2015 IMC® Design, Installation and Inspection Principles

Based on the 2015 International Mechanical Code® (IMC®)

1

1

Contents

- **Welcome**
- Module 1: **Administration and General Regulations** *(Chapters 1-3)*
- Module 2: **Ventilation and Exhaust** *(Chapters 4-6)*
- Module 3: **Venting** *(Chapters 7 and 8)*
- Module 4: **Appliances, Fireplaces, Refrigeration and Piping Systems** *(Chapters 9-14)*

2

Description

This seminar highlights key provisions of the *2015 International Mechanical Code®*. This seminar:

- Provides practice in applying key requirements.
- Reinforces learning by supplying immediate feedback or clarification.
- Walks participants through the content outline of the code book highlights.
- Describes key sections.

3

Goal

Participants will be able to apply key code sections of the 2015 International Mechanical Code to aid in its administration and enforcement while performing their jobs.

4

Objectives

- Upon completion, participants will be better able to:
  - Summarize the purpose and content of each chapter contained in the 2015 IMC®.
  - Describe the intent and application of major sections within the 2015 IMC®.
  - Explain the application of the 2015 IMC® through inspection, plan review and enforcement.

5

Target Audience

- Mechanical inspectors
- Architects
- Building Officials
- Contractors
- Engineers
- Plans examiners

6

Marginal Markings within the codebook

- **Solid vertical lines** indicate a technical change from the requirements of the 2009 edition.
- **Arrows** indicate where a section, paragraph, item in a list, exception or table has been deleted.
- **A single asterisk** [*] indicates that text or a table has been relocated elsewhere in the code.
- **A double asterisk** [**] indicates that the section or table immediately following has been relocated here from a different section.

7

Letter Designations in Front of IBC Section Numbers

- The content of sections that begin with a letter designation is maintained by another code development committee:

[A] = Administrative
[E] = Energy Conservation
[EB] = Existing Building
[F] = Fire
[FG] = Fuel Gas
[M] = Mechanical
[P] = Plumbing

8

Introduction to the 2015 International Mechanical Code

- **Purpose** – Code officials recognize the need for a modern up-to-date mechanical code that addresses the design and installation of mechanical systems through requirements emphasizing performance. The 2015 IMC is designed to meet these needs through model code regulations that safeguard health, safety, property and public welfare internationally.
- **Intent** - The principles utilized in the original development of this code were based on the intent to establish provisions consistent with the scope of a mechanical code that adequately protects public health, safety and welfare.

9

Introduction to the 2015 International Mechanical Code

- **Adoption** – The 2015 IMC is available for adoption and use by jurisdictions internationally. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference in accordance with proceedings establishing the jurisdiction's laws.
- **Maintenance** – The IMC is kept up-to-date through the review of proposed changes submitted by code enforcement officials, industry representatives, design professionals and other interested parties. Proposed changes are carefully considered through an open code development process in which all interested and affected parties may participate.

10

Module 1

Administration and General Regulations

11

Module Introduction

- Chapter 1—Scope and Administration:
  - Provides an introduction to the code
  - Establishes the ground rules for administering a code enforcement program.
  - Identifies the specific mechanical equipment, appliances and systems to which the code is intended to apply.
- Code officials are charged with recognizing and preventing hazards associated with mechanical equipment through enforcing minimum acceptable levels of safety.

12

Module Introduction

- Chapter 2—Definitions:
  - Provides an alphabetical listing of terms that are commonly used throughout the code.
  - Assign specific meanings to words or terms used in the code.
  - Clarify the intent of a requirement.
  - Maintain consistency in code interpretation.
  - Expand or restrict specific code requirements, depending on the specific meaning, contained within the definition.
  - Define terms that are unique to the mechanical trades.

13

Module Introduction

- Chapter 3—General Regulations:
  - Provides requirements for the safe and proper installation of mechanical equipment and appliances with respect to protection of life and property.
  - Requirements are broad in scope
  - Generally apply to equipment and appliances that are also specifically addressed in other chapters.

14

Module Introduction

- The following topics are covered in Chapter 3:
  - Listing and labeling requirements
  - Wind, flood and seismic requirements
  - Appliance location requirements and limitations
  - General installation requirements
  - Protection of structure
  - Mechanical piping support
  - Access and service space requirements
  - Condensate disposal
  - Clearance reduction

15

2015 IMC Chapter 1: Scope and Application

16

Chapter 1: Introduction

- This chapter is largely concerned with maintaining “due process of law” in enforcing the performance criteria contained in the body of the code.
- Chapter 1 is geared toward code officials, design professionals, contractors and building owners.

17

Chapter 1: Introduction

The responsibilities of the various professionals are also established:

- The **code official** reviews the proposed work for code compliance and enforces the code in an unbiased, proper manner.
- The **design professional** designs a safe, operational mechanical system.
- The **contractor** installs the system in strict accordance with the plans and/or manufacturer’s installation requirements.

Every person is guaranteed equal code enforcement.

18

Section 101.2 – General

- Describes the types of mechanical systems for which the code is intended to apply.
- Focuses on heating, ventilating and air conditioning (HVAC) systems.
- Items addressed in the code and items that make a building safe for occupation.

Please note: *One exception directs the user to the International Residential Code® (IRC®) for one- and two-family dwellings and multiple single-family dwellings (townhouses).*

19

Section 101.3 – Intent

- The intent of the code is to set forth requirements that establish the minimum acceptable level to safeguard life or limb, health, property and public welfare. The code does not concern itself with convenience, aesthetics or economics.

20

Section 102 – Applicability

- Administrative provisions for applying the code to the use and installation of all mechanical systems is set forth in this section.

102.2 Existing installations	102.8 Referenced codes and standards
102.3 Maintenance	102.8.1 Conflicts
102.4 Additions, alterations or repairs	102.8.2 Provisions in referenced codes and standards
102.5 Change in occupancy	102.9 Requirements not covered by this code

21

Section 102 – Applicability

- If an office building is converted to a restaurant, the mechanical systems must be altered as necessary to comply with what the code prescribes for such assembly occupancies.
- Outside air may be required for the dining areas, hoods and make up air will be required over the cooking equipment, exhaust ducts may require shaftsor enclosures, these are just a few of the mechanical system issues in such a change of occupancy

22

Section 104 – Duties and Powers of the Code Official

- Interpreting and enforcing code provisions
- Receiving applications and issuing permits
- Issuing notices and orders
- Making required inspections
- Carrying credentials
- Keeping department records
- Preparing annual operations reports

23

Section 105 – Approval

Modifications and consideration of alternatives to code provisions are addressed in this section.

24

105.1 Modifications

- Modifications from the code may be granted when the spirit and intent of the law are observed.

25

105.2 – Alternative materials, methods, equipment and appliances

- The code official is responsible for determining if a requested alternative provides the equivalent level of protection to public property, health, safety and welfare as required by the code.

26

Evaluation Services Reports

- Say some nice stuff, I'm on the PMG ES committee

27

Section 106 – Permits

The administrative rules and procedures concerning the issuance, suspension, revocation or modification of mechanical permits are established for all activities regulated by the code.

28

Section 106 – Permits

- Application for permitting an emergency replacement of critical equipment may be done on the next business day.
- Section 106.1.1 Annual permit.
  - On previously approved installations, an annual permit may be issued for changes to the installation. The work must be done by qualified tradesmen.
- Section 106.1.2 Annual permit records.
  - Detailed records of the changes shall be kept and made available to the AHJ upon request.

29

Annual Permits

- Allows an approved installation to be modified without individual permits for things such as equipment changes in a factory setting
- Requires trained tradesmen preforming the work

30

106.2 – Permits not required

- Permits shall not be required for any of the following:
  - Replacement of any minor part that does not alter approval of equipment or an appliance or make such equipment or appliance unsafe;
  - Portable ventilation appliances and equipment
  - Portable evaporative coolers

31

106.2 – Permits not required

- Permits shall not be required for any of the following:
  - Self-contained refrigeration systems containing 10 lbs or less of refrigerant, or actuated by motors of 1 horsepower or less
  - Portable fuel cell appliances that do not connect to fixed piping systems or the power grid.

32

106.2 – Permits not required

- 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 the jurisdiction.
- The mechanical installations intended to be exempt from the requirement for a permit are very limited, as indicated.

