

## ORDINANCE NO.

### AN ORDINANCE REPEALING AND REPLACING ARTICLE 5 OF CITY CODE CHAPTER 25-12 TO ADOPT THE 2009 UNIFORM MECHANICAL CODE AND LOCAL AMENDMENTS.

#### BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:

**PART 1.** City Code Chapter 25-12 is amended to repeal Article 5 (*Mechanical Code*) and replace it with a new Article 5 to read as follows:

#### **ARTICLE 5. MECHANICAL CODE.**

##### **§ 25-12-131 MECHANICAL CODE.**

(A) The Uniform Mechanical Code, 2009 edition, published by the International Association of Plumbing and Mechanical Officials (2009 Mechanical Code) is adopted and incorporated into this section, including all appendices, with deletions and amendments in Subsection (B) of this section and Section 25-12-133 (*Local Amendments to the Mechanical Code*).

(B) The following provisions of the 2009 Mechanical Code are deleted. All subsections contained within a deleted section or subsection are also deleted, even if not specifically listed below.

Table 1-1	Section 110.0	Section 112.0
Section 112.1	Section 112.2	Section 114.4
Section 115.1	Section 115.2	Section 115.3
Section 116.3	Section 308.0	Section 309.2
Section 311.2	Chapter 4	Section 504.1
Section 604.4	Section 605.0	Section 606.0
Section 606.1	Section 606.2	Section 606.3
Section 606.4	Section 606.5	Section 606.6
Section 606.7	Section 1111.8	Chapter 13
Section 1404.0		

(C) The city clerk shall file a copy of the 2009 Mechanical Code with the official ordinances of the City.

## **§ 25-12-132 CITATIONS TO THE MECHANICAL CODE.**

In the City Code, “Mechanical Code” means the 2009 Mechanical Code adopted by Section 25-12-131 (*Mechanical Code*) of the City Code as amended by Section 25-12-133 (*Local Amendments to the Mechanical Code*).

## **§ 25-12-133 LOCAL AMENDMENTS TO THE MECHANICAL CODE.**

- (A) The following provisions are local amendments to the 2009 Mechanical Code. Each provision in this section is a substitute for the identically numbered provision deleted by Section 25-12-131(B) (*Mechanical Code*) or is an addition to the 2009 Mechanical Code.
- (B) The following provisions of the local amendments are adopted from the International Mechanical Code, 2009 edition, published by the International Code Council, Inc., with modifications: 311.2, Chapter 4, 504.1 (*Makeup-and Exhaust-Air Ducts*), 518.0, 521.0, 606.0 and Chapter 18.

**110.0 Appeals.** A person aggrieved by an order, decision, or determination of the building official relating to the application or interpretation of the Mechanical Code may appeal the order, decision, or determination to the Mechanical, Solar, and Plumbing Board in accordance with City Code Chapter 25-1, Article 7, Division 1 (*Appeals*). The Mechanical, Solar, and Plumbing Board is established in Section 2-1-161 (*Mechanical, Plumbing, and Solar Board*).

## **112.0 Permits.**

**112.1 Permit Required.** Except as provided in Sections 112.2 (*Exempt Work*), 112.5 (*Homestead Permit*), and 120.0 (*Registered Industrial Plant Program*), a person shall obtain a mechanical permit before the person installs, alters, repairs, replaces, or remodels, or causes to be installed, altered, repaired, replaced, or remodeled, a mechanical system regulated by the Mechanical Code. A separate mechanical permit is required for each separate building or structure.

**112.2 Exempt Work.** A mechanical permit shall not be required for the following:

**112.2.1** A portable heating appliance, portable ventilating equipment, a portable cooling unit, or a portable evaporative cooler.

**112.2.2** A closed system of steam, hot, or chilled water piping within heating or cooling equipment regulated by this code.

**112.2.3** Replacement of any component part or assembly of an appliance that does not alter its original approval and complies with other applicable requirements of this code.

**112.2.4** Refrigerating equipment that is part of the equipment for which a permit has been issued pursuant to the requirements of this code.

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

**112.3 Offense.** A person who violates Section 112.1 (*Permit Required*) commits an offense. An offense under this section is a class C misdemeanor. Each day a person commits an offense or remains in violation of Section 112.1 (*Permit Required*) is a separate occurrence. Proof of a culpable mental state is not required for conviction of an offense under this section.

**112.4 Persons Authorized to Obtain Permits.** An air conditioning and refrigeration contractor licensed by the State of Texas to perform mechanical work and registered with the City may obtain permits required by the Mechanical Code.

**112.5 Homestead Permit.** A person who is not licensed to perform mechanical work may perform mechanical work within a residence owned by the person if the requirements of this section are met.

- (1) The residence is the person's homestead.
- (2) The work does not include mechanical work that involves reclaiming and charging a ducted heating and air-conditioning system containing refrigerant.
- (3) The residence is the person's principal residence.
- (4) The person has not secured a homestead permit for another residence within the prior 12 month period.
- (5) The person must have owned and occupied the property as of January 1 of the tax year in which the person applies for a homestead permit.
- (6) A person must obtain a homestead permit and pay required permit fees before beginning any mechanical work. A person must apply for a homestead permit in person and must file an affidavit stating that the location at which the work is to be done is the person's homestead.
- (7) A person who has obtained a homestead permit may not allow or cause any other person to perform mechanical work under the permit.
- (8) A person may not transfer a permit to another person.
- (9) A person performing mechanical work under a homestead permit shall present a picture identification to verify that the person is authorized to

perform work under the homestead permit, when requested by the building official or his designee.

- (10) A homestead permit shall not be issued for mechanical work on a mobile, modular or manufactured home unless the homeowner owns the land on which the mobile, modular, or manufactured home is located. A homestead permit shall not be issued if the mobile, modular, or manufactured home is located in a mobile home park, mobile home community, or other commercial premises.

**112.6 Registration of Air Conditioning and Refrigeration Contractor.** An air conditioning and refrigeration contractor shall register with the City before performing work regulated by the Mechanical Code. A contractor shall pay a registration fee, established by separate ordinance, for initial registration, registration after a license suspension, and registration after a license expiration. A new registration fee is not required for renewal of an unexpired license.

**113.1.7** The registration shall contain the name of the air conditioning and refrigeration contractor who is licensed by the State of Texas and registered with the City to perform the work.

**114.4 Time Limitation on Application; Permit Expiration and Reactivation.** Time limits on permit applications and requirements for permit expiration and reactivation, including a review fee for expired permits, are set forth in Chapter 25-12, Article 13 (*Administration of Technical Codes*).

**114.4.1 Continuance of work inspection.** Where structural or other conditions exist that do not allow for inspections to be performed at intervals less than 180 days, the permit holder may schedule a continuance of work inspection. If it is determined by the inspector, that work has been performed, the expiration date will automatically extend 180 days. If it is determined by the inspector, that no work has begun or continued, the permit will expire and the permit holder will be required to submit for a new plan review and or new permit.

**115.1 Permit Fees and Plan Review Fees.** Permit fees and plan review fees shall be established under a separate ordinance by the City Council.

**115.2 Payment of Plan Review Fees.** An applicant shall pay plan review fees when plans and specifications are submitted to the building official for review.

**116.3 Testing of Equipment.** Refrigeration equipment regulated by this code shall be tested and approved as required by section 1124.0 of the 2009 Uniform Mechanical Code.

Steam and hot-water boilers and piping shall be tested and approved as required by Sections 1022, 1201.2.8, and 1207.0 of the 2009 Uniform Mechanical Code.

Fuel gas piping shall be tested and approved as required by the Adopted Plumbing Code.

## **120.0 Registered Industrial Plant Program.**

**120.1 Program.** A licensed air conditioning and refrigeration contractor may perform the following mechanical installations in a Registered Industrial Plant, as defined by this code and the building code without obtaining a permit required by Section 112.1 (*Permit Required*):

- (1) replacement, modification, or relocation of existing ductwork, fan coil units, VAV boxes volume dampers, environmental make-up air systems and related equipment; and
- (2) modification of existing hazardous production material (HPM) supply systems, HPM drain systems and HPM exhaust systems in H occupancy areas, as defined in the Building Code, and in exterior areas to accommodate the installation or relocation of equipment.

**120.2 Fees.** Plan review fees and permit fees are not required if records are maintained in accordance with Section 1705 (*Registered Industrial Plant*) of the Building Code.

