511.1.5.2 Hoods. The relief vent shall be provided with an approved noncombustible cowl or hood, or with a counterbalanced relief valve or cover arranged to prevent the escape of hazardous materials, gases or liquids.

511.2 Exhaust outlets. Outlets for exhaust that exceed 600°F (315°C) shall be designed as a chimney in accordance with Table 511.2.

511.3 Clearance to combustibles.

511.3.1 Ambient temperature noncombustible materials. Dusts conveying ambient temperature noncombustible materials shall have a minimum clearance of 1/2 inch (12.7 mm) from combustible construction and a minimum of 6 inch (152 mm) clearance to store combustible materials.

511.3.2 Ambient temperature combustible materials. Dusts conveying ambient temperature combustible materials shall have a minimum clearance of 18 inches (457 mm) from combustible construction or combustible materials.

Exceptions:

1. Clearance may be reduced to 6 inches (152 mm) from combustible materials and to 1/2 inch (12.7 mm) from combustible construction if the duct system is provided for the specific hazard.
2. Clearances from ducts to combustible material may be reduced if the combustible material is protected in accordance with Table 308.6.

511.3.3 Systems operating at temperatures above 100°F. Ducts conveying materials whose temperature exceeds 100°F (37.7°C) shall have clearances in accordance with Table 511.3.3. All ducts shall be lined with refractory materials if the temperature of the conveyed material exceeds 900°F.

**TABLE 511.3.3
CLEARANCES FOR DUCTS CONVEYING MATERIALS
TEMPERATURES EXCEEDING 100°F**

PRODUCT TEMPERATURE (IN DUCT)	MAXIMUM DIMENSION OF DUCT (INCHES)	MINIMUM CLEARANCES (INCHES)
101°-600°	Up to and including 8 Over 8	8 12
601°-900°	Up to and including 8 Over 8	18 24
901°	All ducts shall be lined with refractory material	24

For SI: 1 foot = 304.8 mm

511.4 Wood processing and woodworking facilities. Wood processing facilities that produce or utilize finely divided wood particles or wood fibers shall conform to NFPA 664.

**TABLE 511.2
CONSTRUCTION, CLEARANCE AND TERMINATION REQUIREMENTS FOR
SINGLE-WALL METAL CHIMNEYS**

CHIMNEYS SERVING	MINIMUM THICKNESS		TERMINATION				CLEARANCE			
	Walls (inch)	Lining	Above roof opening (feet)	Above any part of building within (feet)			Combustible construction (inches)		Noncombustible construction	
				10	25	50	Interior inst.	Exterior inst.	Interior inst.	Exterior inst.
High-heat appliances (Over 2,000°F) ^a	0.127 (No. 10 MSG)	4 1/2" laid on 4 1/2" bed	20	—	—	20	See Note c			
Low Heat appliances (1,000°F normal operation)	0.127 (No. 10 MSG)	none	3	2	—	—	18	6	Up to 18" diameter, 2" Over 18" diameter, 4"	
Medium-heat appliances (2,000°F maximum) ^b	0.127 (No. 10 MSG)	Up to 18" dia.—2 1/2" Over 18"—4 1/2" On 4 1/2" bed	10	—	10	—	36	24		

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, °C = [(°F)-32]/1.8.

a. Lining shall extend from bottom to top of outlet.

b. Lining shall extend from 24 inches below connector to 24 feet above.

c. Clearance shall be as specified by the design engineer and shall have sufficient clearance from buildings and structures to avoid overheating combustible materials (maximum 160°F).

Exception: Facilities with an area of 2,000 square feet (185.8 m²) or less and have a dust collection flow rate of 1500 cubic feet per minute (0.708 m³/sec) or less.

SECTION 512 SUBSLAB SOIL EXHAUST SYSTEMS

512.1 General. When a subslab soil exhaust system is provided, the duct shall conform to the requirements of this section.

512.2 Materials. Subslab soil exhaust system duct material shall be air duct material listed and labeled to the requirements of UL 181 for Class 0 air ducts, or any of the following piping materials that comply with the *Florida Building Code, Plumbing* as building sanitary drainage and vent pipe: cast iron; galvanized steel; brass or copper pipe; copper tube of a weight not less than that of copper drainage tube, Type DWV; and plastic piping.

512.3 Grade. Exhaust system ducts shall not be trapped and shall have a minimum slope of one-eighth unit vertical in 12 units horizontal (1-percent slope).

512.4 Termination. Subslab soil exhaust system ducts shall extend through the roof and terminate at least 6 inches (152 mm) above the roof and at least 10 feet (3048 mm) from any operable openings or air intake.

512.5 Identification. Subslab soil exhaust ducts shall be permanently identified within each floor level by means of a tag, stencil or other approved marking.

SECTION 513 SMOKE AND CARBON MONOXIDE CONTROL SYSTEMS

[F] 513.1 Scope and purpose. This section applies to mechanical and passive smoke control systems that are required by the *Florida Building Code, Building*, and shall apply to high rise buildings as defined in the *Florida Building Code, Building*. The purpose of this section is to establish minimum requirements for the design, installation and acceptance testing of smoke control systems that are intended to provide a tenable environment for the evacuation or relocation of occupants. These provisions are not intended for the preservation of contents, the timely restoration of operations, or for assistance in fire suppression or overhaul activities. Smoke control systems regulated by this section serve a different purpose than the smoke- and heat-venting provisions found in Section 910 of the *Florida Building Code, Building*.

[F] 513.2 General design requirements. Buildings, structures, or parts thereof required by this code to have a smoke control system or systems shall have such systems designed in accordance with the applicable requirements of Section 909 of the *Florida Building Code, Building* and the generally accepted and well-established principles of engineering relevant to the design. The construction documents shall include sufficient information and detail to describe adequately the elements of the design necessary for the proper implementation of the smoke control systems. These documents shall be accompanied with sufficient information and analysis to demonstrate compliance with these provisions.

[F] 513.3 Special inspection and test requirements. In addition to the ordinary inspection and test requirements which buildings, structures and parts thereof are required to undergo, smoke control systems subject to the provisions of Section 909 of the *Florida Building Code, Building* shall undergo special inspections and tests sufficient to verify the proper commissioning of the smoke control design in its final installed condition. The design submission accompanying the construction documents shall clearly detail procedures and methods to be used and the items subject to such inspections and tests. Such commissioning shall be in accordance with generally accepted engineering practice and, where possible, based on published standards for the particular testing involved. The special inspections and tests required by this section shall be conducted under the same terms as found in Section 909.18 of the *Florida Building Code, Building*.

[F] 513.4 Analysis. A rational analysis supporting the types of smoke control systems to be employed, their methods of operation, the systems supporting them, and the methods of construction to be utilized shall accompany the submitted construction documents and shall include, but not be limited to, the items indicated in Sections 513.4.1 through 513.4.6.

[F] 513.4.1 Stack effect. The system shall be designed such that the maximum probable normal or reverse stack effects will not adversely interfere with the system's capabilities. In determining the maximum probable stack effects, altitude, elevation, weather history and interior temperatures shall be used.

[F] 513.4.2 Temperature effect of fire. Buoyancy and expansion caused by the design fire in accordance with Section 513.9 shall be analyzed. The system shall be designed such that these effects do not adversely interfere with its capabilities.

[F] 513.4.3 Wind effect. The design shall consider the adverse effects of wind. Such consideration shall be consistent with the wind-loading provisions of the *Florida Building Code, Building*.

[F] 513.4.4 HVAC systems. The design shall consider the effects of the heating, ventilating and air-conditioning (HVAC) systems on both smoke and fire transport. The analysis shall include all permutations of systems' status. The design shall consider the effects of fire on the HVAC systems.

[F] 513.4.5 Climate. The design shall consider the effects of low temperatures on systems, property and occupants. Air inlets and exhausts shall be located so as to prevent snow or ice blockage.

[F] 513.4.6 Duration of operation. All portions of active or passive smoke control systems shall be capable of continued operation after detection of the fire event for a period of not less than either 20 minutes or 1.5 times the calculated egress time, whichever is less.

[F] 513.5 Smoke barrier construction. Smoke barriers shall comply with the *Florida Building Code, Building*. Smoke barriers shall be constructed and sealed to limit leakage areas exclusive of protected openings. The maximum allowable

leakage area shall be the aggregate area calculated using the following leakage area ratios:

1. Walls: $A/A_w = 0.00100$
2. Exit enclosures: $A/A_w = 0.00035$
3. All other shafts: $A/A_w = 0.00150$
4. Floors and roofs: $A/A_f = 0.00050$

where:

- A = Total leakage area, square feet (m²).
 A_f = Unit floor or roof area of barrier, square feet (m²).
 A_w = Unit wall area of barrier, square feet (m²).

The leakage area ratios shown do not include openings due to doors, operable windows or similar gaps. These shall be included in calculating the total leakage area.

[F] 513.5.1 Leakage area. Total leakage area of the barrier is the product of the smoke barrier gross area times the allowable leakage area ratio, plus the area of other openings such as gaps and operable windows. Compliance shall be determined by achieving the minimum air pressure difference across the barrier with the system in the smoke control mode for mechanical smoke control systems. Passive smoke control systems tested using other approved means such as door fan testing shall be as approved by the code official.