33

Section 106 – Permits

- **106.5 Fees**
  - All fees are to be paid prior to permit issuance.
- **106.5.1 Work commencing before permit issuance**
  - This section is intended to serve as a deterrent to proceeding with work on a mechanical system without a permit.

34

Section 107 – Inspections and Testing

- All portions of the mechanical system are to be inspected before and after the equipment is installed.

The code official has the authority to require all noncomplying installations to be brought into compliance and reinspected.

35

Section 108 - Violations

This section describes the citing, recording and actions to be taken pursuant to observed code violations. All installations, repairs, alterations and maintenance must comply with the code. If not:

- The code official serves notice of the violation.
- If the notice is disregarded, the code official can request legal counsel to initiate legal action.
- The code specifies penalties for noncompliance.
- The imposition of penalties shall not prevent the legal officer from taking appropriate action.

36

Section 108 - Violations

- **108.5 Stop work orders**
- **108.7 Unsafe mechanical systems**
- **108.7.2 Authority to order disconnection of energy sources**

37

Section 109 – Means of Appeal

- Any person has the right to appeal the code official's decision when the following exist:
  - The provisions of the code do not apply
  - A person believes that the code has been incorrectly interpreted or misapplied
  - Application for appeal must be founded in the intent of the code and the equivalency of the alternative method or material

38

Section 110—Temporary Equipment, Systems and Uses

- AHJ can issue a permit for temporary equipment, systems and uses, these permits sunset after 180 days.
- Installations shall meet all required code.
- Equipment, systems or uses can be supplied with utilities at the discretion of the AHJ.
- Used to regulate fireworks stands, Christmas tree lots, haunted houses and similar activities that may require sanitary facilities, electricity and other utilities for a limited time.

39

Chapter 1 Review

Follow the directions in your workbook on page 14 and complete the worksheet.

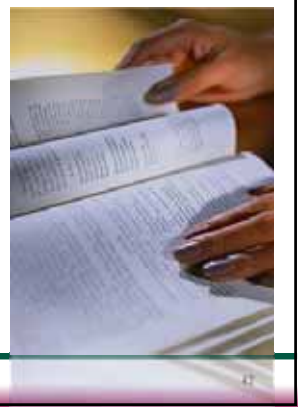
40

2015 IMC Chapter 2: Definitions

41

Chapter 2: Introduction

- Definitions are found both in this chapter and throughout the code. Codes, by their very nature, are technical documents. As such, literally every word, term and punctuation mark can add to or change the meaning of the intended result.



42

Definitions

Significant terms from the 2015 IMC used in this workbook include (definitions new to the 2015 IMC or in ***BOLD ITALIC***) These new definitions are:

- ***Conditioned Space***
- ***Discrete products***
- ***Ductless mini-split systems***
- ***Exfiltration and Infiltration***
- ***Flexible air connector***
- ***Occupational Exposure Limit (OEL)***

43

Conditioned Space

- A greatly enlarged definition that more closely aligns with the energy code
- Provides for indirectly conditioned space by openings, such as archways

44

Discrete products.

- Products that are not part of a piece of listed mechanical equipment, but are part of the mechanical system as a whole.

45

Ductless mini-split system.(mitsubishi web)

46

Exfiltration & Infiltration

- Exfiltration rates are important parts of determining energy efficiency (blower air door testing)
- Infiltration provided enough air to maintain indoor air quality in the past. Modern construction has greatly reduced infiltration, requiring outside air to be introduced.

47

Occupational exposure limit

- The OEL is used to determined required exhaust rates for areas where humans are exposed to chemicals. Total containment may be required in cases of extremely toxic dusts, fumes or vapors.

48

Chapter 2 Review

Follow the directions in your workbook on page 17 and complete the worksheet.

49

2015 IMC Chapter 3: General Regulations

50

Chapter 3: Introduction

- The code depends on a listing and labeling method of approval for appliances and equipment, except where approved by the code official.

51

Section 301 – General

Approval and installation of all mechanical systems are regulated by the code.

- **301.3 – Identification**
  - Each length of pipe and tubing, and each pipe fitting installed in a mechanical system, must have a unique mark that identifies the maker of the item.
- **301.4 - Plastic pipe, fittings and components**
  - Plastic pipe, fittings and components must be third-party certified as conforming to NSF 14.

52

Section 301 - General

- **301.5 - Third-party testing and certification**
  - Piping, tubing and fittings must comply with the applicable referenced standards, specifications and performance criteria of the IMC. Piping, tubing and fittings must comply with the applicable referenced standards, specifications and performance criteria of the IMC.

53

Section 301 - General

- **301.5 - Third-party testing and certification**
  - Third-party certified indicates that the minimum level of quality required by the applicable standard is maintained and the product is often referred to as "listed." Third-party tested indicates a product that has been tested by an approved laboratory and found to be in compliance with the standard.

54

Section 301 - General

- **301.7 – Listed and labeled**
  - The code intends to require listing and labeling for appliances, such as boilers, furnaces, condensing units, factory-built fireplaces, direct-fired heaters, cooking appliances, rooftop HVAC units, etc.

55

Section 302 – Protection of Structure

Installation of mechanical systems must not adversely affect the structural and fire-resistance integrity of building components. The cutting, notching and drilling of structural members, and the penetration of assemblies must be regulated to control the damage.

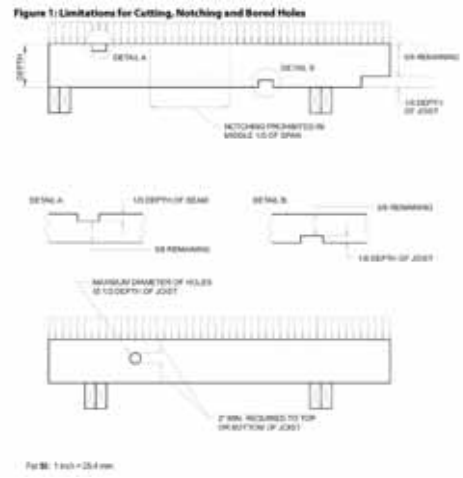
56

Section 302 – Protection of Structure

- **302.3 – Cutting, notching and boring in wood framing**
  - Holes bored for pipes or cable must not be within 2 inches (51 mm) of the top or bottom of the wood joist.

57

302.3 – Cutting, notching and boring in wood framing



58

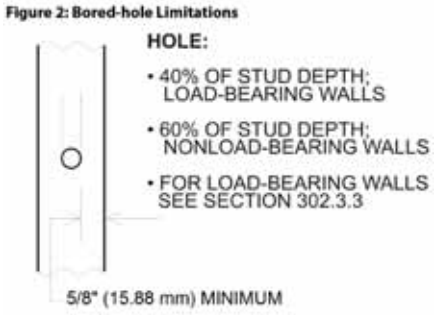
Section 302 – Protection of Structure

- **302.3.3 – Bored holes**
  - Cutting, notching and boring holes in joists and studs reduces the strength of the member.

59

Bored holes in studs located in load-bearing and exterior walls must not exceed 40 percent of the stud depth.

Studs in nonload-bearing walls must not have bored holes that exceed 60 percent of the depth of the stud. A bored-hole's edge must not be less than 5/8 inch away from a stud edge.



60

Section 302 – Protection of Structure

- **302.3.4 – Engineered wood products**
  - The code prohibits cuts, notches and holes in trusses, structural composite veneer lumber, structural glue-laminated members and I-joists except where such alterations were considered in the design of the member.

61

Section 303 – Equipment and Appliance Location

- Mechanical systems and their components must be located as indicated by the manufacturer's installation instructions for the listed equipment or appliances.
- Limits the location of fuel-fired appliances in specific rooms or spaces.

62

Section 303 – Equipment and Appliance Location

- **303.2 – Hazardous locations**
  - A hazardous location does not necessarily warrant classification as a high-hazard use group in accordance with the building code.

63

Section 303 – Equipment and Appliance Location

- **303.3 – Prohibited locations**
  - Fuel-fired appliances shall not be located in, or obtain combustion air from, any of the following rooms or spaces:
    - Sleeping rooms
    - Bathrooms
    - Toilet rooms
    - Storage closets
    - Surgical rooms

64

Section 303 – Equipment and Appliance Location

- **303.4 – Protection from damage**
  - Potential damage includes impact from occupants, vehicles, stored materials and operations that occur in an occupancy. Barriers must be approved and strong enough to resist the type of impact anticipated.