**121.0 Qualified Inspectors.** An inspector who performs inspections under this Code must meet the following qualifications:

### **121.1 Plumbing/Mechanical Inspection Supervisor.**

- (1) The plumbing/mechanical inspection supervisor must:
  - (a) be an employee of the City;
  - (b) maintain a current plumbing inspector license issued by the Texas State Board of Plumbing and the Texas State Board of Examiners;
  - (c) maintain a current certification as a mechanical and plumbing inspector under the certification program established by the International Code Council or International Association of Plumbing and Mechanical Officials; and maintain a current certification in the International Energy Conservation Code (both residential and commercial) established by the International Code Council.
  - (d) have at least ten years of experience as a licensed master plumber or equivalent experience as a state licensed air conditioning and refrigeration contractor, at least three years of which must be in a responsible supervisory capacity.

- (2) Five years of inspection experience may be substituted for five years of craft experience required in Subsection 1(d) above.

**121.2 Commercial Mechanical Inspector.** A commercial mechanical inspector must:

- (1) maintain a current certification as a mechanical inspector under the certification program established by the International Code Council or the International Association of Plumbing and Mechanical Officials; and maintain a current certification in the International Energy Conservation Code (both residential and commercial) established by the International Code Council.
- (2) have at least five years of inspection experience, one year of which must be in a responsible supervisory capacity.

**121.2.1 Certification Requirement.** A person hired by the City as a commercial mechanical inspector after the effective date of this Code must become certified through the certification program established by the International Code Council or the International Association of Plumbing and Mechanical Officials not later than one year after the date of employment and must become certified in the International Energy Conservation Code through the certification program established by the International Code Council not later than two years after the date of employment.

**304.0.1 Access to Appliances.** Appliances which are capable of being inspected, serviced, repaired, and replaced by removing a dropped grid system ceiling shall be considered to have adequate access. A grid system ceiling shall not be considered permanent construction for this purpose.

**304.1.2.3 Ladders and Access.** Access to equipment on roofs shall not require climbing over obstructions greater than 30 inches high or walking on roofs having a slope greater than 4 units vertical in 12 units horizontal (33-percent slope).

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

- (1) The side railing shall extend above the parapet or roof edge not less than 30 inches.
- (2) Ladders shall have rung spacing not to exceed 14 inches on center.
- (3) Ladders shall have a toe spacing not less than 6 inches deep.
- (4) There shall be a minimum of 18 inches between rails.
- (5) Rungs shall have a minimum 0.75-inch diameter and be capable of withstanding a 300-pound load.

- (6) Ladders over 30 feet in height shall be provided with offset sections and landings capable of withstanding 100 pounds per square foot.
- (7) Ladders shall be protected against corrosion by approved means.

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

**307.2.3 Gas and Oil-Fired Furnaces.** A heating system using a gas or oil-fired furnace shall have a float-operated automatic control valve installed in the fuel supply line that shall be set to operate when floodwaters reach an elevation equal to the floor level of the space where furnace equipment is installed. A manually operated gas valve that can be operated from a location above the RFD shall be provided in the fuel supply line to serve as a supplementary safety provision for fuel cutoff.

**308.0 Electrical Connections.** Equipment regulated by this code including rooftop units, rooftop air units, condensing units, heat pumps, exhaust fans, supply fans, and indoor equipment such as air handling units, fan-coil units, vav boxes, and fan-powered boxes requiring electrical connections of more than fifty volts shall have a positive means of disconnect adjacent to and in sight from the equipment served. (This does not apply to plumbing equipment or components, or items such as packaged condensate pumps for steam condensate or cooling coil condensate, or water recovery condensate packaged pumps.) A factory supplied switch or breaker that is an integral part of the mechanical equipment does not satisfy the requirement for a positive means of disconnect within sight of the equipment. Therefore, a disconnect and the power supply feed must be located exterior of the equipment to allow it to be easily replaceable. A 120 volt receptacle shall be located within twenty-five feet of the equipment for service and maintenance purposes. The receptacle need not be located on the same level as the equipment. Low-voltage wiring of fifty volts or less within a structure shall be installed in a manner to prevent physical damage. Equipment containing a refrigeration circuit shall be provided with a 120 volt ground fault circuit interrupter receptacle within twenty five feet of the equipment for service and maintenance purposes.

**309.2 Condensate Control.** If damage may result to a building component from condensate overflow, an additional water-tight pan of corrosion-resistant metal shall be installed beneath the cooling coil or unit top to catch the overflow condensate caused by a clogged primary condensate drain, or one pan with a standing overflow and a separate secondary drain may be provided in lieu of the secondary drain pan. The additional pan shall have a depth of 1 ½ inches (38 mm) and shall not be less than 3 inches (76 mm) larger in width and length. Drain piping shall be a minimum of ¾ inch (19.1 mm) nominal pipe size, discharging at a point that can be readily observed.

**Exception:** A float switch designed to automatically disconnect electrical power to cooling equipment may be installed instead of a secondary drain. The float switch shall be located in a secondary drain pan.

**309.2.1** A condensate termination to an approved inlet shall be located in the area controlled by the same person controlling the air-conditioned space.

## **311.2 Air Filters.**

**311.2.1 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).

**311.2.2 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.

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

**313.0 Compliance with the Energy Code.** Replacement electrical equipment shall comply with the Energy Code. New heating, ventilating, and air-conditioning systems of all structures shall be designed and installed for efficient utilization of energy in accordance with the current adopted energy code.

**314.0 Establishment of flood hazard areas.** Flood hazard areas are established to include the following:

- (1) The flood hazard areas identified by the Federal Emergency Management Agency in a scientific and engineering report entitled, “ The Flood Insurance Study for Austin, Texas,” dated September 26, 2008, with accompanying Flood Insurance Rate Maps and Flood Boundary-Floodway Maps (FIRM and FBFM) and related supporting data along with any amendments or revisions thereto are hereby adopted by referenced and declared to be a part of this section.
- (2) The 100-year and 25-year floodplains based on projected frill development as specified in the Austin City Code and Drainage Criteria Manual are adopted by reference and declared to be part of this section.



## CHAPTER 4

### VENTILATION AIR SUPPLY

#### **401.0 General Ventilation Requirements.**

**401.2 Ventilation required.** Every occupied space shall be ventilated by natural means in accordance with Section 402.1 or by mechanical means in accordance with Section 403.1.

**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. Where a source of contamination is located a minimum of 3 feet (3048 mm) horizontally of an intake opening, such opening shall be located a minimum of 3 feet below the contaminant source. 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.

**401.4.3 Flood hazard.** For structures located in flood hazard areas, outdoor exhaust openings shall be at or above the design flood elevation.

**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 protective in accordance with the International Building Code.

**Table 401.5**  
**Opening Sizes In Louvers, Grilles And Screens Protecting Outdoor**  
**Exhaust And Air Intake Openings**

<b>Outdoor Opening Type</b>	<b>Minimum And Maximum Opening Sizes In Louvers, Grilles And Screens Measured In Any direction</b>
Exhaust openings	Not < ¼ inch and not > ½”
Intake openings in residential Occupancies	Not < ¼ inch and not > ½ inch
Intake openings in other than Residential occupancies	> ¼ inch and not > 1 inch

**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.

**402.4 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.

**403.1 Mechanical 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.

**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 may 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 makeup 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 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, unless the actual occupant load is known. 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.

**404.1 Enclosed parking garages.** Mechanical ventilation systems for enclosed parking garages shall be permitted to operate intermittently where the system is arranged to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices.

**404.2 Minimum ventilation.** Automatic operation of the system shall not reduce the ventilation rate below 0.05 cfm per square foot ( $0.00025 \text{ m}^3/\text{s}\cdot\text{m}^2$ ) of the floor area and the system shall be capable of producing a ventilation rate of 1.5 cfm per square foot ( $0.0076 \text{ m}^3/\text{s}\cdot\text{m}^2$ ) of floor area.

**404.3 Occupied spaces accessory to public garages.** Connecting offices, waiting rooms, ticket booths and similar uses that are accessory to a public garage shall be maintained at a positive pressure and shall be provided with ventilation in accordance with Section 403.3.

**405.1 System Control.** Mechanical ventilation systems shall be provided with manual or automatic controls that will operate such systems wherever the spaces are occupied. Air-conditioning systems that supply required ventilation air shall be provided with controls designed to automatically maintain the required outdoor air supply rate during occupancy.

**406.1 Ventilation of Uninhabited Spaces.** Uninhabited spaces, such as crawl spaces and attics, shall be provided with natural ventilation openings as required by the International Building Code or shall be provided with a mechanical exhaust and supply air system. The mechanical exhaust rate shall be not less than 0.02 cfm per square foot ( $0.00001 \text{ m}^3/\text{s}\cdot\text{m}^2$ ) of horizontal area and shall be automatically controlled to operate when the relative humidity in the space served exceeds 60 percent.