[F] 513.5.2 Opening protection. Openings in smoke barriers shall be protected by automatic-closing devices actuated by the required controls for the mechanical smoke control system. Door openings shall be protected by door assemblies complying with the requirements of the *Florida Building Code, Building* for doors in smoke barriers.

Exceptions:

1. Passive smoke control systems with automatic-closing devices actuated by spot-type smoke detectors listed for releasing service installed in accordance with the *Florida Building Code, Building*.
2. Fixed openings between smoke zones which are protected utilizing the airflow method.
3. In Group I-2 where such doors are installed across corridors, a pair of opposite-swinging doors without a center mullion shall be installed having vision panels with approved fire-rated glazing materials in approved fire-rated frames, the area of which shall not exceed that tested. The doors shall be close-fitting within operational tolerances, and shall not have undercuts, louvers or grilles. The doors shall have head and jamb stops, astragals or rabbets at meeting edges and automatic-closing devices. Positive latching devices are not required.
4. Group I-3.
5. Openings between smoke zones with clear ceiling heights of 14 feet (4267 mm) or greater and bank down capacity of greater than 20 minutes as determined by the design fire size.

[F] 513.5.2.1 Ducts and air transfer openings. Ducts and air transfer openings are required to be protected with a minimum Class II, 250°F (121°C) smoke damper complying with the *Florida Building Code, Building*.

[F] 513.6 Pressurization method. The primary mechanical means of controlling smoke shall be by pressure differences across smoke barriers. Maintenance of a tenable environment is not required in the smoke control zone of fire origin.

[F] 513.6.1 Minimum pressure difference. The minimum pressure difference across a smoke barrier shall be 0.05-inch water gage (12.4 Pa) in fully sprinklered buildings.

In buildings permitted to be other than fully sprinklered, the smoke control system shall be designed to achieve pressure differences at least two times the maximum calculated pressure difference produced by the design fire.

[F] 513.6.2 Maximum pressure difference. The maximum air pressure difference across a smoke barrier shall be determined by required door-opening or closing forces. The actual force required to open exit doors when the system is in the smoke control mode shall be in accordance with the *Florida Building Code, Building*. Opening and closing forces for other doors shall be determined by standard engineering methods for the resolution of forces and reactions. The calculated force to set a side-hinged, swinging door in motion shall be determined by:

$$F = F_{dc} + K(WA\Delta P)/2(W-d) \quad \text{(Equation 5-2)}$$

where:

- A = Door area, square feet (m²).
 d = Distance from door handle to latch edge of door, feet (m).
 F = Total door opening force, pounds (N).
 F_{dc} = Force required to overcome closing device, pounds (N).
 K = Coefficient 5.2 (1.0).
 W = Door width, feet (m).
 ΔP = Design pressure difference, inches (Pa) water gage.

[F] 513.7 Airflow design method. When approved by the code official, smoke migration through openings fixed in a permanently open position, which are located between smoke control zones by the use of the airflow method, shall be permitted. The design airflows shall be in accordance with this section. Airflow shall be directed to limit smoke migration from the fire zone. The geometry of openings shall be considered to prevent flow reversal from turbulent effects.

[F] 513.7.1 Velocity. The minimum average velocity through a fixed opening shall not be less than:

$$v = 217.2 [h(T_f - T_o)/(T_f + 460)]^{1/2} \quad \text{(Equation 5-3)}$$

For SI: $v = 119.9 [h(T_f - T_o)/T_f]^{1/2}$

where:

- H = Height of opening, feet (m).
 T_f = Temperature of smoke, °F (K).

T_o = Temperature of ambient air, °F (K).

v = Air velocity, feet per minute (m/minute).

[F] 513.7.2 Prohibited conditions. This method shall not be employed where either the quantity of air or the velocity of the airflow will adversely affect other portions of the smoke control system, unduly intensify the fire, disrupt plume dynamics or interfere with exiting. In no case shall airflow toward the fire exceed 200 feet per minute (1.02 m/s). Where the formula in Section 513.7.1 requires airflow to exceed this limit, the airflow method shall not be used.

[F] 513.8 Exhaust method. When approved by the building official, mechanical smoke control for large enclosed volumes, such as in atriums or malls, shall be permitted to utilize the exhaust method. Smoke control systems using the exhaust method shall be designed in accordance with NFPA 92B.

[F] 513.8.1 Exhaust rate. The height of the lowest horizontal surface of the accumulating smoke layer shall be maintained at least 6 feet (1829 mm) above any walking surface which forms a portion of a required egress system within the smoke zone.

[F] 513.9 Design fire. The design fire shall be based on a rational analysis performed by the registered design professional and approved by the code official. The design fire shall be based on the analysis in accordance with Section 513.4 and this section.

[F] 513.9.1 Factors considered. The engineering analysis shall include the characteristics of the fuel, fuel load, effects included by the fire, and whether the fire is likely to be steady or unsteady.

[F] 513.9.2 Design fire fuel. Determination of the design fire shall include consideration of the type of fuel, fuel spacing and configuration.

[F] 513.9.3 Heat-release assumptions. The analysis shall make use of the best available data from approved sources and shall not be based on excessively stringent limitations of combustible material.

[F] 513.9.4 Sprinkler effectiveness assumptions. A documented engineering analysis shall be provided for conditions that assume fire growth is halted at the time of sprinkler activation.

[F] 513.10 Equipment. Equipment such as, but not limited to, fans, ducts, automatic dampers and balance dampers shall be suitable for their intended use, suitable for the probable exposure temperatures that the rational analysis indicates, and as approved by the code official.

[F] 513.10.1 Exhaust fans. Components of exhaust fans shall be rated and certified by the manufacturer for the probable temperature rise to which the components will be exposed. This temperature rise shall be computed by:

$$T_s = (Q_c / mc) + (T_o) \quad \text{(Equation 5-4)}$$

where:

c = Specific heat of smoke at smoke-layer temperature, Btu/lb°F (kJ/kg × K).

m = Exhaust rate, pounds per second (kg/s).

Q_c = Convective heat output of fire, Btu/s (kW).

T_o = Ambient temperature, °F (K).

T_s = Smoke temperature, °F (K).

Exception: Reduced T_s as calculated based on the assurance of adequate dilution air.

[F] 513.10.2 Ducts. Duct materials and joints shall be capable of withstanding the probable temperatures and pressures to which they are exposed as determined in accordance with Section 513.10.1. Ducts shall be constructed and supported in accordance with Chapter 6. Ducts shall be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. Measured leakage shall not exceed 5 percent of design flow. Results of such testing shall be a part of the documentation procedure. Ducts shall be supported directly from fire-resistance-rated structural elements of the building by substantial, noncombustible supports.

Exception: Flexible connections, for the purpose of vibration isolation, that are constructed of approved fire-resistance-rated materials.

[F] 513.10.3 Equipment, inlets and outlets. Equipment shall be located so as to not expose uninvolved portions of the building to an additional fire hazard. Outdoor air inlets shall be located so as to minimize the potential for introducing smoke or flame into the building. Exhaust outlets shall be so located as to minimize reintroduction of smoke into the building and to limit exposure of the building or adjacent buildings to an additional fire hazard.

[F] 513.10.4 Automatic dampers. Automatic dampers, regardless of the purpose for which they are installed within the smoke control system, shall be listed and conform to the requirements of approved recognized standards.

[F] 513.10.5 Fans. In addition to other requirements, belt-driven fans shall have 1.5 times the number of belts required for the design duty with the minimum number of belts being two. Fans shall be selected for stable performance based on normal temperature and, where applicable, elevated temperature. Calculations and manufacturer's fan curves shall be part of the documentation procedures. Fans shall be supported and restrained by noncombustible devices in accordance with the structural design requirements of the *Florida Building Code, Building*. Motors driving fans shall not be operating beyond their nameplate horsepower (kilowatts) as determined from measurement of actual current draw. Motors driving fans shall have a minimum service factor of 1.15.

[F] 513.11 Power systems. The smoke control system shall be supplied with two sources of power. Primary power shall be the normal building power systems. Secondary power shall be from an approved standby source complying with Chapter 27 of the *Florida Building Code, Building*. The standby power source and its transfer switches shall be in a separate room from the normal power transformers and switch gear and shall be enclosed in a room constructed of not less than 1-hour fire-resistance-rated fire barriers, ventilated directly to and from the exterior. Power distribution from the two sources shall be by independent routes. Transfer to full standby power

shall be automatic and within 60 seconds of failure of the primary power. The systems shall comply with Chapter 27 of the *Florida Building Code, Building*.

[F] 513.11.1 Power sources and power surges. Elements of the smoke management system relying on volatile memories or the like shall be supplied with uninterruptible power sources of sufficient duration to span 15-minute primary power interruption. Elements of the smoke management system susceptible to power surges shall be suitably protected by conditioners, suppressors or other approved means.

[F] 513.12 Detection and control systems.

513.12.1 Fire detection systems. Fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Chapter 9 of the *Florida Building Code, Building* and NFPA 72. Such systems shall be equipped with a control unit complying with UL 864 and listed as smoke control equipment.

Control systems for mechanical smoke control systems shall include provisions for verification. Verification shall include positive confirmation of actuation, testing, manual override, the presence of power downstream of all disconnects and, through a preprogrammed weekly test sequence report, abnormal conditions audibly, visually and by printed report.