65

Section 303 – Equipment and Appliance Location

- **303.5 – Indoor locations**
  - Fuel-fired furnaces, water heaters and boilers must be either listed for closet/alcove installation or the space or room must have the minimum specified volume.

66

Section 304 – Installation

- All equipment and appliances must comply with the code and manufacturer's installation instructions.

67

Section 304 – Installation

- **304.2 – Conflicts**
  - Although very rare, there are instances where some code provisions intentionally differ or conflict with manufacturer's installation instructions. It is not the intent of this section to cause the manufacturer's requirements to be ignored where such requirements are more stringent or restrictive than the code.

68

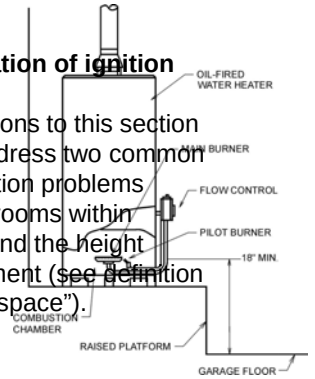
Section 304 – Installation

- **304.3 – Elevation of ignition source**
  - This section will effectively prohibit the installation of most furnaces, boilers, space heaters, clothes dryers and water heaters directly on the floor of residential garages and other occupancies where flammable or combustible vapors may be present.

69

Section 304 – Installation

- **304.3 – Elevation of ignition source**
  - Text revisions to this section clearly address two common interpretation problems involving rooms within garages and the height measurement (see definition of “Living space”).



70

Section 304 – Installation

- **304.5 – Hydrogen generating and refueling operations**
  - Spaces, such as public or private garages and automotive motor fuel-dispensing stations, containing hydrogen generating appliances or refueling systems must be ventilated by either mechanical or natural ventilation to prevent the accumulation of highly flammable hydrogen gas.

71

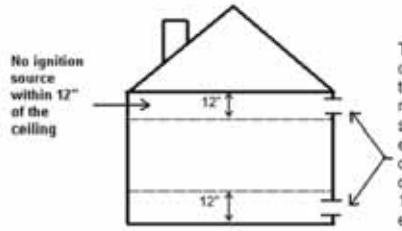
Section 304 – Installation

- **304.5 – Hydrogen generating and refueling operations**
  - This section is revised to delete the limitation of three vehicles that can be located in such spaces.

72

Section 304 – Installation

Figure 4: Hydrogen Generating



Two openings directly communicating with the outdoors are required in the same wall - one entirely within 12" of the ceiling and one entirely within 12" of the floor, each having a minimum area of 0.5 sq. ft. per 1,000 cu. ft. of garage volume

SI: 1 inch =25.4 mm 1 cubic foot = .02832 m³
1 square foot = 0.0929 m²

73

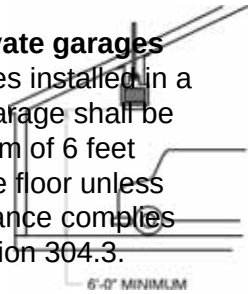
Section 304 – Installation

- **304.6 – Public garages**
  - The height of an appliance above the floor of public garage will now be determined by the height of the access door.

74

Section 304.7 Private garages

- **304.7 – Private garages**
  - Appliances installed in a private garage shall be a minimum of 6 feet above the floor unless the appliance complies with Section 304.3.



75

Section 304 – Installation

- **304.9 – Clearances to combustible construction**
  - Reduction of the required clearances to combustibles is allowed only where the combustibles are protected by one of the methods outlined in Section 308, and clearance reduction is not prohibited by Section 308 or the appliance and equipment listing.

76

Section 304 – Installation

- **304.9 – Clearances to combustible construction**
  - Clearances to combustibles also apply to furnishings, window treatments and moveable components.

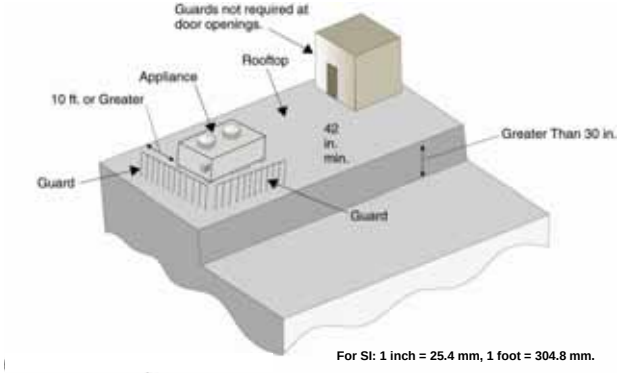
77

Section 304 – Installation

- **304.11 – Guards**
  - Guards are required to provide protection for personnel working on or servicing equipment, appliances or components that are within 10 feet (3048 mm) of a roof edge or surface that is more than 30 inches (762 mm) above the surface below.

78

Section 304.11 Guards



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

79

Section 304.11 Guards

- **Exception:** Guards are not required where permanent fall arrest/restraint anchorage connector devices that comply with ANSI/ASSE Z359.1 are affixed for use during the entire roof covering lifetime.
- The devices shall be re-evaluated for possible replacement when the entire roof covering is replaced.
- The devices shall be placed not more than 10 feet (3048 mm) on center along hip and ridge lines and placed not less than 10 feet (3048 mm) from the roof edge or open side of the walking surface.

80

Section 304 – Installation

- **304.12 – Area served**
  - In the event of an emergency or the need for repair or servicing, appliances must be easily identifiable as to the area served.

81

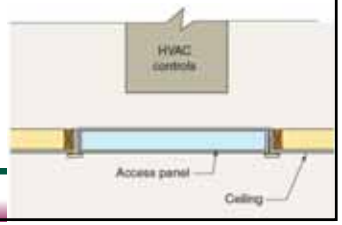
Section 305 – Piping Support

- Piping systems, including refrigerant, and fuel oil, must be supported in accordance with section requirements.
- Support of the system is as important as any other part of the overall design.
- Piping in concealed locations, other than cast-iron or steel that is installed through holes or notches in structural members, must be protected by steel shield plates to prevent damage

82

Section 306 – Access and Service Space

- Appliances, controls devices, heat exchangers and HVAC system components that utilize energy shall be accessible for inspection, service, repair and replacement.
- This allows access to all parts of a mechanical system without damaging or disconnection obstructions



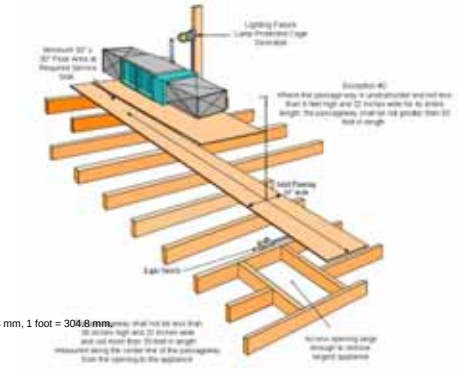
83

Section 306 – Access and Service Space

- **306.1.1 – Central furnaces**
  - The specified minimum clearances apply even though the manufacturer's instructions might permit less clearance.
- **306.3 – Appliances in attics**
  - Requires a suitable access opening, passageway and work space that will allow reasonably easy access without endangering the service person.

84

Section 306.3 – Appliances in attics



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

85

Section 306 – Access and Service Space

- **306.4 – Appliances under floors**
  - The access passageway to the appliances can be extended to unlimited length under floors, if the passageway has a minimum height of 6 feet and width of 22 inches for the entire length.

86

Section 306 – Access and Service Space

- **306.4.1 – Electrical requirements**
  - This section requires that a switched light be located at the required passageway opening and an outlet be provided at or near the appliance in accordance with the NFPA 70.

87

Section 306 – Access and Service Space

- **306.5 – Equipment and appliances on roofs or elevated structures**
  - This section intends to prevent portable ladders from being the only means of access to appliances located more than 16 feet (4877 mm) above grade or roof surface. Specific requirements for permanent ladders and catwalks are provided.