**TABLE 403.3**  
**REQUIRED OUTDOOR VENTILATION AIR**

<b>OCCUPANCY CLASSIFICATION</b>	<b>ESTIMATED MAXIMUM OCCUPANT LOAD, PERSONS PER 1,000 SQUARE FEET<sup>a</sup></b>	<b>OUTDOOR AIR [Cubic feet per minute (cfm) per person] UNLESS NOTED<sup>e</sup></b>
<b>Correctional facilities</b>		
Cells		
without plumbing fixtures	20	20
with plumbing fixtures <sup>g,h</sup>	20	20
Dining Halls	100	15
Guard Stations	40	15
<b>Dry Cleaners, laundries</b>		
Coin-operated dry cleaner	20	15
Coin-operated laundries	20	15
Commercial dry cleaner	30	30
Commercial laundry	10	25
Storage, pick up	30	35
<b>Education</b>		
Auditorium	150	15
Classrooms	50	15
Corridors	--	0.10 cfm/ft <sup>2</sup>
Laboratories	30	20
Libraries	20	15
Locker rooms <sup>h</sup>	--	0.50 cfm/ft <sup>2</sup>
Music rooms	50	15
Smoking lounges <sup>b,g</sup>	70	60
Training shops	30	20
<b>Food and beverage service</b>		
Bars, cocktail lounges	100	30
Cafeteria, fast food	100	20
Dining rooms	70	20
Kitchen (cooking) <sup>f,g</sup>	20	15
<b>Hospitals, nursing and convalescent homes<sup>j</sup></b>		
Autopsy rooms <sup>b</sup>	--	0.50 cfm/ft <sup>2</sup>
Medical procedure rooms	20	15
Operating rooms	20	30
Patient rooms	10	25
Physical therapy	20	15
Recovery and ICU	20	15
<b>Hotels, motels, resorts and dormitories</b>		
Assembly rooms	120	15
Bathrooms <sup>g,h</sup>	--	35
Bedrooms	--	30 cfm per room
Conference rooms	50	20
Dormitory sleeping areas	20	15
Gambling casinos	120	30
Living rooms	--	30 cfm per room
Lobbies	30	15
<b>Offices</b>		
Conference rooms	50	20
Office spaces	7	20
Reception areas	60	15
Telecommunication centers and data entry	60	20

**TABLE 403.3-continued  
REQUIRED OUTDOOR VENTILATION AIR**

<b>OCCUPANCY CLASSIFICATION</b>	<b>ESTIMATED MAXIMUM OCCUPANT LOAD, PERSONS PER 1,000 SQUARE FEET<sup>a</sup></b>	<b>OUTDOOR AIR [Cubic feet per minute (cfm) per person] UNLESS NOTED<sup>e</sup></b>
<b>Private Dwellings, single and multiple</b> Garages, common for Multiple units <sup>b</sup>  Garages, separate for each dwelling  Kitchens <sup>g</sup>  Living areas <sup>c</sup>  Toilet rooms and bathrooms <sup>g,h</sup>	 --  --  --  Based upon number of bedrooms, first bedroom: 2; each additional bedroom: 1  --	 1.5 cfm/ft <sup>2</sup>    100 cfm per car   100 cfm intermittent or 25 cfm continuous  .035 air changes per hour <sup>a</sup> or 15cfm per person, whichever is greater  Mechanical exhaust capacity of 50 cfm intermittent or 20 cfm continuous
<b>Public spaces</b> Corridors and utilities Elevators car <sup>g</sup> Locker rooms <sup>h</sup> Shower rooms (per shower head) <sup>g,h</sup>  Smoking lounges <sup>b,h</sup> Toilet rooms <sup>g,h</sup>	 --      70	 0.05 cfm/ft <sup>2</sup> 1.00 cfm/ft <sup>2</sup> 0.5 cfm/ft <sup>2</sup> 50 cfm Intermittent or 20 cfm continuous  60 75 cfm per water closet or urinal
<b>Retail stores, sales floor and showroom floors</b> Basement and street Dressing rooms Malls and arcades Shipping and receiving Smoking lounges <sup>b</sup> Storage rooms Upper floors Warehouses	 -- -- -- -- 70 -- -- --	 0.30 cfm/ft <sup>2</sup> 0.20 cfm/ft <sup>2</sup> 0.20 cfm/ft <sup>2</sup> 0.15 cfm/ft <sup>2</sup> 60 0.15 cfm/ft <sup>2</sup> 0.20 cfm/ft <sup>2</sup> 0.05 cfm/ft <sup>2</sup>
<b>Specialty shops</b> Automotive motor-fuel dispensing stations Barber Beauty Clothiers, furniture Embalming room <sup>b</sup> Florists Hardware, drugs, fabrics Nail salon <sup>b,i</sup>   Pet shops  Reducing salons Supermarkets	 -- 25 25 -- 8 8 8  --  20 8	 1.5 cfm/ft <sup>2</sup> 15 25 0.30 cfm/ft <sup>2</sup> 2.0 cfm/ft <sup>2</sup> 15 15 50 cfm intermittent or 20 cfm continuous per station  1.0 cfm.ft <sup>2</sup>  15 15

**TABLE 403.3-continued  
REQUIRED OUTDOOR VENTILATION AIR**

<b>OCCUPANCY CLASSIFICATION</b>	<b>ESTIMATED MAXIMUM OCCUPANT LOAD, PERSONS PER 1,000 SQUARE FEET<sup>a</sup></b>	<b>OUTDOOR AIR [Cubic feet per minute (cfm) per person] UNLESS NOTED<sup>e</sup></b>
<b>Sports and amusement</b>		
Ballrooms and discos	100	25
Bowling alleys (seating areas)	70	25
Game rooms	70	25
Ice arenas	--	0.50 cfm/ft <sup>2</sup>
Playing floors (gymnasiums)	30	20
Spectator areas	150	15
Swimming pools (pool and deck area)	--	0.50 cfm/ft <sup>2</sup>
<b>Storage</b>		
Repair garages, enclosed parking garages <sup>d</sup>	--	1.5 cfm/ft <sup>2</sup>
Warehouses	--	0.05 cfm/ft <sup>2</sup>
<b>Theaters</b>		
Auditorium	150	15
Lobbies	150	20
Stages, studios	70	15
Ticket booths	60	20
<b>Transportation</b>		
Platforms	100	15
Vehicles	150	15
Ticket booths	100	15
<b>Workrooms</b>		
Bank vaults	5	15
Darkrooms	--	0.50 cfm/ft <sup>2</sup>
Duplicating, printing	--	0.50 cfm/ft <sup>2</sup>
Meat processing <sup>c</sup>	10	15
Pharmacy	20	15
Photo studios	10	15

For SI: 1 cubic foot per minute = 0.0004719 m<sup>3</sup>/s, 1 ton = 908 kg.

1 cubic foot per minute per square foot = 0.00508 m<sup>3</sup>/(s.m<sup>2</sup>).

°C = [(°F)-32]/1.8, 1 square foot = 0.0929 m<sup>2</sup>.

- a. Based upon net floor area, unless actual occupant load is known.
- b. Mechanical exhaust required and the recirculation of air from such spaces as permitted by Section 403.2.1 is prohibited (see Section 403.2.1, Items 1 and 3).
- c. Spaces unheated or maintained below 50°F are not covered by these requirements unless the occupancy is continuous.
- d. Ventilation systems in enclosed parking garages shall comply with Section 404.1.
- e. Where the ventilation rate is expressed in cfm/ft<sup>2</sup>, such rate is based upon cubic feet per minute per square foot of the floor area being ventilated.
- f. The sum of the outdoor and transfer air from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 cfm/ft<sup>2</sup>.
- g. Transfer air permitted in accordance with Section 403.2.2.
- h. Mechanical exhaust is required and recirculation is prohibited except that recirculation shall be permitted where the resulting supply airstream consists of not more than 10 percent air recirculated from these spaces (see Section 403.2.1, Items 2 and 4).

- i. The required exhaust system shall capture the contaminants and odors at their source.
- j. The State of Texas has minimum outside air requirements for this occupancy, the greater amount of outside air required from table 403.3 and the State of Texas shall be utilized.

**502.2 Motion picture projectors.** Motion picture projectors shall be exhausted in accordance with Section 502.2.1 or 502.2.2.