[F] 513.12.1.1 Wiring. In addition to meeting the requirements of Chapter 27 of the *Florida Building Code, Building*, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways.

[F] 513.12.1.2 Activation. Smoke control systems shall be activated in accordance with the *Florida Building Code, Building*.

[F] 513.12.1.3 Automatic control. Where completely automatic control is required or used, the automatic control sequences shall be initiated from an appropriately zoned automatic sprinkler system complying with the *Florida Fire Prevention Code* or from manual controls that are readily accessible to the fire department, and any smoke detectors required by engineering analysis.

[F] 513.12.2 Carbon monoxide control systems. See Section 913 of the *Florida Building Code, Building*.

[F] 513.13 Control-air tubing. Control-air tubing shall be of sufficient size to meet the required response times. Tubing shall be flushed clean and dry prior to final connections. Tubing shall be adequately supported and protected from damage. Tubing passing through concrete or masonry shall be sleeved and protected from abrasion and electrolytic action.

[F] 513.13.1 Materials. Control-air tubing shall be hard-drawn copper, Type L, ACR in accordance with ASTM B 42, ASTM B 43, ASTM B 68, ASTM B 88, ASTM B 251 and ASTM B 280. Fittings shall be wrought copper or brass, solder type in accordance with ASME B 16.18 or ASME B 16.22. Changes in direction shall be made with appropriate tool bends. Brass compression-type fittings shall be used at final connection to devices; other joints shall be brazed using a BCuP5 brazing alloy with solidus

above 1,100°F (593°C) and liquids below 1,500°F (816°C). Brazing flux shall be used on copper-to-brass joints only.

Exception: Nonmetallic tubing used within control panels and at the final connection to devices provided all of the following conditions are met:

1. Tubing shall be listed by an approved agency for flame and smoke characteristics.
2. Tubing and connected device shall be completely enclosed within a galvanized or paint-grade steel enclosure of not less than 0.030 inch (0.76 mm) (No. 22 galvanized sheet gage) thickness. Entry to the enclosure shall be by copper tubing with a protective grommet of neoprene or teflon or by suitable brass compression to male barbed adapter.
3. Tubing shall be identified by appropriately documented coding.
4. Tubing shall be neatly tied and supported within the enclosure. Tubing bridging cabinets and doors or moveable devices shall be of sufficient length to avoid tension and excessive stress. Tubing shall be protected against abrasion. Tubing serving devices on doors shall be fastened along hinges.

[F] 513.13.2 Isolation from other functions. Control tubing serving other than smoke control functions shall be isolated by automatic isolation valves or shall be an independent system.

[F] 513.13.3 Testing. Test control-air tubing at three times the operating pressure for not less than 30 minutes without any noticeable loss in gauge pressure prior to final connection to devices.

[F] 513.14 Marking and identification. The detection and control systems shall be clearly marked at all junctions, accesses and terminations.

[F] 513.15 Control diagrams. Identical control diagrams shall be provided and maintained as required by the *Florida Fire Prevention Code*.

[F] 513.16 Fire fighter's smoke control panel. A fire fighter's smoke control panel for fire department emergency response purposes only shall be provided in accordance with the *Florida Fire Prevention Code*.

[F] 513.17 System response time. Smoke control system activation shall comply with the *Florida Fire Prevention Code*.

[F] 513.18 Acceptance testing. Devices, equipment, components and sequences shall be tested in accordance with the *Florida Fire Prevention Code*.

[F] 513.19 System acceptance. Acceptance of the smoke control system shall be in accordance with the *Florida Fire Prevention Code*.

SECTION 514 ENERGY RECOVERY VENTILATION SYSTEMS

514.1 General. Energy recovery ventilation systems shall be installed in accordance with this section. Where required for purposes of energy conservation, energy recovery ventilation

systems shall also comply with Chapter 13 of the *Florida Building Code, Building*.

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

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

514.3 Access. A means of access shall be provided to the heat exchanger and other components of the system as required for service, maintenance, repair or replacement.

SECTION 515 MAUSOLEUM RELIEF VENT

515.1 General. A pressure relief vent shall be provided for each crypt. Niches shall not require pressure relief systems.

515.2 Materials. The pressure relief vent pipe and fittings shall conform to one of the standards listed in Table 515.2A and Table 515.2B.

**TABLE 515.2A
CRYPT PRESSURE RELIEF PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2661 ASTM F 628 CSA B181.1
Polyolefin pipe	CSA CAN/CSA B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D 2665 ASTM D 2949, ASTM F 891

**TABLE 515.2B
CRYPT PRESSURE RELIEF FITTINGS**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 3311, CSA B 181.1
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D 3311, ASTM D 2949, ASTM F 891
Plastic, general	ASTM F 409

515.3 Pressure relief vent. For family mausoleum units where all crypts are bordering an exterior wall, pressure relief ventilation shall be provided from the crypt to the outside of the mausoleum through the exterior wall or roof. For all other mausoleum units, each crypt shall have a pressure relief vent from the crypt to the roof of the mausoleum. The minimum nominal pipe size shall be 1 inch (25.4 mm). The system shall have a minimum of one-eighth unit vertical to 12 units horizontal (1-percent slope). The piping shall not be trapped or installed to trap water or condensate.

515.4 Termination. Except for family mausoleum units where all crypts are bordering an exterior wall, the crypt pressure relief system shall extend through the roof and terminate at least 6 inches (152 mm) above the roof and at least 10 feet (3048 mm) from any openable opening, air intake, or property line. The termination of the relief system pipe shall be done by a roof and vent cap compatible with the relief pressure pipe. The roof and vent cap shall be waterproof. For family mausoleum units where all crypts are bordering an exterior wall, pressure relief ventilation shall be provided from the crypt to the outside of the mausoleum through the exterior wall or roof.

3. Mastics or mastic-plus-embedded fabric systems.

603.4.2.2 Mechanical fastening. Attachments of ductwork to air-handling equipment shall be by mechanical fasteners. Where access is limited, two fasteners on one side shall be acceptable when installed in accordance with Section 603.1.6.

603.5 Flexible air ducts and flexible air connectors. Flexible air ducts, both metallic and nonmetallic, shall comply with Sections 603.5.1, 603.5.1.1 and 603.5.3 through 603.5.5. Flexible air connectors, both metallic and nonmetallic, shall comply with Sections 603.5.2 through 603.5.5.

603.5.1 Flexible air ducts. Flexible air ducts, both metallic and nonmetallic, shall be tested in accordance with UL 181. Such ducts shall be listed and labeled as Class 0 or Class 1 flexible air ducts and shall be installed in accordance with Section 304.1.

603.5.1.1 Duct length. Flexible air ducts shall not be limited in length.

603.5.2 Flexible air connectors. Flexible air connectors, both metallic and nonmetallic, shall be tested in accordance with UL 181. Such connectors shall be listed and labeled as Class 0 or Class 1 flexible air connectors and shall be installed in accordance with Section 304.1.

603.5.2.1 Connector length. Flexible air connectors shall be limited in length to 14 feet (4267 mm).

603.5.3 Air temperature. The design temperature of air to be conveyed in flexible air ducts and flexible air connectors shall be less than 250°F (121°C).

603.5.4 Flexible air duct and air connector clearance. Flexible air ducts and air connectors shall be installed with a minimum clearance to an appliance as specified in the appliance manufacturer's installation instructions.

603.5.5 Penetrations prohibited. Flexible air ducts and flexible air connectors shall not pass through any fire-resistance-rated assembly. Flexible air connectors shall not pass through any wall, floor or ceiling.

603.5.6 Flexible air duct systems, nonmetal. Flexible nonmetal ducts shall be joined to all other air distribution system components by either terminal or intermediate fittings. All duct collar fittings shall have a minimum $\frac{5}{8}$ inch (15.9 mm) integral flange for sealing to other components and a minimum 3-inch (76 mm) shaft for insertion into the inner duct core.

Flexible ducts having porous inner cores shall not be used.

Exception: Ducts having a nonporous liner between the porous inner core and the outer jacket. Fastening and sealing requirements shall be applied to such intermediate liners.

All joints of flexible ducts to fittings and fittings to other air distribution system components shall be mechanically attached and sealed as specified in Sections 603.5.6.1 through 603.5.6.6.

603.5.6.1 Duct core to duct fitting, mechanical attachment. The reinforced core shall be mechanically attached to the duct fitting by a drawband installed

directly over the wire-reinforced core and the duct fitting. The duct fitting shall extend a minimum of 2 inches (51 mm) into each section of duct core. When the flexible duct is larger than 12 inches (305 mm) in diameter or the design pressure exceeds 1 inch water gauge, the drawband shall be secured by a raised bead or indented groove on the fitting.

603.5.6.2 Duct core to duct fitting, approved closure systems. The reinforced lining shall be sealed to the duct fitting using one of the following sealing materials which conforms to the approved closure and mechanical attachment requirements of Section 603.1:

1. Gasketing.
2. Mastic, mastic-plus-embedded fabric or mastic ribbons.
3. Pressure-sensitive tape.
4. Aerosol sealants, provided that their use is consistent with UL 181.

603.5.6.3 Duct outer jacket to duct collar fitting. The outer jacket of a flexible duct section shall be secured at the juncture of the air distribution system component and intermediate or terminal fitting in such a way as to prevent excess condensation. The outer jacket of a flexible duct section shall not be interposed between the flange of the duct fitting and the flexible duct, rigid fibrous glass duct board or sheet metal to which it is mated.