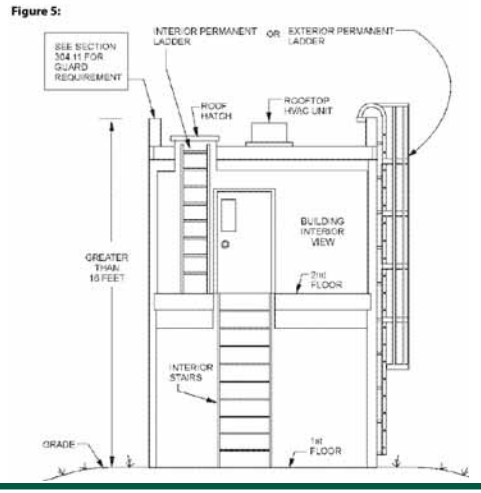
88

Section 306 – Access and Service Space

- **306.5 – Equipment and appliances on roofs or elevated structures**
  - This section provides a permanent means of access for equipment or appliances that are located on a roof or elevated structure.
  - Once it is determined that a permanent means of access is required, even if a roof hatch is provided inside the building, a permanent ladder to the roof hatch would be required.

89

This means that just about every two story building will require a permanent means of access.



90

Section 306 – Access and Service Space

- **306.5.1 – Sloped roofs**
  - Section intends to include equipment such as kitchen exhaust and makeup air fans that require routine servicing to be provided with platform and guards.

91

Section 307 – Condensate Disposal

Requirements are prescribed for the disposal of condensate from appliances and equipment, such as evaporators, cooling coils and condensing fuel-fired appliances.

92

Section 307 – Condensate disposal

- Condensate from all cooling coils and evaporators shall be conveyed from the drain pan outlet to an *approved* place of disposal.
- Condensate shall not discharge into a street, alley or other areas so as to cause a nuisance.

93

Section 307 – Condensate disposal

- **307.1 – Fuel-burning appliances**
  - Condensation must be collected in accordance with manufacturer's installation instructions and this section.
- **307.2.1 – Condensate disposal**
  - Prohibits condensate drains from directly connecting to a sanitary sewer.
  - Must be approved by jurisdiction based on sewage treatment capacity, sewer loading, etc.

94

Section 307 – Condensate disposal

- **307.2.2 – Drain pipe materials and sizes**
  - Must be constructed of corrosion-resistant materials.
  - All horizontal sections of drain piping must be installed in uniform alignment at a uniform slope.

95

Section 307 – Condensate disposal

- **307.2.2 – Drain pipe materials and sizes**

TABLE 307.2.2
CONDENSATE DRAIN SIZING

EQUIPMENT CAPACITY	MINIMUM CONDENSATE PIPE DIAMETER
Up to 20 tons of refrigeration	$^3/_4$ inch
Over 20 tons to 40 tons of refrigeration	1 inch
Over 40 tons to 90 tons of refrigeration	$1^1/_4$ inch
Over 90 tons to 125 tons of refrigeration	$1^1/_2$ inch
Over 125 tons to 250 tons of refrigeration	2 inch

1 inch = 25.4 mm, 1 ton = 3.517 kW.

96

Section 307 – Condensate disposal

- **307.2.3 – Auxiliary and secondary drain system**
  - Required for equipment and appliance locations where condensate overflow would cause damage to a building or its contents.
  - Requirement added for drain pans under fuel-fired appliances that produce condensate with an exception for appliances that shut down when a blockage occurs in the condensate drain system.

97

307.2.3 – Auxiliary and secondary drain system

Fourth method of preventing pan overflow has been added which uses a water level detection device

98

Section 307 – Condensate disposal

- **307.2.3.1 – Water-level monitoring devices**
  - This subsection adds a requirement for rooftop package units and other coils with no secondary drain pan to have a water level detection device installed in the primary drain pan to shut down the appliance.

99

Section 307 – Condensate disposal

- **307.2.3.2 – Appliance, equipment and insulation in pans**
- Requires portions of appliances that must be:
  - supported within the drain pan to be corrosion resistant
  - requires insulation or components that could be damaged by water to be located above the flood rim level of the pan.

100

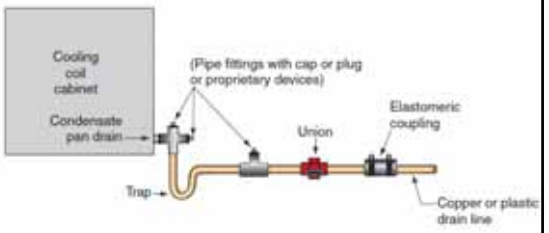
Section 307 – Condensate disposal

- **307.2.3.4 – Traps**
  - The traps addressed in this section are unrelated to plumbing traps and serve a different purpose.
  - Condensate drain traps must not directly connect in any way to the plumbing drainage waste and venting system of a building.

101

307.2.5 Drain line maintenance

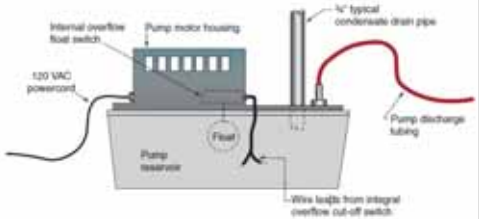
- Drains that convey condensate water from cooling coils and evaporators are known to develop blockages as a result of debris and biological growth in the system.
- These drains are commonly cleared of blockages by a compressed gas such as air or nitrogen being forced through the drain.



102

307.3 Condensate pumps

- Requires the installation of condensate pumps that have overflow shutoff capability and requires that the appliance/equipment served be connected to take advantage of that feature.



103

Section 308 – Clearance Reduction

Heat-producing appliances and mechanical equipment must be installed in accordance with the required minimum clearances to combustible materials indicated on the label.

104

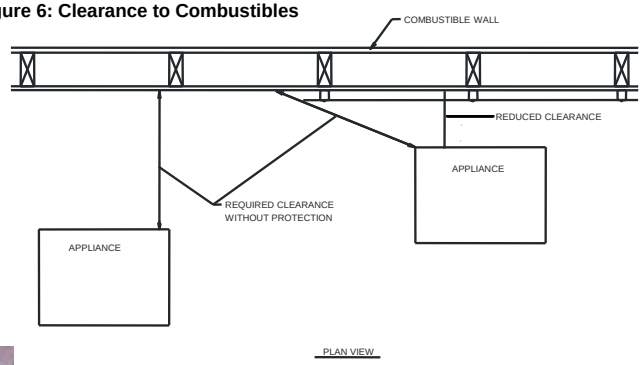
Section 308 – Clearance Reduction

- **308.2 – Listed appliances and equipment**
  - Manufacturer's instructions or label for many appliances will state an absolute minimum clearance, regardless of any clearance reduction method used.
  - Such clearance requirements take precedence over those allowed in Table 308.6.

105

Section 308 Clearance Reduction

Figure 6: Clearance to Combustibles



106

Table 308.4.2 Clearance reduction methods

- Type of Protective Assembly
- Reduced Clearance with Protection (inches)

107

TABLE 308.4.2
CLEARANCE REDUCTION METHODS[a]

TYPE OF PROTECTIVE ASSEMBLY[b]	REDUCED CLEARANCE WITH PROTECTION (inches)[c]							
	Horizontal combustible assemblies located above the heat source				Horizontal combustible assemblies located beneath the heat source and all vertical combustible assemblies			
	Required clearance to combustibles without protection (inches)[c]				Required clearance to combustibles without protection (inches)			
	36	18	9	6	36	18	9	6
Galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), mounted on 1 inch glass fiber or mineral wool batt reinforced with wire on the back, 1 inch off the combustible assembly	18	9	5	3	12	6	3	3
Galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), spaced 1 inch off the combustible assembly	18	9	5	3	12	6	3	2
Two layers of galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), having a 1 inch airspace between layers, spaced 1 inch off the combustible assembly	18	9	5	3	12	6	3	3
Two layers of galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), having 1 inch of fiberglass insulation between layers, spaced 1 inch off the combustible assembly	18	9	5	3	12	6	3	3
0.5-inch lowspeed insulating board, over 1 inch of fiberglass or mineral wool batt, against the combustible assembly	24	12	6	4	18	9	5	3
3½-inch brick wall, spaced 1 inch off the combustible wall	—	—	—	—	12	6	6	6
3½-inch brick wall, against the combustible wall	—	—	—	—	24	12	6	5

For SI: 1 inch = 25.4 mm, °C = [(°F)-32]/1.8, 1 pound per cubic foot = 16.02 kg/m³, 1.0 Btu • in/(h² • ft² • °F) = 0.144 W/m² • K.

a. Mineral wood and glass fiber batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1,500°F. Insulation material utilized as part of a clearance reduction system shall have a thermal conductivity of 1.0 Btu • in/(h² • ft² • °F) or less. Insulation board shall be formed of noncombustible material.

b. For limitations on clearance reduction for solid fuel-burning appliances, masonry chimneys, connector pass-throughs, masonry fire places and kitchen ducts, see Sections 308.4.2.1 through 308.4.2.5.