**502.2.1 Projectors with an exhaust discharge.** Projectors equipped with an exhaust discharge shall be directly connected to a mechanical exhaust system. The exhaust system shall operate at an exhaust rate as indicated by the manufacturer's installation instructions.

**502.2.2 Projectors without exhaust connection.** Projectors without an exhaust connection shall have contaminants exhausted through a mechanical exhaust system. The exhaust rate for electric arc projectors shall be a minimum of 200 cubic feet per minute (cfm) (0.09 m<sup>3</sup>/s) per lamp. The exhaust rate for xenon projectors shall be a minimum of 300 cfm (0.14 m<sup>3</sup>/s) per lamp. Xenon projector exhaust shall be at a rate such that the exterior temperature of the lamp housing does not exceed 130°F (54°C). The lamp and projection room exhaust systems, whether combined or independent, shall not be interconnected with any other exhaust or return system within the building.

**504.1 Makeup-and Exhaust-Air Ducts.** Environmental air ducts not regulated by other provisions of the Mechanical Code shall comply with this section. Ducts shall be substantially airtight and shall comply with the provisions of Chapter 6 (*Duct Systems*). Exhaust ducts shall not extend into or through ducts or plenums. Environmental air ducts that have an alternate function as a part of an approved smoke-control system do not require design as Class 1 product-conveying ducts. Exhaust ducts shall be equipped with back draft dampers. Exhaust ducts shall terminate at the exterior of a building, in locations such as exterior walls and roofs, or with a minimum of three feet from property lines and openings into the building. Exhaust ducts serving domestic clothes dryers shall not terminate over a covered walkway unless the duct is extended to the outer edge of the covered walkway. Exhaust ducts serving domestic ranges and bathroom exhaust fans shall not terminate over a covered walkway unless there are two sides open for dilution air movement. When adequate dilution air cannot be provided, exhaust ducts serving a domestic range or a bathroom exhaust fan shall be extended to the outer edge of the covered walkway. Environmental air ducts may terminate over a private use balcony if the balcony serves the same space as the duct and required clearances from openings are maintained.

**Exception:** A duct under positive or negative pressure may be routed through a plenum when a longitudinal and traverse joint are sealed with listed materials for that use in accordance with acceptable methods. Hazardous fumes may not be run through a plenum under positive pressure unless the plenum is sealed



and encased in another air tight enclosure, chase, or metal sleeve complete to connection and to point of discharge.

## **518.0 Storage and Handling of Flammable and Combustible Liquids.**

### **518.1 Hazardous materials.**

**518.1.1 General requirements.** Exhaust ventilation systems for structures containing hazardous materials shall comply with Sections 518.1.2 (*Storage in excess of the maximum allowable quantities*) through 518.1.7 (*Closed systems*).

**518.1.2 Storage in excess of the maximum allowable quantities.** Indoor storage areas and storage buildings for hazardous materials in amounts exceeding the maximum allowable quantity per control area shall be provided with mechanical exhaust ventilation or natural ventilation where natural ventilation can be shown to be acceptable for the materials as stored.

**Exception:** Storage areas for flammable solids complying with the Fire Code.

**518.1.3 System requirements.** Exhaust ventilation systems shall comply with all of the following:

- (1) The installation shall be in accordance with this code.
- (2) Mechanical ventilation shall be provided at a rate of not less than 1 cfm/ft<sup>2</sup> [0.00508 m<sup>3</sup>/(s·m<sup>2</sup>)] of floor area over the storage area.
- (3) The systems shall operate continuously unless alternate designs are approved.
- (4) A manual shutoff control shall be provided outside of the room in a position adjacent to the access door to the room or in another approved location. The switch shall be of the break-glass or other approved type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.
- (5) The exhaust ventilation system shall be designed to consider the density of the potential fumes or vapors released. For fumes or vapors that are heavier than air, exhaust shall be taken from a point within 12 inches (304 mm) of the floor. For fumes or vapors that are lighter than air, exhaust shall be taken from a point within 12 inches of the highest point of the room.
- (6) The location of both the exhaust and inlet air openings shall be designed to provide air movement across all portions of the floor or room to prevent the accumulation of vapors.
- (7) The exhaust air shall not be recirculated to occupied areas if the materials stored are capable of emitting hazardous vapors and contaminants have not been removed. Air contaminated with explosive or flammable vapors, fumes

or dusts; flammable, highly toxic or toxic gases; or radioactive materials shall not be recirculated.

**518.1.4 Gas rooms, exhausted enclosures and gas cabinets.** The ventilation system for gas rooms, exhausted enclosures and gas cabinets for any quantity of hazardous material shall be designed to operate at a negative pressure in relation to the surrounding area. Highly toxic and toxic gases shall also comply with Sections 518.2.7.1 (Gas cabinets), 518.2.7.2 (*Exhausted enclosures*) and 518.2.8.4 (*Gas rooms*).

**518.1.5 Indoor dispensing and use.** Indoor dispensing and use areas for hazardous materials in amounts exceeding the maximum allowable quantity per control area shall be provided with exhaust ventilation in accordance with Section 518.1.8 (*Ventilation during construction*).

**518.1.6 Indoor dispensing and use -- point sources.** Where gases, liquids or solids in amounts exceeding the maximum allowable quantity per control area and having a hazard ranking of 3 or 4 in accordance with NFPA 704 are dispensed or used, mechanical exhaust ventilation shall be provided to capture gases, fumes, mists or vapors at the point of generation.

**Exception:** Where it can be demonstrated that the gases, liquids or solids do not create harmful gases, fumes, mists or vapors.

**518.1.7 Closed systems.** Where closed systems for the use of hazardous materials in amounts exceeding the maximum allowable quantity per control area are designed to be opened as part of normal operations, ventilation shall be provided in accordance with Section 518.1.6 (*Indoor dispensing and use -- points sources*).

**518.1.8 Ventilation during construction.** Ventilation shall be provided for operations involving the application of materials containing flammable solvents in the course of construction, alteration or demolition of a structure.

**518.2 Hazardous materials -- requirements for specific hazardous materials.** Exhaust ventilation systems for specific hazardous materials shall be provided as required in Section 518.1.1 (*General Requirements*) and Sections 518.2.1 (*Compressed gases medical gas systems*) through 518.2.8 (*Highly toxic and toxic compressed gases – quantities exceeding the maximum allowable per control area*).

**518.2.1 Compressed gases medical gas systems.** Rooms for the storage of compressed medical gases in amounts exceeding the maximum allowable exempt quantity per control area, and which do not have an exterior wall, shall be exhausted through a duct to the exterior of the building. Both separate airstreams shall be enclosed in a 1-hour-rated shaft enclosure from the room to the exterior. Approved mechanical ventilation shall be provided at a minimum rate of 1 cfm/ft<sup>2</sup> [0.00508 m<sup>3</sup>/(s·m<sup>2</sup>)] of the area of the room. Gas cabinets for the storage of compressed medical gases in amounts exceeding the maximum

allowable quantity per control area shall be connected to an exhaust system. The average velocity of ventilation at the face of access ports or windows shall be not less than 200 feet per minute (1.02 m/s) with a minimum velocity of 150 feet per minute (0.76m/s) at any point at the access port or window.

**Exception:** All ventilation requirements of the latest edition of the NFPA 99C “Medical Gas and Vacuum Systems” and the Fire Code shall be adhered to.

**518.2.2 Corrosives.** Where corrosive materials in amounts exceeding the maximum allowable quantity per control area are dispensed or used, mechanical exhaust ventilation in accordance with Section 518.1.6 (*Indoor dispensing and use -- point sources*) shall be provided.

**518.2.3 Cryogenics.** Storage areas for stationary or portable containers of cryogenic fluids in any quantity shall be ventilated in accordance with Section 518.1.1 (*Hazardous materials*). Indoor areas where cryogenic fluids in any quantity are dispensed shall be ventilated in accordance with the requirements of Section 518.1.6 (*Indoor dispensing and use -- point sources*) in a manner that captures any vapor at the point of generation.

**Exception:** All ventilation requirements of the latest edition of the NFPA 99C “Medical Gas and Vacuum Systems” shall be adhered to.

**518.2.4 Explosives.** Squirrel cage blowers shall not be used for exhausting hazardous fumes, vapors or gases in operating buildings and rooms for the manufacture, assembly or testing of explosives. Only nonferrous fan blades shall be used for fans located within the ductwork and through which hazardous materials are exhausted. Motors shall be located outside the duct.