603.5.6.4 Duct collar fitting to rigid duct, mechanical attachment. The duct collar fitting shall be mechanically attached to the rigid duct board or sheet metal by appropriate mechanical fasteners; either screws, spin-in flanges, or dovetail flanges.

603.5.6.5 Duct collar fitting to rigid duct, approved closure systems. The duct collar fitting's integral flange shall be sealed to the rigid duct board or sheet metal using one of the following closure systems/materials which conforms to the approved closure and mechanical attachment standards of Section 603.1:

1. Gasketing.
2. Mastic or mastic-plus-embedded fabric.
3. Mastic ribbons when used to attach a duct collar to sheet metal.
4. Pressure-sensitive tape.
5. Aerosol sealants, provided that their use is consistent with UL 181.

603.5.6.6 Flexible duct installation and support. Flexible ducts shall be configured and supported so as to prevent the use of excess duct material, prevent duct dislocation or damage, and prevent constriction of the duct below the rated duct diameter in accordance with the following requirements:

1. Ducts shall be installed fully extended. The total extended length of duct material shall not exceed 5 percent of the minimum required length for that run.

2. Bends shall maintain a center line radius of not less than one duct diameter.
3. Terminal devices shall be supported independently of the flexible duct.
4. Horizontal duct shall be supported at intervals not greater than 5 feet (1524 mm). Duct sag between supports shall not exceed 1/2 inch per foot of length. Supports shall be provided within 6 inches (152 mm) of intermediate fittings and between intermediate fittings and bends. Ceiling joists and rigid duct or equipment may be considered to be supports.
5. Vertical duct shall be stabilized with support straps at intervals not greater than 6 feet (1829 mm).
6. Hangers, saddles and other supports shall meet the duct manufacturer's recommendations and shall be of sufficient width to prevent restriction of the internal duct diameter. In no case shall the material supporting flexible duct that is in direct contact with it be less than 1 1/2 inches (38 mm) wide.

603.6 Terminal and intermediate fittings. All seams and joints in terminal and intermediate fittings, between fitting subsections and between fittings and other air distribution system components or building components shall be mechanically attached and sealed as specified in Section 603.6.1 or Section 603.6.2.

603.6.1 Fittings and joints between dissimilar duct types, approved closure systems. Approved closure systems shall be as designated by air distribution system component material type in Section 603.1.

Exception: When the components of a joint are fibrous glass duct board and metal duct, including collar fittings and metal equipment housings, the closure systems approved for fibrous glass duct shall be used.

603.6.2 Terminal fittings and air ducts to building envelope components, approved closure systems. Terminal fittings and air ducts which penetrate the building envelope shall be mechanically attached to the structure and sealed to the envelope component penetrated and shall use one of the following closure systems/materials which conform to the approved closure and mechanical application requirements of Section 603.1:

1. Mastics or mastic-plus-embedded fabrics.
2. Gaskets used in terminal fitting/grille assemblies which compress the gasket material between the fitting and the wall, ceiling or floor sheathing.

603.7 Air handling units. All air handling units shall be mechanically attached to other air distribution system components. Air handling units located outside the conditioned space shall be sealed using approved closure systems conforming to the approved closure and mechanical application requirements of 603.3.

603.7.1 Approved closure systems. Systems conforming to the product and application standards of Section 603.1 may be used when sealing air handling units.

603.8 Cavities of the building structure. Cavities in framed spaces, such as dropped soffits and walls, shall not be used to deliver air from or return air to the conditioning system unless they contain an air duct insert which is insulated in accordance with Table 13-410.AB.2.2 or Table 13-610.AB.2.1 of Chapter 13 of the *Florida Building Code, Building* and constructed and sealed in accordance with the requirements of Section 603.1 appropriate for the duct materials used.

Exception: Return air plenums.

Cavities designed for air transport such as mechanical closets, chases, air shafts, etc. shall be lined with an air barrier and sealed in accordance with Section 603.9 and shall be insulated in accordance with Table 13-410.AB.2.2 or Table 13-610.AB.2.1 of Chapter 13 of the *Florida Building Code, Building*.

Building cavities which will be used as return air plenums shall be lined with a continuous air barrier made of durable nonporous materials. All penetrations of the air barrier shall be sealed with a suitable long-life mastic material.

Exception: Surfaces between the plenum and conditioned spaces from which the return/mixed air is drawn.

Building cavities beneath a roof deck that will be used as return air plenums shall have an insulated roof with the insulation having an R-value of at least R-19.

603.9 Mechanical closets. The interior surfaces of mechanical closets shall be sheathed with a continuous air barrier as specified in Section 603.9.1 and shall be sealed with approved closure systems as specified in Section 603.9.2. All joints shall be sealed between air barrier segments and between the air barriers of walls and those of the ceiling, floor and door framing. All penetrations of the air barrier including, but not limited to, those by air ducts, plenums, pipes, service lines, refrigerant lines, electrical wiring and condensate drain lines shall be sealed to the air barrier and approved closure systems.

Exception: Air passageways into the closet from conditioned space that are specifically designed for return air flow.

Through-wall, through-floor and through-ceiling air passageways into the closet shall be framed and sealed to form an airtight passageway using approved air duct materials and approved closure systems.

Duct penetrations through any part of the ceiling, walls or floor of a mechanical closet shall have sufficient space between surrounding ceiling, walls or floor and any duct or plenum penetration to allow for sealing of the penetration and inspection of the seal.

Clothes washers, clothes dryers, combustion water heaters and atmospheric combustion furnaces shall not be located in mechanical closets used as return air plenums.

603.9.1 Approved air barriers. The following air barriers are approved for use in mechanical closets:

1. One-half-inch-thick (12.7 mm) or greater gypsum wallboard, taped and sealed.
2. Other panelized materials having inward facing surfaces with an air porosity no greater than that of a duct

product meeting Section 22 of UL 181 which are sealed on all interior surfaces to create a continuous air barrier.

603.9.2 Approved closure systems. The following closure systems are approved for use in mechanical closets:

1. Gypsum wallboard joint compound over taped joints between gypsum wallboard panels.
2. Sealants complying with the product and application standards of Section 603.4.2.1 for fibrous glass duct board.
3. A suitable long-life caulk or mastic compliant with the locally adopted mechanical code for all applications.

603.10 Enclosed support platforms. Enclosed support platforms located between the return air inlet(s) from conditioned space and the inlet of the air handling unit or furnace, shall contain a duct section constructed entirely of rigid metal, rigid fibrous glass duct board, or flexible duct which is constructed and sealed according to the respective requirements of Section 603.1 and insulated according to the requirements of Section 13-410.AB.2.2 and Section 13-610.AB.2.1 of Chapter 13 of the *Florida Building Code, Building*.

- The duct section shall be designed and constructed so that no portion of the building structure, including adjoining walls, floors and ceilings, shall be in contact with the return air stream or function as a component of this duct section.
- The duct section shall not be penetrated by a refrigerant line chase, refrigerant line, wiring, pipe or any object other than a component of the air distribution system.
- Through-wall, through-floor and through-ceiling penetrations into the duct section shall contain a branch duct which is fabricated of rigid fibrous glass duct board or rigid metal and which extends to and is sealed to both the duct section and the grille side wall surface. The branch duct shall be fabricated and attached to the duct insert in accordance with Section 603.3 or 603.4.2, respective to the duct type used.

603.11 Furnace connection. Reserved.

603.12 Condensation. Provisions shall be made to prevent the formation of condensation on the exterior of any duct.

603.13 Flood hazard areas. Floodplain Management Construction Standards. This code specifically defers to the authority granted to local government by Title 44 CFR, sections 59 and 60. This code is not intended to supplant or supercede local ordinances adopted pursuant to that authority, nor are local floodplain management ordinances to be deemed amendments to the code.

603.14 Location. Ducts shall not be installed in or within 6 inches (152 mm) of the earth, except where such ducts comply with Section 603.18.

603.15 Mechanical protection. Ducts installed in locations where they are exposed to mechanical damage by vehicles or from other causes shall be protected by approved barriers.

603.16 Weather protection. All ducts including linings, coverings and vibration isolation connectors installed on the exterior of the building shall be protected against the elements.

603.17 Registers, grilles and diffusers. Duct registers, grilles and diffusers shall be installed in accordance with the manufacturer's installation instructions and shall have a flame spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating not over 50 when tested in accordance with ASTM E 84. Volume dampers or other means of supply air adjustment shall be provided in the branch ducts or at each individual duct register, grille or diffuser. Each volume damper or other means of supply air adjustment used in balancing shall be provided with access.

603.17.1 Floor registers. Floor registers shall resist, without structural failure, a 200-pound (90.8 kg) concentrated load on a 2-inch (51 mm) diameter disc applied to the most critical area of the exposed face.

603.17.2 Prohibited locations. Diffusers, registers and grilles shall be prohibited in the floor or its upward extension within toilet and bathing room floors required by the *Florida Building Code, Building*, to have smooth, hard, nonabsorbent surfaces.

Exception: Dwelling units.

603.18 Underground ducts. Ducts shall be approved for underground installation. Metallic ducts not having an approved protective coating shall be completely encased in a minimum of 2 inches (51 mm) of concrete.