108

Section 308 – Clearance Reduction

- **308.4.1 - Labeled assemblies**
  - The allowable clearance reduction shall be based on an approved reduced clearance protective assembly that is listed and labeled in accordance with UL 1618.

109

Section 308 – Clearance Reduction

- **308.4.2.1 – Solid fuel-burning appliances**
- Protection method could be inadequate because of:
  - radiation intensity
  - reradiation
  - inability of the protection method to dissipate the heat energy at the rate received from the appliance.

110

Section 308 – Clearance Reduction

- **308.8 – Masonry chimneys**
- **308.9 – Chimney connector pass-throughs**
- **308.10 – Masonry fireplaces**
- **308.11 – Kitchen exhaust ducts**

111

Section 309 – Temperature Control

- **309.1 – Space-heating systems**
  - For the first time, the IMC has a requirement for space heating in occupied structures. This was previously found only in the *International Property Maintenance Code*® (IPMC®).
  - **Note** that this text is more stringent (68°F) than the IPMC (65°F). The installation of portable heater cannot be used to achieve compliance with this requirement.

112

Section 312 – Heating and Cooling Load Calculations

- **312.1 – Load calculations**
  - Previous editions of the IMC did not specify load calculation methodology. As part of plan review, the designer's load calculation method will have to be verified as being consistent with ASHRAE or other equipment methods.

113

Chapter 3 Review

Follow the directions in your workbook on page 35 and complete the worksheet.

114

Module 2

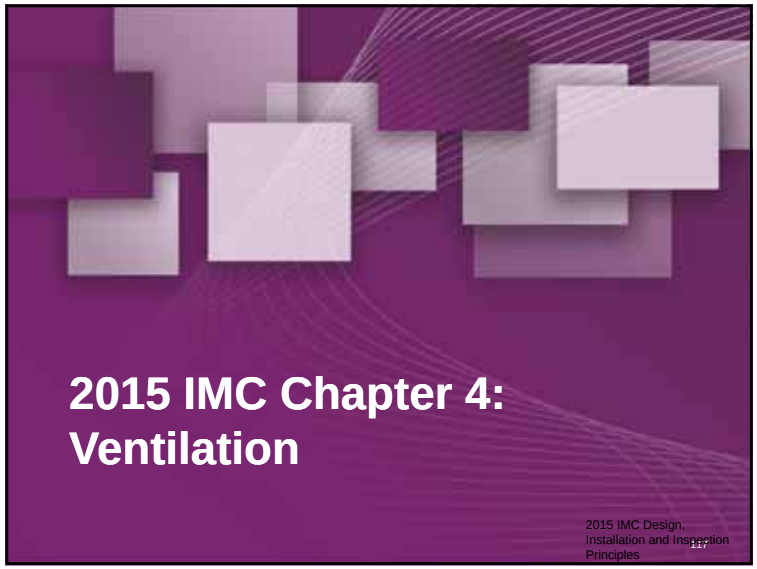
Ventilation and Exhaust

115

Module Introduction

- Module 2 addresses key concepts relative to the air movement for ventilation, exhaust and environmental conditioning.
  - Chapter 4—Ventilation
  - Chapter 5—Exhaust Systems
  - Chapter 6—Duct Systems

116



117

Chapter 4: Introduction

- Ventilation controls air contaminants and moisture.
- Chapter 4 provides requirements for ventilation in buildings intended to be occupied when the space or room in the building is occupied.

118

Section 401 – General

- **401.2 – Ventilation required**
  - Method of ventilation to be provided, mechanical or natural, is the choice of the owner or designer.
  - Method of ventilation to be provided, mechanical or natural, is the choice of the owner or designer.

119

Section 401 – General

- **401.3 – When required**
  - The mechanical ventilation system shall be designed with controls that provide for continuous ventilation air movement during the entire time that the building is occupied.
- **401.4 – Intake opening location**
  - This section includes requirements for outdoor exhaust and intake openings.

120

401.4 Intake openings

- Both this section and Section 501.3.1 addresses exhaust openings. These two sections must be applied in harmony because they both can affect the separation between intakes and exhaust openings.

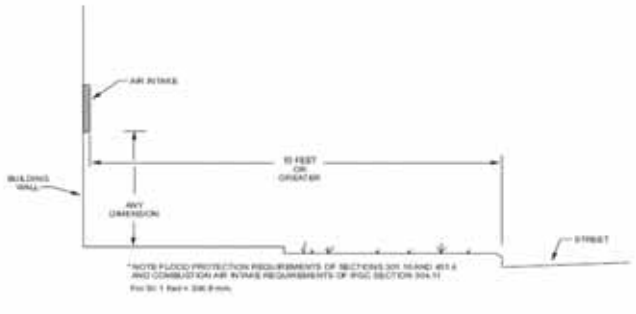
121

401.4 Intake openings

- **Item 1** requires a minimum separation of 10 feet between outdoor air intake openings and any lot lines or buildings on the same lot.
- **Item 2** addresses intake openings that face a street or public way. The 10- foot distance would be measured from the closest edge of a street, alley, parking lot and loading dock.

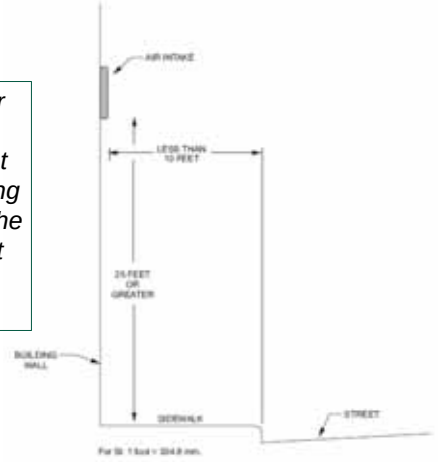
122

Intake openings



123

Mechanical and gravity air intake openings may be located closer than 10 feet from streets, alleys, parking lots and loading docks if the opening is located at least 25 feet vertically above these locations.



124

Section 401 – General

- **401.5 – Outdoor opening protection**
  - Provides specific criteria for various types of opening protection. In hurricane-prone regions, the opening protection must comply with AMCA 550.

125

Section 401 – General

- **401.6 – Contaminant sources**
  - Ducts cannot terminate in attics and crawl spaces
  - Exhaust ducts must connect directly to terminals that pass through the building envelope to the outside atmosphere.
  - ***Examples***: nail salons, indoor firing ranges, internal combustion engine repair shops and painting operations (see Section 502).

126

Section 402 – Natural Ventilation

- Natural ventilation requirements are also found in Section 1203.4 of the IBC.
- Natural ventilation openings must be 4 percent of the floor area being ventilated.
- Bathtubs, showers, spas or similar bathing fixtures must be mechanically ventilated

127

Section 403 – Mechanical Ventilation

- Addresses the mechanical means of ventilation.
- Mechanical ventilation is the alternative to providing natural ventilation.
- Mechanical ventilation systems must also comply with the applicable sections of Chapters 3, 5 and 6 of the code.

128

Section 403 – Mechanical Ventilation

- **403.2 – Outdoor air required**
  - Design professional to demonstrate to the code official that a proposed engineered system will provide air quality at least equivalent to that achievable by the ventilation rate method of Section 403.
  - This section includes a exception that allows a reduction of required outdoor air

129

Section 403 – Mechanical Ventilation

- **403.2.1 – Recirculation of air**
  - Only the ventilation air that is in excess of the required amount is allowed to be recirculated.
  - Table 403.3 prescribes outdoor air only and the occupant load calculation is determined by the table as opposed to the building code.