**518.2.5 Flammable and combustible liquids.** Exhaust ventilation systems shall be provided as required by Sections 518.2.5.1 (Vaults) through 518.2.5.5 (*Bulk plants or terminals*) for the storage, use, dispensing, mixing and handling of flammable and combustible liquids. Unless otherwise specified, this section shall apply to any quantity of flammable and combustible liquids.

**Exception:** This section shall not apply to flammable and combustible liquids that are exempt from the Fire Code.

**518.2.5.1 Vaults.** Vaults that contain tanks of Class I liquids shall be provided with continuous ventilation at a rate of not less than 1 cfm/ft<sup>2</sup> of floor area [0.00508 m<sup>3</sup>/(s·m<sup>2</sup>)], but not less than 150 cfm (4m<sup>3</sup>/min). Failure of the exhaust airflow shall automatically shut down the dispensing system. The exhaust system shall be designed to provide air movement across all parts of the vault floor. Supply and exhaust ducts shall extend to a point not greater than 12 inches (305 mm) and not less than 3 inches (76 mm) above the floor. The exhaust system shall be installed in accordance with the provisions of NFPA 91. Means shall be provided to automatically detect any flammable vapors and

to automatically shut down the dispensing system upon detection of such flammable vapors in the exhaust duct at a concentration of 25 percent of the LFL.

**518.2.5.2 Storage rooms and warehouses.** Liquid storage rooms and liquid storage warehouses for quantities of liquids exceeding those specified in the International Fire Code shall be ventilated in accordance with Section 518.1.2 (*Storage in excess of the maximum allowable quantities*).

**518.2.5.3 Cleaning machines.** Areas containing machines used for parts cleaning in accordance with the Fire Code shall be adequately ventilated to prevent accumulation of vapors.

**518.2.5.4 Use, dispensing, and mixing.** Continuous mechanical ventilation shall be provided for the use, dispensing and mixing of flammable and combustible liquids in open or closed systems in amounts exceeding the maximum allowable quantity per control area and for bulk transfer and process transfer operations. The ventilation rate shall be not less than 1 cfm/ft<sup>2</sup> [0.00508m<sup>3</sup>/(s·m<sup>2</sup>)] of floor area over the design area. Provisions shall be made for the introduction of makeup air in a manner that will include all floor areas or pits where vapors can collect. Local or spot ventilation shall be provided where needed to prevent the accumulation of hazardous vapors.

**Exception:** Where natural ventilation can be shown to be effective for the materials used, dispensed, or mixed.

**518.2.5.5 Bulk plants or terminals.** Ventilation shall be provided for portions of properties where flammable and combustible liquids are received by tank vessels, pipelines, tank cars or tank vehicles and which are stored or blended in bulk for the purpose of distributing such liquids by tank vessels, pipelines, tank cars, tank vehicles or containers as required by this section.

**518.2.5.5.1 General.** Ventilation shall be provided for rooms, buildings and enclosures in which Class I liquids are pumped, used or transferred. Design of ventilation systems shall consider the relatively high specific gravity of the vapors. Where natural ventilation is used, adequate openings in outside walls at floor level, unobstructed except by louvers or coarse screens, shall be provided. Where natural ventilation is inadequate, mechanical ventilation shall be provided.

**518.2.5.5.2 Basements and pits.** Class I liquids shall not be stored or used within a building having a basement or pit into which flammable vapors can travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.

**518.2.5.5.3 Dispensing of Class I liquids.** Containers of Class I liquids shall not be drawn from or filled within buildings unless a provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical

ventilation is required, it shall be kept in operation while flammable vapors could be present.

**518.2.6 Highly toxic and toxic liquids.** Ventilation exhaust shall be provided for highly toxic and toxic liquids as required by this section.

**518.2.6.1 Treatment system.** This provision shall apply to indoor and outdoor storage and use of highly toxic and toxic liquids in amounts exceeding the maximum allowable quantities per control area. Exhaust scrubbers or other systems for processing vapors of highly toxic liquids shall be provided where a spill or accidental release of such liquids can be expected to release highly toxic vapors at normal temperature and pressure.

**518.2.6.2 Open and closed systems.** Mechanical exhaust ventilation shall be provided for highly toxic and toxic liquids used in open systems in accordance with Section 518.1.6 (*Indoor dispensing and use -- point sources*). Mechanical exhaust ventilation shall be provided for highly toxic and toxic liquids used in closed systems in accordance with Section 518.1.7 (*Closed systems*).

**Exception:** Liquids or solids that do not generate highly toxic or toxic fumes, mists or vapors.

**518.2.7 Highly toxic and toxic compressed gases -- any quantity.** Ventilation exhaust shall be provided for highly toxic and toxic compressed gases in any quantity as required by this section.

**518.2.7.1 Gas cabinets.** Gas cabinets containing highly toxic or toxic compressed gases in any quantity shall comply with Section 518.1.4 (*Gas rooms exhausted enclosures and gas cabinets*) and the following requirements:

- (1) The average ventilation velocity at the face of gas cabinet access ports or windows shall be not less than 200 feet per minute (1.02 m/s) with a minimum velocity of 150 feet per minute (0.76 m/s) at any point at the access port or window.
- (2) Gas cabinets shall be connected to an exhaust system.
- (3) Gas cabinets shall not be used as the sole means of exhaust for any room or area.

**518.2.7.2 Exhausted enclosures.** Exhausted enclosures containing highly toxic or toxic compressed gases in any quantity shall comply with Section 518.1.4 (*Gas rooms exhausted enclosures and gas cabinets*) and the following requirements:

- (1) The average ventilation velocity at the face of the enclosure shall be not less than 200 feet per minute (1.02 m/s) with a minimum velocity of 150 feet per minute (0.76 m/s).

- (2) Exhausted enclosures shall be connected to an exhaust system.
- (3) Exhausted enclosures shall not be used as the sole means of exhaust for any room or area.

**518.2.8 Highly toxic and toxic compressed gases -- quantities exceeding the maximum allowable per control area.** Ventilation exhaust shall be provided for highly toxic and toxic compressed gases in amounts exceeding the maximum allowable quantities per control area as required by this section.

**518.2.8.1 Ventilated areas.** The room or area in which indoor gas cabinets or exhausted enclosures are located shall be provided with exhaust ventilation. Gas cabinets or exhausted enclosures shall not be used as the sole means of exhaust for any room or area.

**518.2.8.2 Local exhaust for portable tanks.** A means of local exhaust shall be provided to capture leakage from indoor and outdoor portable tanks. The local exhaust shall consist of portable ducts or collection systems designed to be applied to the site of a leak in a valve or fitting on the tank. The local exhaust system shall be located in a gas room. Exhaust shall be directed to a treatment system where required by the Fire Code.

**518.2.8.3 Piping and controls -- stationary tanks.** Filling or dispensing connections on indoor stationary tanks shall be provided with a means of local exhaust. Such exhaust shall be designed to capture fumes and vapors. The exhaust shall be directed to a treatment system where required by the Fire Code.

**518.2.8.4 Gas rooms.** The ventilation system for gas rooms shall be designed to operate at a negative pressure in relation to the surrounding area. The exhaust ventilation from gas rooms shall be directed to an exhaust system.

**518.2.8.5 Treatment system.** The exhaust ventilation from gas cabinets, exhausted enclosures and gas rooms, and local exhaust systems required in Sections 518.2.8.2 (*Local exhaust for portable tanks*) and 518.2.8.3 (*Piping and controls – stationary tanks*) shall be directed to a treatment system where required by the Fire Code.

**518.2.8.6 Process equipment.** Effluent from indoor and outdoor process equipment containing highly toxic or toxic compressed gases, which could be discharged to the atmosphere, shall be processed through an exhaust scrubber or other processing system. Such systems shall be in accordance with the Fire Code.

**519.0 Hazardous Exhaust Ducts.** Fire dampers shall comply with Section 606.0 of this Code.

**520.0 Listed Recirculating Hoods.** Listed recirculation hoods are subject to approval by the administrative authority having jurisdiction.

**521.0 Smoke Control Systems.**

**521.1 Scope and purpose.** This section applies to mechanical and passive smoke control systems that are required by the International Building Code. 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 International Building Code.

**521.2 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 International Building Code 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.

**521.3 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 International Building Code 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 1704 of the International Building Code.

**521.4 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 521.4.1 through 521.4.6.

**521.4.1 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.

**521.4.2 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.

**521.4.3 Wind effect.** The design shall consider the adverse effects of wind. Such consideration shall be consistent with the wind-loading provisions of the International Building Code.

**521.4.4 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.

**521.4.5 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.

**521.4.6 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.

**521.5 Smoke barrier construction.** Smoke barriers shall comply with the International Building Code. 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 (m<sup>2</sup>).