603.18.1 Slope. Ducts shall slope to allow drainage to a point provided with access.

603.18.2 Sealing. Ducts shall be sealed and secured prior to pouring the concrete encasement.

603.18.3 Plastic ducts and fittings. Plastic ducts shall be constructed of PVC having a minimum pipe stiffness of 8 psi (55 kPa) at 5-percent deflection when tested in accordance with ASTM D 2412. Plastic duct fittings shall be constructed of either PVC or high-density polyethylene. Plastic duct and fittings shall be utilized in underground installations only. The maximum design temperature for systems utilizing plastic duct and fittings shall be 150°F (66°C).

SECTION 604 INSULATION

604.1 General. Duct insulation shall conform to the requirements of Sections 604.2 through 604.13 and Chapter 13 of the *Florida Building Code, Building*.

604.2 Surface temperature. Ducts that operate at temperatures exceeding 120°F (49°C) shall have sufficient thermal insulation to limit the exposed surface temperature to 120°F (49°C).

604.3 Coverings and linings. Coverings and linings, including adhesives when used, shall have a flame spread index not more than 25 and a smoke-developed index not more than 50, when tested in accordance with ASTM E 84, using the specimen preparation and mounting procedures of ASTM E 2231. Duct coverings and linings shall not flame, glow, smolder or

smoke when tested in accordance with ASTM C 411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C).

604.4 Foam plastic insulation. Foam plastic used as duct coverings and linings shall conform to the requirements of Section 604.

604.5 Appliance insulation. Listed and labeled appliances that are internally insulated shall be considered as conforming to the requirements of Section 604.

604.6 Penetration of assemblies. Duct coverings shall not penetrate a wall or floor required to have a fire-resistance rating or required to be fireblocked.

[EC] 604.7 Identification. External duct insulation and factory-insulated flexible duct shall be legibly printed or identified at intervals not greater than 36 inches (914 mm) with the name of the manufacturer, the thermal resistance *R*-value at the specified installed thickness and the flame spread and smoke-developed indexes of the composite materials. All duct insulation product *R*-values shall be based on insulation only, excluding air films, vapor retarders or other duct components, and shall be based on tested *C*-values at 75°F (24°C) mean temperature at the installed thickness, in accordance with recognized industry procedures. The installed thickness of duct insulation used to determine its *R*-values shall be determined as follows:

1. For duct board, duct liner and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
2. For duct wrap, the installed thickness shall be assumed to be 75 percent (25-percent compression) of nominal thickness.
3. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.

604.8 Lining installation. Linings shall be interrupted at the area of operation of a fire damper and at a minimum of 6 inches (152 mm) upstream of and 6 inches (152 mm) downstream of electric-resistance and fuel-burning heaters in a duct system. Metal nosings or sleeves shall be installed over exposed duct liner edges that face opposite the direction of airflow.

604.9 Thermal continuity. Where a duct liner has been interrupted, a duct covering of equal thermal performance shall be installed.

604.10 Service openings. Service openings shall not be concealed by duct coverings unless the exact location of the opening is properly identified.

604.11 Vapor retarders. Where ducts used for cooling are externally insulated, the insulation shall be covered with a vapor retarder having a maximum permeance of 0.05 perm [2.87 ng/(Pa · s · m²)] or aluminum foil having a minimum thickness of 2 mils (0.051 mm). Insulations having a permeance of 0.05 perm [2.87 ng/(Pa · s · m²)] or less shall not be required to be covered. All joints and seams shall be sealed to maintain the continuity of the vapor retarder.

604.12 Weatherproof barriers. Insulated exterior ducts shall be protected with an approved weatherproof barrier.

604.13 Internal insulation. Materials used as internal insulation and exposed to the airstream in ducts shall be shown to be durable when tested in accordance with UL 181. Exposed internal insulation that is not impermeable to water shall not be used to line ducts or plenums from the exit of a cooling coil to the downstream end of the drain pan.

SECTION 605 AIR FILTERS

605.1 General. Heating and air-conditioning systems of the central type shall be provided with approved air filters. Filters shall be installed in the return air system, upstream from any heat exchanger or coil, in an approved convenient location. Liquid adhesive coatings used on filters shall have a flash point not lower than 325°F (163°C).

605.2 Approval. Media-type and electrostatic-type air filters shall be listed and labeled. Media-type air filters shall comply with UL 900. High efficiency particulate air filters shall comply with UL 586. Electrostatic-type air filters shall comply with UL 867. Air filters utilized within dwelling units shall be designed for the intended application and shall not be required to be listed and labeled.

605.3 Airflow over the filter. Ducts shall be constructed to allow an even distribution of air over the entire filter.

SECTION 606 SMOKE DETECTION SYSTEMS CONTROL

606.1 Controls required. Air distribution systems shall be equipped with smoke detectors listed and labeled for installation in air distribution systems, as required by this section. Duct smoke detectors shall comply with UL 268A. Other smoke detectors shall comply with UL 268.

Exception: Structures classified as R-3 occupancy type. ||

606.2 Where required. Smoke detectors shall be installed where indicated in Sections 606.2.1 through 606.2.3 and NFPA 90A. ||

606.2.1 Supply air systems. Smoke detectors shall be installed in supply air systems with a design capacity greater than 2,000 cfm (0.9 m³/s), in the supply air duct. ||

Exception: Smoke detectors are not required in the supply air system where the space served by the air distribution system is protected by a system of area smoke detectors in accordance with the *Florida Fire Prevention Code*. The area smoke detector system shall comply with Section 606.4. ||

606.2.2 Common supply, return air and supply air systems. Where multiple air-handling systems share common supply or return air ducts or plenums with a combined design capacity greater than 2,000 cfm (0.9 m³/s), the return air and supply air system shall be provided with smoke detectors in accordance with Section 606.2.1. ||

Exception: Reserved. ||

CHAPTER 10

BOILERS, WATER HEATERS AND PRESSURE VESSELS

SECTION 1001 GENERAL

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

Exceptions:

1. Pressure vessels used for unheated water supply.
2. Portable unfired pressure vessels and Interstate Commerce Commission containers.
3. Containers for bulk oxygen and medical gas.
4. Unfired pressure vessels having a volume of 5 cubic feet (0.14 m³) or less operating at pressures not exceeding 250 pounds per square inch (psi) (1724 kPa) and located within occupancies of Groups B, F, H, M, R, S and U.
5. Pressure vessels used in refrigeration systems that are regulated by Chapter 11 of this code.
6. Pressure tanks used in conjunction with coaxial cables, telephone cables, power cables and other similar humidity control systems.
7. Any boiler or pressure vessel subject to inspection by federal or state inspectors.
8. Boilers or pressure vessels subject to inspection as provided in the *Florida Statutes 554-Boiler Safety Act*, administered by the Boiler Safety Program, State Fire Marshal's Office.

SECTION 1002 WATER HEATERS

1002.1 General. Non-potable water heaters and hot water storage tanks shall be designed and stamped under ANSI Z10.1, ANSI Z10.3, ASME *Boiler and Pressure Vessel Code*, Section IV, or shall be listed and labeled in accordance with national standards, and installed in accordance with the manufacturer's installation instructions and this code. All water heaters shall be capable of being removed without first removing a permanent portion of the building structure. The potable water connections and relief valves for all water heaters shall conform to the requirements of the *Florida Building Code, Plumbing*.

1002.2 Water heaters utilized for space heating. Water heaters utilized both to supply potable hot water and provide hot water for space-heating applications shall be listed and labeled for such applications by the manufacturer and shall be installed in accordance with the manufacturer's installation instructions and the *Florida Building Code, Plumbing*.

1002.2.1 Sizing. Water heaters utilized for both potable water heating and space-heating applications shall be sized to prevent the space-heating load from diminishing the required potable water-heating capacity.

1002.2.2 Temperature limitation. Where a combination potable water-heating and space-heating system requires water for space heating at temperatures higher than 140°F (60°C), a temperature actuated mixing valve that conforms to ASSE 1017 shall be provided to temper the water supplied to the potable hot water distribution system to a temperature of 140°F (60°C) or less.

1002.3 Supplemental water-heating devices. Potable water-heating devices that utilize refrigerant-to-water heat exchangers shall be approved and installed in accordance with the *Florida Building Code, Plumbing* and the manufacturer's installation instructions.

SECTION 1003 PRESSURE VESSELS

1003.1 General. All pressure vessels shall bear the label of an approved agency and shall be installed in accordance with the manufacturer's installation instructions. Pressure vessels shall be designed and stamped per ASME *Boiler and Pressure Vessel Code*, Section VIII-Division 1, Division 2 or Division 3.

1003.2 Piping. All piping materials, fittings, joints, connections and devices associated with systems utilized in conjunction with pressure vessels shall be designed for the specific application and shall be approved.

1003.3 Welding. Welding on pressure vessels shall be performed by approved welders in compliance with nationally recognized standards.

SECTION 1004 BOILERS

1004.1 Standards. Oil-fired boilers and their control systems shall be listed and labeled in accordance with UL 726. Electric boilers and their control systems shall be listed and labeled in accordance with UL 834. Boilers shall be designed and constructed in accordance with the requirements of ASME CSD-1 and as applicable, the ASME *Boiler and Pressure Vessel Code*, Sections I or IV; NFPA 8501; NFPA 8502 or NFPA 8504.