130

Section 403 – Mechanical Ventilation

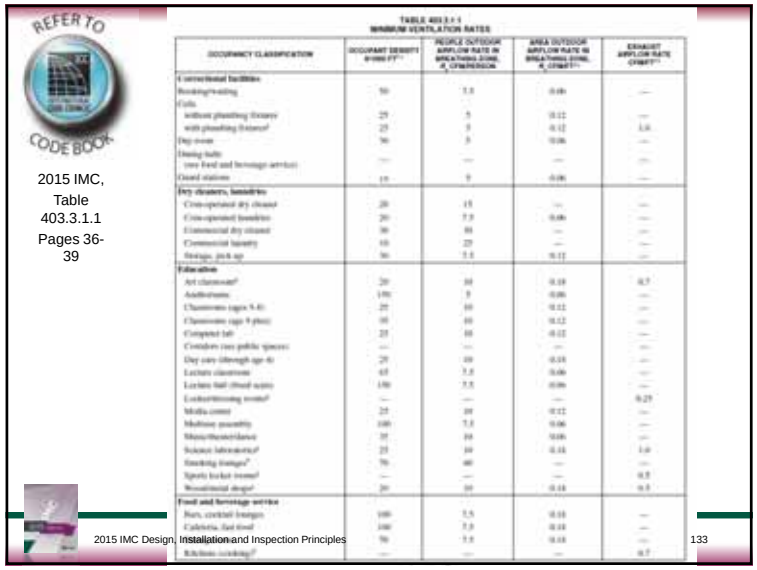
- **403.2.1 – Recirculation of air**
  - The ventilation air amounts specified by Table 403.3 consist of 100-percent outdoor air, none of which can be recirculated except as listed in the 4 exceptions.

131

Recirculation of Air (note b & g)

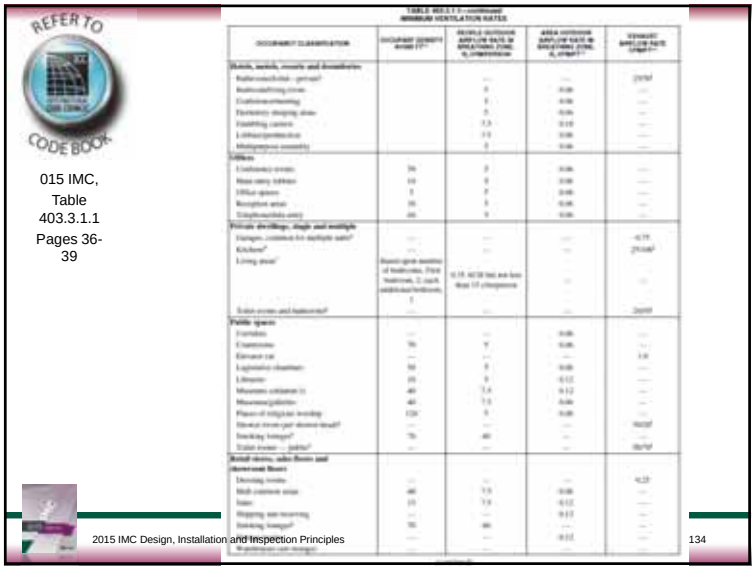
- 403.2.1 exceptions 3 & 4 provide for recirculation of air if it is confined completely to the space. HVAC units must be dedicated exclusively to the space and outside air introduced into the space and exhausted out of the space in quantities prescribed in the table.

132



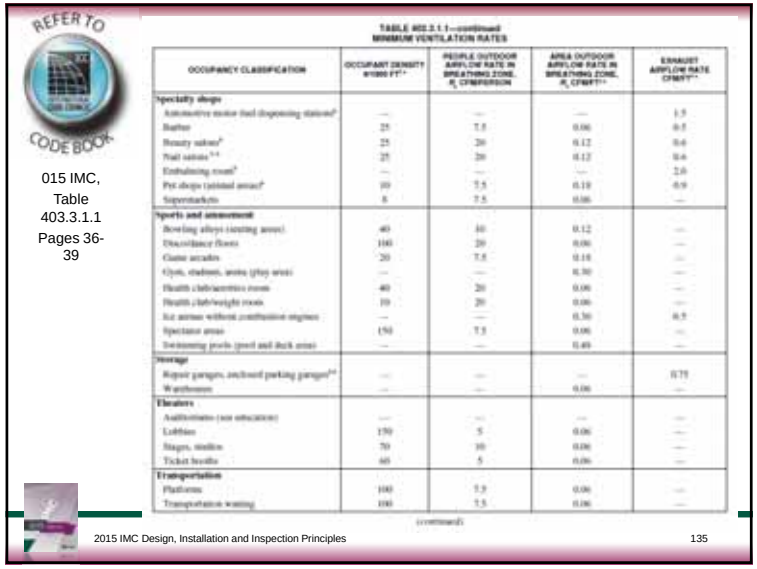
2015 IMC, Table 403.3.1.1 Pages 36-39

133



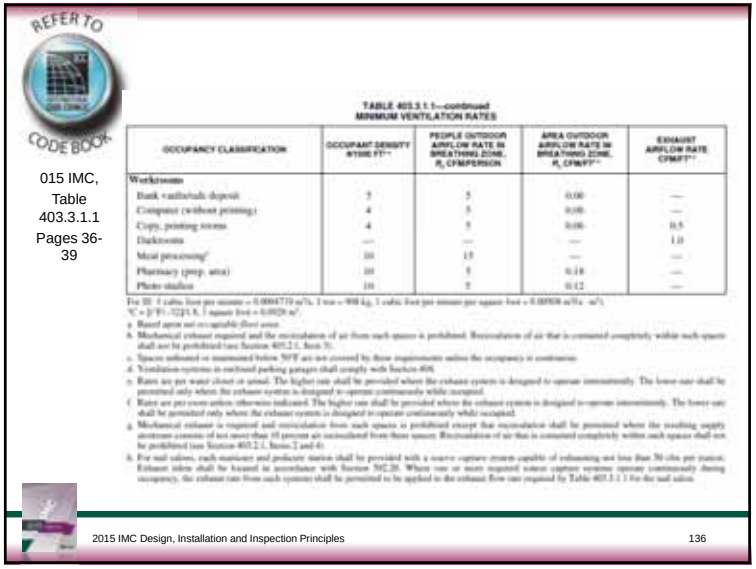
015 IMC, Table 403.3.1.1 Pages 36-39

134



015 IMC, Table 403.3.1.1 Pages 36-39

135



015 IMC, Table 403.3.1.1 Pages 36-39

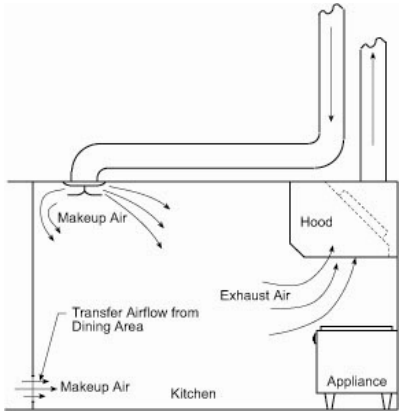
136

Section 403 – Mechanical Ventilation

- **403.2.2 – Transfer air**
  - Air required by Table 403.3.1.1 must be directly introduced into the space being ventilated or must be introduced into an adjoining space and then transferred into the space being ventilated.

137

Section 403.2.2 Transfer air



138

Section 403.3 – Outdoor airflow rate

Two significant features of Table 403.3.1.1:

- It prescribes outdoor air only and the occupant load is determined by the table as opposed to the IBC.
- It includes a rate per person and a rate per floor area, both of which apply in most cases.

139

Table 403.3 Minimum Ventilation Rates

The application of Table 403.3.1.1 has become more complex than ever and requires the application of at least two mathematical equations for single-zone systems and several more for multiple-zone recirculating systems..

140

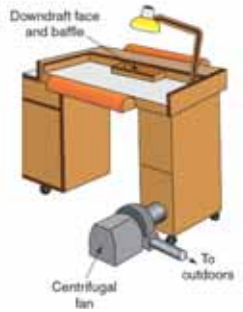
Multiple Zone System Calculations

- The advantage of the Multiple Zone System Calculations is efficiency. It takes into account that when people on staff are in a conference room, they are not breathing at their desks doing data entry. The total required using this method means less outside air delivered to the space as a whole.

141

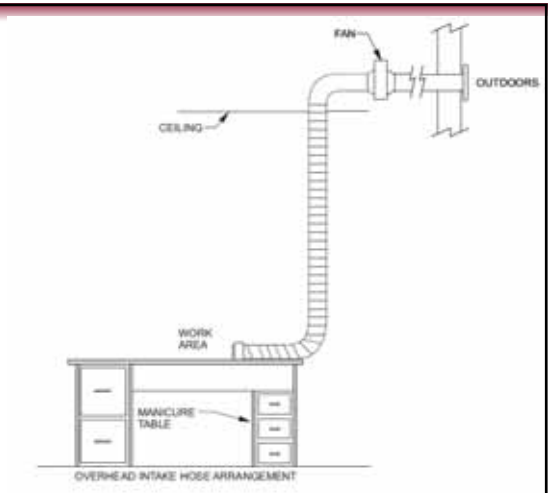
Section 403 – Mechanical Ventilation

- **Nail salons**
  - Note h addresses nail salons and requires a source capture system for each table/station in addition to the other requirements for ventilation and exhaust in Table 403.3.1.1.