A<sub>F</sub> = Unit floor or roof area of barrier, square feet (m<sup>2</sup>).

A<sub>w</sub> = Unit wall area of barrier, square feet (m<sup>2</sup>).

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.

**521.5.1 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.



**521.5.2 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 International Building Code 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 International Building Code.
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.

**521.5.2.1 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 International Building Code.

**521.6 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.

**521.6.1 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.

**521.6.2 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 International Building Code. 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:

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

where:

- A = Door area, square feet (m<sup>2</sup>).
- d = Distance from door handle to latch edge of door, feet (m).
- F = Total door opening force, pounds (N).
- F<sub>dc</sub> = Force required to overcome closing device, pounds (N).
- K = Coefficient 5.2 (1.0).
- W = Door width, feet (m).
- DP = Design pressure difference, inches (Pa) water gage.

**521.7 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.

**521.7.1 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<sub>f</sub> = Temperature of smoke, °F (K).
- T<sub>o</sub> = Temperature of ambient air, °F (K).
- v = Air velocity, feet per minute (m/minute).

**521.7.2 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 521.7.1 requires airflow to exceed this limit, the airflow method shall not be used.

**521.8 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.

**521.8.1 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.

**521.9 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 521.4 and this section.

**521.9.1 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.

**521.9.2 Design fire fuel.** Determination of the design fire shall include consideration of the type of fuel, fuel spacing and configuration.

**521.9.3 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.

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

**521.10 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.

**521.10.1 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:

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

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<sub>c</sub> = Convective heat output of fire, Btu/s (kW).
- T<sub>a</sub> = Ambient temperature, °F (K).
- T<sub>s</sub> = Smoke temperature, °F (K).

**Exception:** Reduced T<sub>s</sub> as calculated based on the assurance of adequate dilution air.

**521.10.2 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 521.10.1. 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.

**521.10.3 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.

**521.10.4 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.

**521.10.5 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 International Building Code. 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.

**521.11 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 the Electrical Code. 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 the Electrical Code.

**521.11.1 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.

**521.12 Detection and control 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 International Building Code 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.

**521.12.1 Wiring.** In addition to meeting the requirements of the Electrical Code, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways.

**521.12.2 Activation.** Smoke control systems shall be activated in accordance with the International Building Code.

**521.12.3 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 Section 903.3.1.1 of the International Fire Code or from manual controls that are readily accessible to the fire department, and any smoke detectors required by engineering analysis.

**521.13 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.

**521.13.1 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.

**521.13.2 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.

**521.13.3 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.

**521.14 Marking and identification.** The detection and control systems shall be clearly marked at all junctions, accesses and terminations.

**521.15 Control diagrams.** Identical control diagrams shall be provided and maintained as required by the International Fire Code.

**521.16 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 International Fire Code.

**521.17 System response time.** Smoke control system activation shall comply with the International Fire Code.

**521.18 Acceptance testing.** Devices, equipment, components and sequences shall be tested in accordance with the International Fire Code.

**521.19 System acceptance.** Acceptance of the smoke control system shall be in accordance with the International Fire Code.

**604.4 Protection of Ducts.** Ducts installed in locations where they are exposed to mechanical damage by vehicles or from other causes shall be protected by approved barriers.

**Exception:** A nonmetallic plenum, when protected from the weather, shall be attached to a coil or furnace with a hard cast system. A nonmetallic plenum, when exposed to the weather, shall be attached to a coil for furnace with a waterproof hard cast system or its equivalent.

#### **604.5 Attachment of Ducts.**

**604.5.1** A duct shall be cut flush with the top sides of ceiling materials or with the back side of wall materials and held in place with a metal angle assembly of one inch by one inch 26 gauge steel attached to the duct on all four sides. A grill assembly shall be attached to the angle assembly in accordance with product listing and shall be airtight.

**604.5.2** A flexible duct shall be attached to an approved adapter bucket in accordance with the product listing. Each bucket shall be firmly attached to a joist, stud, or grid with one inch by one inch 26 gauge steel angles on at least two sides of the bucket.

**605.0 Installation of Ducts.** All supply and return air ducts and plenums located within indirectly conditioned spaces shall be insulated with a minimum R-3.5 insulation to protect against condensation.

**605.1 Conflicts between codes.** When the requirements within the jurisdiction of this mechanical code conflict with the requirements of the International Energy Conservation Code, the most restrictive requirement will apply.

### **606 - DUCT AND TRANSFER OPENINGS**

**606.1 General.** The provisions of this section shall govern the protection of duct penetrations and air transfer openings in assemblies required to be protected.

**606.1.1 Ducts without dampers.** Ducts that penetrate fire-resistance-rated assemblies and are not required by this section to have dampers shall comply with the requirements of Section 712 of the International Building Code.

**606.2 Installation.** Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers located within air distribution and smoke control systems shall be installed in accordance with the requirements of this section, and the manufacturer's installation instructions and listing.

**606.2.1 Smoke control system.** Where the installation of a fire damper will interfere with the operation of a required smoke control system in accordance with Section 521, approved alternative protection shall be utilized.

**606.3 Damper testing and ratings.** Dampers shall be listed and bear the label of an approved testing agency indicating compliance with the standards in this section. Fire dampers shall comply with the requirements of UL 555. Only fire dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire. Smoke dampers shall comply with the requirements of UL 555S. Combination fire/smoke dampers shall comply with the requirements of both UL 555 and UL 555S. Ceiling radiation dampers shall comply with the requirements of UL 555C.

**606.3.1 Fire protection rating.** Fire dampers shall have the minimum fire protection rating specified in Table 606.3.1 for the type of penetration.

**TABLE 606.3.1 FIRE DAMPER RATING**

TYPE OF PENETRATION (hour)	MINIMUM DAMPER RATING
Less than 3-hour fire-resistance-rated assemblies	1 1/2
3-hour or greater fire-resistance-rated assemblies	3

**606.3.1.1 Fire damper actuating device.** The fire damper actuating device shall meet one of the following requirements:

- (1) The operating temperature shall be approximately 50°F (27.8°C) above the normal temperature within the duct system, but not less than 160°F (71°C).
- (2) The operating temperature shall be not more than 286°F (141°C) where located in a smoke control system complying with Section 521.
- (3) Where a combination fire/smoke damper is located in a smoke control system complying with Section 521, the operating temperature rating shall be approximately 50°F (27.8°C) above the maximum smoke control system designed operating temperature, or a maximum temperature of 350°F (177°C). The temperature shall not exceed the UL 555S degradation test temperature rating for a combination fire/smoke damper.



**606.3.2 Smoke damper ratings.** Smoke damper leakage ratings shall not be less than Class II. Elevated temperature ratings shall be not less than 250°F (121°C).

**606.3.2.1 Smoke damper actuation methods.** The smoke damper shall close upon actuation of a listed smoke detector or detectors installed in accordance with Section 606 of this code and Sections 907.10 and 907.11 of the International Building Code and one of the following methods, as applicable:

- (1) Where a damper is installed within a duct, a smoke detector shall be installed in the duct within 5 feet (1524 mm) of the damper with no air outlets or inlets between the detector and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed. Other than in mechanical smoke control systems, dampers shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
- (2) Where a damper is installed above smoke barrier doors in a smoke barrier, a spot-type detector listed for releasing service shall be installed on either side of the smoke barrier door opening.
- (3) Where a damper is installed within an unducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5 feet (1524 mm) horizontally of the damper.
- (4) Where a damper is installed in a corridor wall or ceiling, the damper shall be permitted to be controlled by a smoke detection system installed in the corridor.
- (5) Where a total-coverage smoke detector system is provided within areas served by an HVAC system, dampers shall be permitted to be controlled by the smoke detection system.

**606.4 Access and identification.** Fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts. The access shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly. Access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch (12.7 mm) in height reading: FIRE/SMOKE DAMPER, SMOKE DAMPER or FIRE DAMPER. Access doors in ducts shall be tight fitting and suitable for the required duct construction.

**606.5 Where required.** Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers shall be provided at the locations prescribed in Sections 606.5.1 through 606.5.5. Where an assembly is required to have both fire dampers and smoke dampers, combination fire/smoke dampers or a fire damper and a smoke damper shall be required.

**606.5.1 Fire walls.** Ducts and air transfer openings permitted in fire walls in accordance with Section 705.11 of the International Building Code shall be protected with listed fire dampers installed in accordance with their listing.