1004.2 Installation. In addition to the requirements of this code, the installation of boilers shall conform to the manufacturer's instructions. Operating instructions of a permanent type shall be attached to the boiler. Boilers shall have all controls set, adjusted and tested by the installer. The manufacturer's rating data and the nameplate shall be attached to the boiler.

1004.3 Working clearance. Clearances shall be maintained around boilers, generators, heaters, tanks and related equipment and appliances so as to permit inspection, servicing, repair, replacement and visibility of all gauges. When boilers are installed or replaced, clearance shall be provided to allow access for inspection, maintenance and repair. Passageways

around all sides of boilers shall have an unobstructed width of not less than 18 inches (457 mm), unless otherwise approved.

1004.3.1 Top clearance. High-pressure steam boilers having a steam-generating capacity in excess of 5,000 pounds per hour (2268 kg/h) or having a heating surface in excess of 1,000 square feet (93 m²) or input in excess of 5,000,000 Btu/h (1465 kW) shall have a minimum clearance of 7 feet (2134 mm) from the top of the boiler to the ceiling. Steam-heating boilers and hot-water-heating boilers that exceed one of the following limits: 5,000,000 Btu/h input (1465 kW); 5,000 pounds of steam per hour (2268 kg/h) capacity or a 1,000-square-foot (93 m²) heating surface; and high-pressure steam boilers that do not exceed one of the following limits: 5,000,000 Btu/h input (1465 kW); 5,000 pounds of steam per hour (2268 kg/h) capacity or a 1,000-square-foot (93 m²) heating surface; and all boilers with manholes on top of the boiler, shall have a minimum clearance of 3 feet (914 mm) from the top of the boiler to the ceiling. Package boilers, steam-heating boilers and hot-water-heating boilers without manholes on top of the shell and not exceeding one of the limits of this section shall have a minimum clearance of 2 feet (610 mm) from the ceiling.

1004.4 Mounting. Equipment shall be set or mounted on a level base capable of supporting and distributing the weight contained thereon. Boilers, tanks and equipment shall be secured in accordance with the manufacturer's installation instructions.

1004.5 Floors. Boilers shall be mounted on floors of noncombustible construction, unless listed for mounting on combustible flooring.

1004.6 Boiler rooms and enclosures. Boiler rooms and enclosures and access thereto shall comply with the *Florida Building Code, Building* and Chapter 3 of this code. Boiler rooms shall be equipped with a floor drain or other approved means for disposing of liquid waste.

1004.7 Operating adjustments and instructions. Hot water and steam boilers shall have all operating and safety controls set and operationally tested by the installing contractor. A complete control diagram and boiler operating instructions shall be furnished by the installer for each installation.

SECTION 1005 BOILER CONNECTIONS

1005.1 Valves. Every boiler or modular boiler shall have a shutoff valve in the supply and return piping. For multiple boiler or multiple modular boiler installations, each boiler or modular boiler shall have individual shutoff valves in the supply and return piping.

Exception: Shutoff valves are not required in a system having a single low-pressure steam boiler.

1005.2 Potable water supply. The water supply to all boilers shall be connected in accordance with the *Florida Building Code, Plumbing*.

SECTION 1006 SAFETY AND PRESSURE RELIEF VALVES AND CONTROLS

1006.1 Safety valves for steam boilers. All steam boilers shall be protected with a safety valve.

1006.2 Safety relief valves for hot water boilers. Hot water boilers shall be protected with a safety relief valve.

1006.3 Pressure relief for pressure vessels. All pressure vessels shall be protected with a pressure relief valve or pressure-limiting device as required by the manufacturer's installation instructions for the pressure vessel.

1006.4 Approval of safety and safety relief valves. Safety and safety relief valves shall be listed and labeled, and shall have a minimum rated capacity for the equipment or appliances served. Safety and safety relief valves shall be set at a maximum of the nameplate pressure rating of the boiler or pressure vessel.

1006.5 Installation. Safety or relief valves shall be installed directly into the safety or relief valve opening on the boiler or pressure vessel. Valves shall not be located on either side of a safety or relief valve connection. The relief valve shall discharge by gravity.

1006.6 Safety and relief valve discharge. Safety and relief valve discharge pipes shall be of rigid pipe that is approved for the temperature of the system. The discharge pipe shall be the same diameter as the safety or relief valve outlet. Safety and relief valves shall not discharge so as to be a hazard, a potential cause of damage or otherwise a nuisance. High-pressure-steam safety valves shall be vented to the outside of the structure. Where a low-pressure safety valve or a relief valve discharges to the drainage system, the installation shall conform to the *Florida Building Code, Plumbing*.

1006.7 Boiler safety devices. Boilers shall be equipped with controls and limit devices as required by the manufacturer's installation instructions and the conditions of the listing.

1006.8 Electrical requirements. The power supply to the electrical control system shall be from a two-wire branch circuit that has a grounded conductor, or from an isolation transformer with a two-wire secondary. Where an isolation transformer is provided, one conductor of the secondary winding shall be grounded. Control voltage shall not exceed 150 volts nominal, line to line. Control and limit devices shall interrupt the ungrounded side of the circuit. A means of manually disconnecting the control circuit shall be provided and controls shall be arranged so that when deenergized, the burner shall be inoperative. Such disconnecting means shall be capable of being locked in the off position and shall be provided with ready access.

SECTION 1007 BOILER LOW-WATER CUTOFF

1007.1 General. All steam and hot water boilers shall be protected with a low-water cutoff control.

1007.2 Operation. The low-water cutoff shall automatically stop the combustion operation of the appliance when the water

inches (457 mm) from a plastic-to-metal adapter in the same water line.

1203.12 PVC plastic pipe. Joints between PVC plastic pipe and fittings shall be solvent-cemented or threaded joints conforming to Section 1203.3.

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

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

1203.15 Polyethylene plastic pipe and tubing for ground source heat pump loop systems. Joints between polyethylene plastic pipe and tubing or fittings for ground source heat pump loop systems shall be heat fusion joints conforming to Section 1203.15.1, electrofusion joints conforming to Section 1203.15.2, or stab-type insertion joints conforming to Section 1203.15.3.

1203.15.1 Heat-fusion joints. Joints shall be of the socket-fusion, saddle-fusion or butt-fusion type, fabricated in accordance with the piping manufacturer's instructions. Joint surfaces shall be clean and free of moisture. Joint surfaces shall be heated to melt temperatures and joined. The joint shall be undisturbed until cool. Fittings shall be manufactured in accordance with ASTM D 2683.

1203.15.2 Electrofusion joints. Joints shall be of the electrofusion type. Joint surfaces shall be clean and free of moisture, and scoured to expose virgin resin. Joint surfaces shall be heated to melt temperatures for the period of time specified by the manufacturer. The joint shall be undisturbed until cool. Fittings shall be manufactured in accordance with ASTM F 1055.

1203.15.3 Stab-type insert fittings. Joint surfaces shall be clean and free of moisture. Pipe ends shall be chamfered and inserted into the fittings to full depth. Fittings shall be manufactured in accordance with ASTM D 2513.

SECTION 1204 PIPE INSULATION

1204.1 Insulation characteristics. Pipe insulation installed in buildings shall conform to the requirements of Chapter 13 of the *Florida Building Code, Building*, shall be tested in accordance with ASTM E 84, using the specimen preparation and mounting procedures of ASTM E 2231; and shall have a maximum flame spread index of 25 and a smoke-developed index not exceeding 450. Insulation installed in an air plenum shall comply with Section 602.2.1.

Exception: The maximum flame spread index and smoke-developed index shall not apply to one- and two-family dwellings.

1204.2 Required thickness. Hydronic piping shall be insulated to the thickness required by Chapter 13 of the *Florida Building Code, Building*.

SECTION 1205 VALVES

1205.1 Where required. Shutoff valves shall be installed in hydronic piping systems in the locations indicated in Sections 1205.1.1 through 1205.1.6.

1205.1.1 Heat exchangers. Shutoff valves shall be installed on the supply and return side of a heat exchanger.

Exception: Shutoff valves shall not be required when heat exchangers are integral with a boiler; or are a component of a manufacturer's boiler and heat exchanger packaged unit and are capable of being isolated from the hydronic system by the supply and return valves required by Section 1005.1.

1205.1.2 Central systems. Shutoff valves shall be installed on the building supply and return of a central utility system.

1205.1.3 Pressure vessels. Shutoff valves shall be installed on the connection to any pressure vessel.

1205.1.4 Pressure-reducing valves. Shutoff valves shall be installed on both sides of a pressure-reducing valve.

1205.1.5 Equipment and appliances. Shutoff valves shall be installed on connections to mechanical equipment and appliances. This requirement does not apply to components of a hydronic system such as pumps, air separators, metering devices and similar equipment.

1205.1.6 Expansion tanks. Shutoff valves shall be installed at connections to nondiaphragm-type expansion tanks.

1205.2 Reduced pressure. A pressure relief valve shall be installed on the low-pressure side of a hydronic piping system that has been reduced in pressure. The relief valve shall be set at the maximum pressure of the system design. The valve shall be installed in accordance with Section 1006.

SECTION 1206 PIPING INSTALLATION

1206.1 General. Piping, valves, fittings and connections shall be installed in accordance with the conditions of approval.