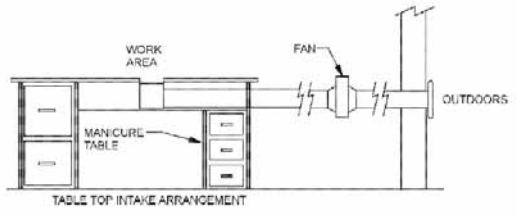
142

Nail salons



143

Nail salons



144

403.3.1.1 Breathing zone outdoor airflow

Vbz = RpPz + RaAz (Equation 4-1)

- The equation sums the rate per person times the number of occupants and the rate per area times the square footage of the zone floor.

145

403.3.2 – R-2, R-3 and R-4 Occupancies, Three Stories and Less

- Applies to R-2, R-3 and R-4 3 stories or less
- A simple formula that uses the floor area and the bedrooms
- Exhaust fans commonly found in dwellings can be used to draw in the required quantities of outside air

146

Section 403.3.2.1 – Outdoor Air for Dwelling Units

- $Q_{OA} = 0.03A_{floor} + 7.5(N_{br} + 1)$
- where:
- Q_{OA} = outdoor airflow rate, cfm
- A_{floor} = floor area, ft2
- N_{br} = number of bedrooms; not to be less than one

147

403.3.1.2 Exhaust ventilation

- Table 403.3.1.1 has an additional column; an exhaust airflow cfm/feet^2 column.
- Required exhaust rate airflow must occur in addition to any other ventilation rates prescribed by the table.

148

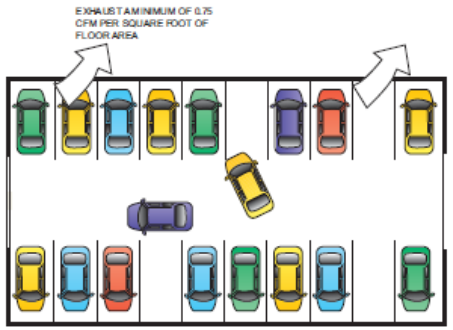
Section 403 – Mechanical Ventilation

- **403.3.1.5 – Balancing**
  - This section requires systems to be balanced by a method approved by the code official.
  - Outside air circulation in the quantities provided by the code can only be determined using special equipment.
- **404.1 – Enclosed parking garages**
  - Mechanical ventilation systems for enclosed parking garages are permitted to operate intermittently where the system is designed to operate automatically upon detection of vehicle operation or presence of occupants..

149

Section 403 – Mechanical Ventilation

404.1 – Enclosed parking garages



150

Section 405 – Systems Control

Air supplied by air conditioning systems automatically controlled to supply the minimum required rates.

151

Section 406—Ventilation of uninhabited spaces

- This section requires either ventilation openings or a mechanical ventilation system for areas such as crawl spaces and attics.

152

Section 407—Ambulatory Care Facilities and Group I-2 Occupancies

- Ambulatory Care Facilities and Group I-2 Occupancies shall have ventilation in accordance with this code and ASHRAE 170 - 2008 Ventilation of Health Care Facilities.

153

Single Zone Recirculating System

- A 3,000-square-foot dining room is served by a rooftop air handling unit by means of ducted ceiling supply registers and ceiling return grilles. Determine the system outdoor air intake flow rate (V_{ot}) for the dining room.
- For SI: 1 square foot = 0.0929 m^2, 1 cubic foot per minute = 0.0004719 m^3/s.

154

Single Zone Recirculating System

- This dining room with a single rooftop unit is considered as a single zone system. In order to determine the outdoor air intake flow rate (V_{ot}) for a single zone system using Equation 4-3, the breathing zone airflow rate (V_{bz}) of the occupied space must first be determined using Equation 4-1. Then, the zone airflow effectiveness (E_z) must be determined in accordance with Table 403.3.1.1.1.2. Next, the zone outdoor airflow rate (V_{oz}) must be determined using Equation 4-2. The outdoor air intake flow rate for a single zone system is then simply $V_{ot} = V_{oz}$, Equation 4-3.

155

Single Zone Recirculating System – Step 1

No specific occupancy criterion is given for the dining room. Therefore, from Table 403.3.1.1 for dining rooms, the default occupant density is used (70 occupants/1,000 sq ft):

$$3,000 \text{ sq ft} \times \frac{70 \text{ occupants}}{1,000 \text{ sq ft}} = 210 \text{ occupants} = P_z$$

156

Single Zone Recirculating System – Step 2

First, the outdoor air rates for people (R_p) and area (R_a) must be obtained for the dining room from Table 403.3.1.1:

R_p = 7.5 cfm/person and R_a = 0.18 cfm/sq ft

Equation 4-1 can now be solved:

$V_{bz} = R_p P_z + R_a A_z$

V_{bz} = [7.5 cfm/person × 210 people] + [0.18 cfm/sq ft × 3,000 sq ft]

V_{bz} = 2,115 cfm

157

Single Zone Recirculating System – Step 3

It is given that the room is served by a rooftop air handling unit by means of ducted ceiling supply registers and ceiling return grilles. Thus, the zone air distribution effectiveness (E_z) can be obtained from Table 403.3.1.1.1.2. In cooling mode, E_z = 1.0, and in heating mode, E_z = 0.8. The most restrictive value, E_z = 0.8, must be used.

For SI: 1 square foot = 0.0929 m^2, 1 cubic foot per minute = 0.0004719 m^3/s.

Equation 4-2 can now be solved for the room:

$$V_{oz} = \frac{V_{bz}}{E_z}$$

Cooling Mode: $V_{oz} = \frac{2,115}{1.0} = 2,115$ cfm

Heating Mode: $V_{oz} = \frac{2,115 \text{ cfm}}{0.8} = 2,644$ cfm

158

Single Zone Recirculating System

- A 3,000-square-foot dining room is served by a rooftop air handling unit by means of ducted ceiling supply registers and ceiling return grilles. Determine the system outdoor air intake flow rate (V_{ot}) for the dining room.

Workbook page 46

159

Multiple Zone Recirculating Systems

- A single-story, 8,000-square-foot office building consists of 7,250 square feet of general office space and a 500-square-foot conference room. The building is served by a rooftop unit by means of ducted ceiling supply registers and ceiling return grilles. The primary airflow provided by the rooftop unit is 8,100 cfm for the office space and 780 cfm for the conference room. Determine the outdoor air intake flow rate for the office area and conference room.

160

Multiple Zone Recirculating Systems

- This office area and conference room constitutes two separate zones that are served by a single rooftop unit. In order to determine the outdoor air intake flow rate (V_{ot}) for a multiple zone system using Equation 4-8, the breathing zone air flow rate (V_{bz}) of the occupied space must first be determined using Equation 4-1. Then, the zone airflow effectiveness (E_z) must be determined in accordance with Table 403.3.1.1.1.2. Next, the zone outdoor airflow rate (*Voz*) must be determined using Equation 4-2. After determining the previously listed variables, the outdoor air intake flow rate for a multiple zone recirculating system must be determined using Sections 403.3.1.1.2.3.1 through 403.3.1.1.2.3.4. The primary outdoor air fraction (Z_p) must be determined using Equation 4-5. Then the system ventilation efficiency (E_v) is determined in accordance with Table 403.3.1.1.2.3.2, and then the uncorrected outdoor air intake flow rate (V_{ou}) is determined using Equations 4-6 and 4-7. Finally, the outdoor air intake flow rate (V_{ot}) is determined using Equation 4-8.

161

Multiple Zone Recirculating Systems – Step 1

Step 1: Determine occupant loads (P_z) for each zone:

For the general office space (Zone 1), no specific occupancy criterion is given. Therefore, from Table 403.3.1.1 for office spaces, the default occupant density is used (5 occupants/1,000 sq ft):

P_z (Zone 1) = 7,250 square feet × 5 occupants/1,000 square feet = 37

For the conference room (Zone 2), the occupant density of 50 occupants/1,000 square feet is used:

P_z (Zone 2) = 500 square feet × 50 occupants/1,000 square feet = 25

162

Multiple Zone Recirculating Systems – Step 2

Step 2: Determine the breathing zone outdoor airflow (V_{bz}) for each zone:

First, the outdoor air rates for people (R_p) and area (R_a) must be obtained for each zone from Table 403.3.1.1:

Zone 1 values: R_p (Zone 1) = 5 cfm/person and R_a (Zone 1) = 0.06 cfm/sq ft.