**606.5.2 Fire barriers.** Ducts and air transfer openings that penetrate fire barriers shall be protected with listed fire dampers installed in accordance with their listing. Ducts and air transfer openings shall not penetrate exit enclosures and exit passageways except as permitted by Sections 1020.1.2 and 1021.5, respectively, of the International Building Code.

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

1. Penetrations are tested in accordance with ASTM E 119 as part of the fire-resistance-rated assembly.
2. Ducts are used as part of an approved smoke control system in accordance with Section 521 and where the fire damper would interfere with the operation of the smoke control system.
3. Such walls are penetrated by ducted HVAC systems, have a required fire-resistance rating of 1 hour or less, are in areas of other than Group H and are in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 of the International Building Code. For the purposes of this exception, a ducted HVAC system shall be a duct system for the structure's HVAC system. Such a duct system shall be constructed of sheet steel not less than 26 gage [0.0217 inch (0.55 mm)] thickness and shall be continuous from the air-handling appliance or equipment to the air outlet and inlet terminals.

**606.5.3 Fire partitions.** Ducts and air transfer openings that penetrate fire partitions shall be protected with listed fire dampers installed in accordance with their listing.

**Exception:** In occupancies other than Group H, fire dampers are not required where any of the following apply:

1. The partitions are tenant separation or corridor walls in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 of the International Building Code and the duct is protected as a through penetration in accordance with Section 712 of the International Building Code.
2. The partitions are tenant partitions in covered mall buildings where the walls are not required by provisions elsewhere in the International Building Code to extend to the underside of the floor or roof deck above.

3. The duct system is constructed of approved materials in accordance with Section 603 and the duct penetrating the wall complies with all of the following requirements:
  - 3.1. The duct shall not exceed 100 square inches (0.06 m<sup>2</sup>).
  - 3.2. The duct shall be constructed of steel a minimum of 0.0217-inch (0.55 mm) in thickness.
  - 3.3. The duct shall not have openings that communicate the corridor with adjacent spaces or rooms.
  - 3.4. The duct shall be installed above a ceiling.
  - 3.5. The duct shall not terminate at a wall register in the fire-resistance-rated wall.
  - 3.6. A minimum 12-inch-long (305 mm) by 0.060-inch-thick (1.52 mm) steel sleeve shall be centered in each duct opening. The sleeve shall be secured to both sides of the wall and all four sides of the sleeve with minimum 1½-inch by 1½-inch by 0.060-inch (38 mm by 38 mm by 1.52 mm) steel retaining angles. The retaining angles shall be secured to the sleeve and the wall with No. 10 (M5) screws. The annular space between the steel sleeve and the wall opening shall be filled with rock (mineral) wool batting on all sides.

**606.5.4 Corridors/smoke barriers.** A listed smoke damper designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a smoke barrier wall or a corridor enclosure required to have smoke and draft control doors in accordance with the International Building Code. Smoke dampers and smoke damper actuation methods shall comply with Section 606.5.4.1.

**Exceptions:**

1. Smoke dampers are not required in corridor penetrations where the building is equipped throughout with an approved smoke control system in accordance with Section 521 and smoke dampers are not necessary for the operation and control of the system.
2. Smoke dampers are not required in smoke barrier penetrations where the openings in ducts are limited to a single smoke compartment and the ducts are constructed of steel.
3. Smoke dampers are not required in corridor penetrations where the duct is constructed of steel not less than 0.019 inch (0.48 mm) in thickness and there are no openings serving the corridor.

**606.5.4.1 Smoke damper.** The smoke damper shall close upon actuation of a listed smoke detector or detectors installed in accordance with the International Building Code and one of the following methods, as applicable:

1. Where a damper is installed within a duct, a smoke detector shall be installed in the duct within 5 feet (1524 mm) of the damper with no air outlets or inlets between the detector and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed.
2. Where a damper is installed above smoke barrier doors in a smoke barrier, a spot-type detector listed for releasing service shall be installed on either side of the smoke barrier door opening.
3. Where a damper is installed within an unducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5 feet (1524 mm) horizontally of the damper.
4. Where a damper is installed in a corridor wall, the damper shall be permitted to be controlled by a smoke detection system installed in the corridor.
5. Where a total-coverage smoke detector system is provided within all areas served by an HVAC system, dampers shall be permitted to be controlled by the smoke detection system.

**606.5.5 Shaft enclosures.** Shaft enclosures that are permitted to be penetrated by ducts and air transfer openings shall be protected with listed fire and smoke dampers installed in accordance with their listing.

**Exceptions:**

1. Fire dampers are not required at penetrations of shafts where:
  - 1.1. Steel exhaust subducts extend at least 22 inches (559 mm) vertically in exhaust shafts provided that there is a continuous airflow upward to the outdoors;
  - 1.2. Penetrations are tested in accordance with ASTM E 119 as part of the fire-resistance-rated assembly;
  - 1.3. Ducts are used as part of an approved smoke control system in accordance with Section 909 of the International Building Code, and where the fire damper will interfere with the operation of the smoke control system; or

- 1.4. The penetrations are in parking garage exhaust or supply shafts that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.
2. In Group B and R occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 of the International Building Code, smoke dampers are not required at penetrations of shafts where kitchen, clothes dryer, bathroom and toilet room exhaust openings with steel exhaust subducts, having a wall thickness of at least 0.019 inch (0.48 mm) extend at least 22 inches (559 mm) vertically and the exhaust fan at the upper terminus is powered continuously in accordance with the provisions of Section 909.11 of the International Building Code, and maintains airflow upward to the outdoors.
3. Smoke dampers are not required at penetration of exhaust or supply shafts in parking garages that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.
4. Smoke dampers are not required at penetrations of shafts where ducts are used as part of an approved mechanical smoke control system designed in accordance with Section 909 of the International Building Code and where the smoke damper will interfere with the operation of the smoke control system.

**606.6 Horizontal assemblies.** Penetrations by air ducts of a floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall be protected by a shaft enclosure that complies with Section 707 and Sections 716.6.1 through 716.6.3 the International Building Code or shall comply with Sections 606.6.1 through 606.6.3.

**606.6.1 Through penetrations.** In occupancies other than Groups I-2 and I-3, a duct constructed of approved materials in accordance with Section 603 that penetrates a fire-resistance-rated floor/ceiling assembly that connects not more than two stories is permitted without shaft enclosure protection provided that a listed fire damper is installed at the floor line or the duct is protected in accordance with Section 712.4 of the International Building Code. For air transfer openings, see Exception 7 to Section 707.2 of the International Building Code.

**Exception:** A duct is permitted to penetrate three floors or less without a fire damper at each floor provided it meets all of the following requirements.

1. The duct shall be contained and located within the cavity of a wall and shall be constructed of steel not less than 0.019 inch (0.48 mm) (26 gage) in thickness.

2. The duct shall open into only one dwelling unit or sleeping unit and the duct system shall be continuous from the unit to the exterior of the building.
3. The duct shall not exceed 4-inch (102 mm) nominal diameter and the total area of such ducts shall not exceed 100 square inches (0.065 m<sup>2</sup>) for any 100 square feet (9.3 m<sup>2</sup>) of the floor area.
4. The annular space around the duct is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 time-temperature conditions under a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.
5. Grille openings located in a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with a listed ceiling radiation damper installed in accordance with Section 607.6.2.

**606.6.2 Membrane penetrations.** Ducts and air transfer openings constructed of approved materials, in accordance with Section 604, that penetrate the ceiling membrane of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with one of the following:

- (1) A shaft enclosure in accordance with Sections 707 of the International Building Code.
- (2) A listed ceiling radiation damper installed at the ceiling line where a duct penetrates the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly.
- (3) A listed ceiling radiation damper installed at the ceiling line where a diffuser with no duct attached penetrates the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly.

**606.6.2.1 Ceiling radiation dampers.** Ceiling radiation dampers shall be tested in accordance with UL 555C and installed in accordance with the manufacturer's installation instructions and listing. Ceiling radiation dampers are not required where either of the following apply:

- (1) Tests in accordance with ASTM E 119 have shown that ceiling radiation dampers are not necessary in order to maintain the fire-resistance rating of the assembly.
- (2) Where exhaust duct penetrations are protected in accordance with Section 712.4.1.2 of the International Building Code and the exhaust ducts are

located within the cavity of a wall, and do not pass through another dwelling unit or tenant space.