1206.1.1 Prohibited tee applications. Reserved. ||

1206.2 System drain down. Hydronic piping systems shall be designed and installed to permit the system to be drained. Where the system drains to the plumbing drainage system, the installation shall conform to the requirements of the *Florida Building Code, Plumbing*.

1206.3 Protection of potable water. The potable water system shall be protected from backflow in accordance with the *Florida Building Code, Plumbing*.

1206.4 Pipe penetrations. Openings for pipe penetrations in walls, floors or ceilings shall be larger than the penetrating pipe. Openings through concrete or masonry building elements shall be sleeved. The annular space surrounding pipe penetrations shall be protected in accordance with the *Florida Building Code, Building*.

HYDRONIC PIPING

1206.5 Clearance to combustibles. A pipe in a hydronic piping system in which the exterior temperature exceeds 250°F (121°C) shall have a minimum clearance of 1 inch (25 mm) to combustible materials.

1206.6 Contact with building material. A hydronic piping system shall not be in direct contact with building materials that cause the piping material to degrade or corrode, or that interfere with the operation of the system.

1206.7 Water hammer. The flow velocity of the hydronic piping system shall be controlled to reduce the possibility of water hammer. Where a quick-closing valve creates water hammer, an approved water-hammer arrestor shall be installed. The arrestor shall be located within a range as specified by the manufacturer of the quick-closing valve.

1206.8 Steam piping pitch. Steam piping shall be installed to drain to the boiler or the steam trap. Steam systems shall not have drip pockets that reduce the capacity of the steam piping.

1206.9 Strains and stresses. Piping shall be installed so as to prevent detrimental strains and stresses in the pipe. Provisions shall be made to protect piping from damage resulting from expansion, contraction and structural settlement. Piping shall be installed so as to avoid structural stresses or strains within building components.

1206.9.1 Flood hazard. See Section 301.13.

1206.10 Pipe support. Pipe shall be supported in accordance with Section 305.

1206.11 Condensation. Provisions shall be made to prevent the formation of condensation on the exterior of piping.

SECTION 1207 TRANSFER FLUID

1207.1 Flash point. The flash point of transfer fluid in a hydronic piping system shall be a minimum of 50°F (28°C) above the maximum system operating temperature.

1207.2 Makeup water. The transfer fluid shall be compatible with the makeup water supplied to the system.

SECTION 1208 TESTS

1208.1 General. Hydronic piping systems other than ground-source heat pump loop systems shall be tested hydrostatically at one and one half times the maximum system design pressure, but not less than 100 psi (689 kPa). The duration of each test shall be not less than 15 minutes. Ground-source heat pump loop systems shall be tested in accordance with Section 1208.1.1.

1208.1.1 Ground source heat pump loop systems. Before connection (header) trenches are backfilled, the assembled loop system shall be pressure tested with water at 100 psi (689 kPa) for 30 minutes with no observed leaks. Flow and pressure loss testing shall be performed and the actual flow rates and pressure drops shall be compared to the calculated design values. If actual flow rate or pressure drop values dif-

fer from calculated design values by more than 10 percent, the problem shall be identified and corrected.

SECTION 1209 EMBEDDED PIPING

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

1209.2 Pressurizing during installation. Piping to be embedded in concrete shall be pressure tested prior to pouring concrete. During pouring, the pipe shall be maintained at the proposed operating pressure.

1209.3 Embedded joints. Joints of pipe or tubing that are embedded in a portion of the building, such as concrete or plaster, shall be in accordance with the requirements of Sections 1209.3.1 through 1209.3.3.

1209.3.1 Steel pipe joints. Steel pipe shall be welded by electrical arc or oxygen/acetylene method.

1209.3.2 Copper tubing joints. Copper tubing shall be joined by brazing with filler metals having a melting point of not less than 1,000°F (538°C).

1209.3.3 Polybutylene joints. Polybutylene pipe and tubing shall be installed in continuous lengths or shall be joined by heat fusion in accordance with Section 1203.10.1.

1209.4 Not embedded related piping. Joints of other piping in cavities or running exposed shall be joined by approved methods in accordance with manufacturer's installation instructions and related sections of this code.

CHAPTER 13

FUEL OIL PIPING AND STORAGE

SECTION 1301 GENERAL

1301.1 Scope. This chapter shall govern the design, installation, construction and repair of fuel-oil storage and piping systems. The storage of fuel oil and flammable and combustible liquids shall be in accordance with the *Florida Fire Prevention Code*.

1301.2 Storage and piping systems. Fuel-oil storage systems shall comply with the *Florida Fire Prevention Code*. Fuel-oil piping systems shall comply with the requirements of this code.

1301.3 Fuel type. An 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 code official.

1301.4 Fuel tanks, piping and valves. The tank, piping and valves for appliances burning oil shall be installed in accordance with the requirements of this chapter. 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 antisiphon valve or other siphon-breaking device shall be installed in lieu of the shutoff valve.

1301.5 Tanks abandoned or removed. All exterior above-grade fill piping shall be removed when tanks are abandoned or removed. Tank abandonment and removal shall be in accordance with the *Florida Fire Prevention Code*.

SECTION 1302 MATERIAL

1302.1 General. Piping materials shall conform to the standards cited in this section.

1302.2 Rated for system. All materials shall be rated for the operating temperatures and pressures of the system, and shall be compatible with the type of liquid.

1302.3 Pipe standards. Fuel oil pipe shall comply with one of the standards listed in Table 1302.3.

1302.4 Nonmetallic pipe. All nonmetallic pipe shall be listed and labeled as being acceptable for the intended application for flammable and combustible liquids. Nonmetallic pipe shall be installed only outside, underground.

1302.5 Fittings and valves. Fittings and valves shall be approved for the piping systems, and shall be compatible with, or shall be of the same material as, the pipe or tubing.

1302.6 Bending of pipe. Pipe shall be approved for bending. Pipe bends shall be made with approved equipment. The bend shall not exceed the structural limitations of the pipe.

**TABLE 1302.3
FUEL OIL PIPING**

MATERIAL	STANDARD (see Chapter 15)
Brass pipe	ASTM B 43
Brass tubing	ASTM B 135
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, L or M)	ASTM B 75; ASTM B 88; ASTM B 280
Labeled pipe	(See Section 1302.4)
Nonmetallic pipe	ASTM D 2996
Steel pipe	ASTM A 53; ASTM A 106
Steel tubing	ASTM A 254; ASTM A 539

1302.7 Pumps. Pumps that are not part of an appliance shall be of a positive-displacement type. The pump shall automatically shut off the supply when not in operation. Pumps shall be listed and labeled in accordance with UL 343.

1302.8 Flexible connectors and hoses. Flexible connectors and hoses shall be listed and labeled in accordance with UL 536.

SECTION 1303 JOINTS AND CONNECTIONS

1303.1 Approval. Joints and connections shall be approved and of a type approved for fuel-oil piping systems. 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 1,000°F (538°C) shall not be used in oil lines. Cast-iron fittings shall not be used. Joints and connections shall be tight for the pressure required by test.

1303.1.1 Joints between different piping materials. Joints between different piping materials shall be made with approved adapter fittings. Joints between different metallic piping materials shall be made with approved dielectric fittings or brass converter fittings.

1303.2 Preparation of pipe ends. All pipe shall be cut square, reamed and chamfered and be free of all burrs and obstructions. Pipe ends shall have full-bore openings and shall not be undercut.

1303.3 Joint preparation and installation. Where required by Sections 1303.4 through 1303.10, the preparation and

installation of brazed, mechanical, threaded and welded joints shall comply with Sections 1303.3.1 through 1303.3.4.

1303.3.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joints shall be brazed with a filler metal conforming to AWS A5.8.

1303.3.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

1303.3.3 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

1303.3.4 Welded joints. All joint surfaces shall be cleaned by an approved procedure. The joint shall be welded with an approved filler metal.

1303.4 Brass pipe. Joints between brass pipe or fittings shall be brazed, mechanical, threaded or welded joints complying with Section 1303.3.

1303.5 Brass tubing. Joints between brass tubing or fittings shall be brazed or mechanical joints complying with Section 1303.3.

1303.6 Copper or copper-alloy pipe. Joints between copper or copper-alloy pipe or fittings shall be brazed, mechanical, threaded or welded joints complying with Section 1303.3.

1303.7 Copper or copper-alloy tubing. Joints between copper or copper-alloy tubing or fittings shall be brazed or mechanical joints complying with Section 1303.3 or flared joints. Flared joints shall be made by a tool designed for that operation.

1303.8 Nonmetallic pipe. Joints between nonmetallic pipe or fittings shall be installed in accordance with the manufacturer's instructions for the labeled pipe and fittings.

1303.9 Steel pipe. Joints between steel pipe or fittings shall be threaded or welded joints complying with Section 1303.3 or mechanical joints complying with Section 1303.9.1.

1303.9.1 Mechanical joints. Joints shall be made with an approved elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical joints shall be installed outside, underground, unless otherwise approved.

1303.10 Steel tubing. Joints between steel tubing or fittings shall be mechanical or welded joints complying with Section 1303.3.

1303.11 Piping protection. Proper allowance shall be made for expansion, contraction, jarring and vibration. Piping other than tubing, connected to underground tanks, except straight fill lines and test wells, shall be provided with flexible connectors, or otherwise arranged to permit the tanks to settle without impairing the tightness of the piping connections.