**606.6.3 Nonfire-resistance-rated floor assemblies.** Duct systems constructed of approved materials in accordance with Section 604 that penetrate nonfire-resistance-rated floor assemblies shall be protected by any of the following methods:

- (1) A shaft enclosure in accordance with Section 707 of the International Building Code.
- (2) The duct connects not more than two stories, and the annular space around the penetrating duct is protected with an approved noncombustible material that resists the free passage of flame and the products of combustion.
- (3) The duct connects not more than three stories, and the annular space around the penetrating duct is protected with an approved noncombustible material that resists the free passage of flame and the products of combustion, and a listed fire damper is installed at each floor line.

**Exception:** Fire dampers are not required in ducts within individual residential dwelling units.

**606.7 Flexible ducts and air connectors.** Flexible ducts and air connectors shall not pass through any fire-resistance-rated assembly.

**904.10.3.4** Permanent ladders for equipment access on roofs shall be provided at parapet walls exceeding 30 inches in height.

**1024.1 Licensing Requirements for Steam and Hot-Water Boilers and Piping.** Steam and hot-water boilers and piping shall be installed and maintained according to applicable regulations of the Texas Department of Licensing and Regulations.

**1111.8** Piping shall meet the reference standard for identification in Chapter 17, Part II (*Referenced Standards*). The type of refrigerant, function, and pressure shall be indicated.

**Exception:** Individual split systems being used for human-comfort refrigerant piping need not be identified.

**1404.0 Plans Required.** Plans, engineering calculations, diagrams, and other data shall be submitted in one or more sets with each application for a permit. The authority having jurisdiction may require plans, and specifications to be prepared and designed by an engineer licensed by the state. Permit fees and plan review fees shall be established under a separate ordinance by the City Council.

## **Chapter 18 Specific Appliances, Fireplaces and Solid Fuel-Burning Equipment**

### **1801.0 General.**

**1801.1 Scope.** This chapter shall govern the approval, design, installation, construction, maintenance, alteration and repair of the appliances and equipment specifically identified herein and factory-built fireplaces. The Uniform Plumbing Code shall regulate the installation of natural gas in relationship to gas-fired appliances.

**1801.2 General.** The requirements of this chapter shall apply to the mechanical equipment and appliances regulated by this chapter, in addition to the other requirements of this Code.

**1801.3 Hazardous locations.** Fireplaces and solid fuel burning appliances shall not be installed in hazardous locations.

**1801.4 Fireplace accessories.** Listed fireplace accessories shall be installed in accordance with the conditions of the listing and the manufacturer's installation instructions.

## **1802.0 Masonry Fireplaces.**

**1802.1 General.** Masonry fireplaces shall be constructed in accordance with the Building Code.

## **1803.0 Factory-Built Fireplaces.**

**1803.1 General.** Factory-built fireplaces shall be listed and labeled and shall be installed in accordance with the conditions of the listing. Factory-built fireplaces shall be tested in accordance with UL 127.

**1803.2 Hearth extensions.** Hearth extensions of approved factory-built fireplaces and fireplace stoves shall be installed in accordance with the listing of the fireplace. The hearth extension shall be readily distinguishable from the surrounding floor area.

**1803.3 Unvented gas log heaters.** An unvented gas log heater shall not be installed in a factory-built fireplace unless the fireplace system has been specifically tested, listed and labeled for such use in accordance with UL 127.

## **1804.0 Pellet Fuel-Burning Appliances.**

**1804.1 General.** Pellet fuel-burning appliances shall be listed and labeled and shall be installed in accordance with the terms of the listing.

## **1805.0 Fireplaces Stoves and Room Heaters.**

**1805.1 General.** Fireplace stoves and solid-fuel-type room heaters shall be listed and labeled and shall be installed in accordance with the conditions of the listing. Fireplace stoves shall be tested in accordance with UL 737. Solid-fuel-type room heaters shall be tested in accordance with UL 1482. Fireplace inserts intended for installation in fireplaces shall be listed and labeled in accordance with the requirements of UL 1482 and shall be installed in accordance with the manufacturer's installation instructions.



**1805.2 Connection to fireplace.** The connection of solid fuel appliances to chimney flues serving fireplaces shall comply with Chapter 8 (*Chimneys and Vents*).

## **1806.0 Sauna Heaters.**

**1806.1 Location and protection.** Sauna heaters shall be located so as to minimize the possibility of accidental contact by a person in the room.

**1806.2 Guards.** Sauna heaters shall be protected from accidental contact by an approved guard or barrier of material having a low coefficient of thermal conductivity. The guard shall not substantially affect the transfer of heat from the heater to the room.

**1806.3 Installation.** Sauna heaters shall be listed and labeled and shall be installed in accordance with their listing and the manufacturer's installation instructions.

**1806.4 Access.** Panels, grilles and access doors that are required to be removed for normal servicing operations shall not be attached to the building.

**1806.5 Heat and time controls.** Sauna heaters shall be equipped with a thermostat that will limit room temperature to 194°F (90°C). If the thermostat is not an integral part of the sauna heater, the heat-sensing element shall be located within 6 inches (152 mm) of the ceiling. If the heat-sensing element is a capillary tube and bulb, the assembly shall be attached to the wall or other support, and shall be protected against physical damage.

**1806.6 Timers.** A timer, if provided to control main burner operation, shall have a maximum operating time of 1 hour. The control for the timer shall be located outside the sauna room.

**1806.7 Sauna room.** A ventilation opening into the sauna room shall be provided. The opening shall be not less than 4 inches by 8 inches (102 mm by 203 mm) located near the top of the door into the sauna room.

**1806.8 Warning notice.** The following permanent notice, constructed of approved material, shall be mechanically attached to the sauna room on the outside:

**WARNING: DO NOT EXCEED 30 MINUTES IN SAUNA. EXCESSIVE EXPOSURE CAN BE HARMFUL TO HEALTH. ANY PERSON WITH POOR HEALTH SHOULD CONSULT A PHYSICIAN BEFORE USING SAUNA.**

The words shall contrast with the background and the wording shall be in letters not less than 0.25-inch (6.4 mm) high.

**Exception:** This section shall not apply to one-and two-family dwellings.

## **1807.0 Forced Air Furnaces**

**1807.1 Forced-air furnaces.** Oil-fired furnaces shall be tested in accordance with UL 727. Electric furnaces shall be tested in accordance with UL 1995. Solid fuel furnaces

shall be tested in accordance with UL 391. Forced-air furnaces shall be installed in accordance with the listings and the manufacturer's installation instructions.

**1807.2 Minimum duct sizes.** The minimum unobstructed total area of the outside and return air ducts or openings to a forced-air warm-air furnace shall be not less than 2 square inches per 1,000 Btu/h (4402 mm<sup>2</sup>/kW) output rating capacity of the furnace and not less than that specified in the furnace manufacturer's installation instructions. The minimum unobstructed total area of supply ducts from a forced-air warm-air furnace shall not be less than 2 square inches for each 1,000 Btu/h (4402 mm<sup>2</sup>/kW) output rating capacity of the furnace and not less than that specified in the furnace manufacturer's installation instructions.

**Exception:** The total area of the supply air ducts and outside and return air ducts shall not be required to be larger than the minimum size required by the furnace manufacturer's installation instructions.

**1807.3 Heat pumps.** The minimum unobstructed total area of the outside and return air ducts or openings to a heat pump shall be not less than 6 square inches per 1,000 Btu/h (13,208 mm<sup>2</sup>/kW) output rating or as indicated by the conditions of listing of the heat pump. Electric heat pumps shall be tested in accordance with UL 1995.

**1807.4 Dampers.** Volume dampers shall not be placed in the air inlet to a furnace in a manner that will reduce the required air to the furnace.

**1807.5 Circulating air ducts for forced-air warm-air furnaces.** Circulating air for fuel-burning, forced-air-type, warm-air furnaces shall be conducted into the blower housing from outside the furnace enclosure by continuous airtight ducts.

#### **1808.0 Kerosene and Oil-Fired Stoves.**

**1808.1 General.** Kerosene and oil-fired stoves shall be listed and labeled and shall be installed in accordance with the conditions of the listing and the manufacturer's installation instructions. Kerosene and oil-fired stoves shall comply with NFPA 31. Oil-fired stoves shall be tested in accordance with UL 896.

#### **1809.0 Masonry Heaters.**

**1809.1 General.** Masonry heaters shall be constructed in accordance with the Building Code.

**PART 2.** This ordinance takes effect on \_\_\_\_\_, 2010.

**PASSED AND APPROVED**

\_\_\_\_\_, 2010

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\_\_\_\_\_  
Lee Leffingwell  
Mayor

**APPROVED:** \_\_\_\_\_  
David Allan Smith  
City Attorney

**ATTEST:** \_\_\_\_\_  
Shirley A. Gentry  
City Clerk