SECTION 1304 PIPING SUPPORT

1304.1 General. Pipe supports shall be in accordance with Section 305.

SECTION 1305 FUEL OIL SYSTEM INSTALLATION

1305.1 Size. The fuel oil system shall be sized for the maximum capacity of fuel oil required. The minimum size of a supply line shall be $\frac{3}{8}$ -inch (9.5 mm) inside diameter nominal pipe or $\frac{3}{8}$ -inch (9.5 mm) OD tubing. The minimum size of a return line shall be $\frac{1}{4}$ -inch (6.4 mm) inside diameter nominal pipe or $\frac{5}{16}$ -inch (7.9 mm) outside diameter tubing. Copper tubing shall have 0.035-inch (0.9 mm) nominal and 0.032-inch (0.8 mm) minimum wall thickness.

1305.2 Protection of pipe, equipment and appliances. All fuel oil pipe, equipment and appliances shall be protected from physical damage.

1305.2.1 Flood hazard. See Section 301.13.

1305.3 Supply piping. Supply piping shall connect to the top of the fuel oil tank. Fuel oil shall be supplied by a transfer pump or automatic pump or by other approved means.

Exception: This section shall not apply to inside or above-ground fuel oil tanks.

1305.4 Return piping. Return piping shall connect to the top of the fuel oil tank. Valves shall not be installed on return piping.

1305.5 System pressure. The system shall be designed for the maximum pressure required by the fuel-oil-burning appliance. Air or other gases shall not be used to pressurize tanks.

1305.6 Fill piping. A fill pipe shall terminate outside of a building at a point at least 2 feet (610 mm) 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.

1305.7 Vent piping. Liquid fuel vent pipes shall terminate outside of buildings at a point not less than 2 feet (610 mm) measured vertically or horizontally from any building opening. Outer ends of vent pipes shall terminate in a weatherproof vent cap or fitting or be provided with a weatherproof 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 ground 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 pounds per square inch (psi) (69 kPa), the tank shall be designed for the maximum static head that will be imposed.

Liquid fuel vent pipes shall not be cross connected with fill pipes, lines from burners or overflow lines from auxiliary tanks.

Florida Codes - continued

FFPC-07	Florida Fire Prevention Code	201.3, 310.1, 311, 502.5, 502.7.2, 502.8.1, 502.9.5, 502.9.5.2, 502.9.5.3, 502.9.8.2, 502.9.8.3, 502.9.8.5, 502.9.8.6, 502.10, 502.10.3, 502.16.2, 509, 510.2.1, 510.2.2, 510.4, 513.12.3, 513.15, 513.16, 513.17, 513.18, 606.2.1, 908.7, 1101.9, 1105.3, 1106.5, 1106.6, 1301.1, 1301.2
---------	--	---

FS

Federal Specifications*
 General Services Administration
 7th & D Streets
 Specification Section, Room 6039
 Washington, DC 20407

Standard Reference Number	Title	Referenced in code section number
WW-P-325B (1976)	Pipe, Bends, Traps, Caps and Plugs; Lead (for Industrial Pressure and Soil and Waste Applications)	Table 1202.4

* Standards are available from the Supt. of Documents, U.S. Government Printing Office, Washington, DC 20402-9325.

IAR

International Institute of Ammonia Refrigeration
 Suite 250
 1110 North Glebe Road
 Arlington, VA 22201

Standard Reference Number	Title	Referenced in code section number
2—99	Equipment, Design, and Installation of Ammonia Mechanical Refrigerating Systems.	1101.6

MSS

Manufacturers Standardization Society of the Valve & Fittings Industry, Inc.
 127 Park Street, N.E.
 Vienna, VA 22180

Standard Reference Number	Title	Referenced in code section number
SP-69—2002	Pipe Hangers and Supports—Selection and Application	305.4

NAIMA

North American Insulation Manufacturers Association
 Suite 310
 44 Canal Center Plaza
 Alexandria, VA 22314

Standard Reference Number	Title	Referenced in code section number
AH116—02	Fibrous Glass Duct Construction Standards	603.5, 603.9

NFPA

National Fire Protection Association
 Batterymarch Park
 Quincy, MA 02269

Standard Reference Number	Title	Referenced in code section number
30A—03	Code for Motor Fuel-dispensing Facilities and Repair Garages.	304.5
31—01	Installation of Oil-burning Equipment	801.2.1, 801.18.1, 801.18.2, 920.2, 922.1, 1308.1
37—02	Stationary Combustion Engines and Gas Turbines	915.1, 915.2
58—04	Liquefied Petroleum Gas Code	502.9.10
69—02	Explosion Prevention Systems	510.8.3
70—08	National Electrical Code	306.31, 306.6.4.1, 602.2.1, 1106.8
72—02	National Fire Alarm Code	606.3
82—04	Incinerators and Waste and Linen Handling Systems and Equipment	601.1
86—03	Standard for Ovens and Furnaces	924.1

REFERENCED STANDARDS

NFPA - continued

90A-02	Standard for the Installation of Air Conditioning and Ventilating Systems	301.15, 606.2
90B-06	Standard for the Installation of Warm Air Heating and Air Conditioning Systems	301.15
91-04	Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids . . . . .	.502.9.5.1, 502.17
92B-05	Smoke Management Systems in Malls, Atria and Large Spaces . . . . .	.513.8
96-04	Ventilation Control and Fire Protection of Commercial Cooking Operations . . . . .	.506.1
211-03	Chimneys, Fireplaces, Vents and Solid Fuel-burning Appliances . . . . .	.806.1
214-05	Standard on Water Cooling Towers . . . . .	.908.1
262-02	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-handling Spaces . . . . .	.602.2.1.1
664-02	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities . . . . .	.511.4
704-01	Identification of the Hazards of Materials for Emergency Response . . . . .	.502.8.4, Table 1103.1, 510.1
853-03	Installation of Stationary Fuel Power Plants . . . . .	.924.1
8501-01	Boiler and Combustion Systems Hazards Code . . . . .	.1004.1
8502-99	Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler-furnaces . . . . .	.1004.1
8504-96	Atmospheric Fluidized-bed Boiler Operation . . . . .	.1004.1

SMACNA

Sheet Metal & Air Conditioning Contractors National Assoc., Inc.
4201 Lafayette Center Drive
Chantilly, VA 20151-1209

Standard Reference Number	Title	Referenced in code section number
SMACNA-85	HVAC Air Duct Leakage Test Manual . . . . .	.603.3.3
SMACNA-95	HVAC Duct Construction Standards—Metal and Flexible . . . . .	.603.4, 603.9
SMACNA-03	Fibrous Glass Duct Construction Standards . . . . .	.603.5, 603.9

UL

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062-2096

Standard Reference Number	Title	Referenced in code section number
17-94	Vent or Chimney Connector Dampers for Oil-fired Appliances—with Revisions through September 1998 . . . . .	.803.6
103-01	Factory-built Chimneys, Residential Type and Building Heating Appliance—with Revisions through March 1999 . . . . .	.805.2
127-96	Factory-built Fireplaces—with Revisions through November 1999 . . . . .	.805.3, 903.1, 903.3
174-04	Household Electric Storage Tank Water Heaters—with Revisions through October 1999 . . . . .	.1002.1
181-96	Factory-made Air Ducts and Air Connectors—with Revisions through December 1998 . . . . .	.512.2, 603.5, 603.6.1, 603.6.2, 604.13
181A-05	Closure Systems for Use with Rigid Air Ducts and Air Connectors . . . . .	.603.1.7
181B-05	Closure Systems for Use with Flexible Air Ducts and Air Connectors . . . . .	.603.1.7
207-01	Refrigerant-containing Components and Accessories, Nonelectrical—with Revisions through October 1997 . . . . .	.1101.2
268-96	Smoke Detectors for Fire Prevention Signaling Systems—with Revisions through January 1999 . . . . .	.606.1
268A-98	Smoke Detectors for Duct Applications—with Revisions through September 2001 . . . . .	.606.1
343-97	Pumps for Oil-Burning Appliances—with Revisions through May 2002 . . . . .	.1302.7
391-95	Solid-fuel and Combination-fuel Central and Supplementary Furnaces—with Revisions through May 1999 . . . . .	.918.1
412-04	Refrigeration Unit Coolers—with Revisions through November 1998 . . . . .	.1101.2
471-95	Commercial Refrigerators and Freezers—with Revisions through April 1998 . . . . .	.1101.2
508-99	Industrial Control Equipment . . . . .	.307.2.3
536-97	Flexible Metallic Hose—with Revisions through June 2003 . . . . .	.1302.8
555-99	Fire Dampers—with Revisions through January 2002 . . . . .	.607.3
555C-96	Ceiling Dampers . . . . .	.607.3, 607.6.2.1
555S-99	Smoke Dampers—with Revisions through April 2003 . . . . .	.607.3, 607.3.1.1
586-96	High-efficiency, Particulate, Air Filter Units—with Revisions through August 2004 . . . . .	.605.2
641-95	Type L Low-temperature Venting Systems—with Revisions through April 1999 . . . . .	.802.1
710-95	Exhaust Hoods for Commercial Cooking Equipment—with Revisions through April 1999 . . . . .	.507.1
710B-04	Recirculating Systems . . . . .	.507.1
723C-03	Standard for Test for Surface Burning Characteristics of Building Materials . . . . .	.603.1.7