Zone 2 values: R_p (Zone 2) = 5 cfm/person and R_a (Zone 2) = 0.06 cfm/sq ft.

Equation 4-1 can now be solved for each zone:

$V_{bz} = R_p P_z + R_a A_z$

Zone 1: V_{bz} = [5 cfm/person × 37 people] + [0.06 cfm/sq ft × 7,250 sq ft]

V_{bz} = 620 cfm

Zone 2: V_{bz} = [5 cfm/person × 25 people] + [0.06 cfm/sq ft × 500 sq ft]

V_{bz} = 155 cfm

163

Multiple Zone Recirculating Systems – Step 3

Step 3: Determine the zone outdoor airflow (V_{oz}) for each zone:

It is given that the room is served by a rooftop air handling unit by means of ducted ceiling supply registers and ceiling return grilles. Thus, the zone air distribution effectiveness (E_z), can be obtained from Table 403.3.1.1.1.2. In cooling mode, E_z = 10.0, and in heating mode, E_z = 0.8.

(Assume that Note g of Table 403.3.1.1.1.2 does not apply.)

Equation 4-2 can now be solved for each zone:

$$V_{oz} = \frac{V_{oz}}{E_z}$$

Zone 1: Cooling Mode: V_{oz} = 620 cfm/1.0 = 620 cfm

Heating Mode: V_{oz} = 620 cfm/0.8 = 775 cfm

Zone 2: Cooling Mode: V_{oz} = 155 cfm/1.0 = 155 cfm

Heating Mode: V_{oz} = 155 cfm/0.8 = 194 cfm

164

Multiple Zone Recirculating Systems – Step 4

Step 4: Determine the primary outdoor air fraction (Z_p) for each zone:

The primary airflow (V_{pz}) is given:

V_{pz} (Zone 1) = 8,100 cfm and V_{pz} (Zone 2) = 780 cfm.

Equation 4-5 can now be solved for each zone:

$$Z_p = \frac{V_{oz}}{V_{pz}}$$

Zone 1: Z_p = 775 cfm/8,100 cfm = 0.096

Zone 2: Z_p = 194 cfm/780 = 0.25

165

Multiple Zone Recirculating Systems – Step 5

Step 5: Determine the system ventilation efficiency (E_v):

The largest value of Z_p among all zones served by the system must be used. Therefore, for Z_p = 0.25, Table 403.3.1.1.2.3.2 yields E_v = 0.9.

166

Multiple Zone Recirculating Systems – Step 6

This results in a system population (P_s) as follows:

P_s = system population = Zone 1 population + Zone 2 visitors

P_s = 37 people + [25 people × 0.2 visitor rate] = 42 occupants which are expected to be concurrently in all zones served by the system. The denominator of Equation 4-7 is simply the sum of the occupant loads of all zones, that being the sum of Zone 1, 37 occupants and Zone 2, 25 occupants.

Equation 4-7 can now be solved for D, occupant diversity:

$$D = \frac{P_s}{\Sigma_{all\ zones} P_z}$$

D = 42 occupants/(37 occupants + 25 occupants) = 0.68

As stated earlier, D = 1 will be used in the remainder of the example.

167

Multiple Zone Recirculating Systems – Step 6

Equation 4-6 can now be solved, as follows:

$V_{ou} = D \times \Sigma_{all\ zones} R_p P_z + \Sigma_{all\ zones} R_a A_z$

$V_{ou} = D\{[R_p\ (\text{Zone 1}) \times P_z\ (\text{Zone 1})] + [R_p\ (\text{Zone 2}) \times P_z\ (\text{Zone 2})]\} + \{[(R_a\ (\text{Zone 1}) \times A_z\ (\text{Zone 1})] + [R_a\ (\text{Zone 2}) \times A_z\ (\text{Zone 2})]\}$

V_{ou} = 1{[(5 cfm/person × 37 people) + (5 cfm/person × 25 people)]

+ [(0.06 cfm/sq ft × 7,250 sq ft) + (0.06 cfm/sq ft × 500 sq ft)]}

V_{ou} = 185 + 125 + 435 + 30 = 775 cfm

168

Multiple Zone Recirculating Systems – Step

169

Multiple Zone Recirculating Systems – Step

Step 7: Determine the outdoor air intake flow rate (V_{ot}):

Equation 4-8 gives the adjusted overall outdoor air flow rate required for the system, using the most restrictive value for system ventilation efficiency (Step 5), E_v:

$V_{ot} = V_{ou}/E_v$

V_{ot} = 775 cfm/0.9 = 861 cfm

170

Multiple Zone Recirculating Systems – Step

For Zone 1, the outdoor/primary air fraction (Z_p) of 0.25 would require that 2,025 cfm be supplied to Zone 1 (2,025/8,100 = 0.25).

For Zone 2, the outdoor/primary air fraction (Z_p) of 0.25 would require the same as before, 194 cfm (194/780 = 0.25).

Adding both zones: 2,025 + 194 = 2,219 cfm. As can be seen, the process of Section 403.3.1.1.2.3 has reduced (corrected) the outdoor rate by 1,358 cfm. If the occupant diversity factor (D) had been applied in this example, the true nature of the "correction" from Equation 4-8 would have been obscured.

In comparison, the amount of outdoor air required using the 2006 IMC would be the following:

Zone 1:

$$7,250 \text{ sq ft} \times \frac{7 \text{ occupants}}{1,000 \text{ sq ft}} = 51 \text{ occupants} \times 20 \text{ cfm/occupant} = 1,020 \text{ cfm OA}$$

Zone 2:

500 sq ft × 50 occupants/1,000 sq ft = 25 occupants × 20 cfm/occupant = 500 cfm OA

171

Outdoor Air for Dwelling Units

Outdoor Air for Dwelling Units

Calculate the outside air requirement of a R-2 one room efficiency apartment in a two story apartment building. The apartment has 600 square feet. It has a bathroom exhaust duct balanced to exhaust 35 cfm and runs continuously. What is the outside air required and will the bathroom exhaust cover the amount?

For SI: 1 square foot = 0.0929 m^2, 1 cubic foot per minute = 0.0004719 m^3/s.

(Equation 4-9)

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

where:

Q_{OA} = outdoor airflow rate, cfm

A_{floor} = floor area, ft^2

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

172

Outdoor Air for Dwelling Units

Step 1:

.03 × 600 sq. ft. = 18

Step 2:

7.5 × (1 + 1) = 15

Step 3:

18 +15 = 33 cfm

Total: 33 cfm exhaust is required and the existing exhaust duct will cover the required amount.

173

Chapter 4 Review

Follow the directions in your workbook on page 60 and complete the worksheet.

174

2015 IMC Chapter 5: Exhaust Systems

175

Chapter 5: Introduction

- Chapter 5 covers exhaust system code requirements ranging from clothes dryers and kitchen exhausts to dust, stock, refuse and hazardous exhausts.

176

Chapter 5: Introduction

- The code regulates the materials and methods used for construction and installation of the following:
  - Materials and methods.
  - System controls.
  - Exhaust equipment.
  - Fire protection systems.
  - Related components.

177

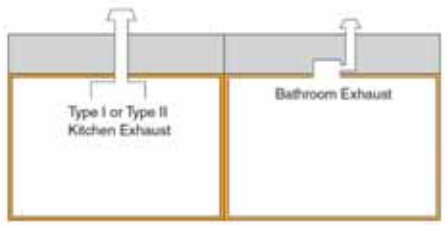
Section 501 – General

This section introduces the basic requirements for the construction, discharge, pressure relationship among and interconnection of mechanical exhaust systems.

178

Section 501 – General

- **501.2 - Independent system required**
  - Single or combined mechanical exhaust systems for environmental air must be independent of all other exhaust systems.



179

Section 501 – General

- **501.2 – Exhaust discharge**
  - The primary intent of this section is to avoid the exhaust of contaminants onto areas that may be occupied by people or other buildings.
  - The exhaust discharge cannot become a public nuisance (dripping grease, producing smoke, etc.)

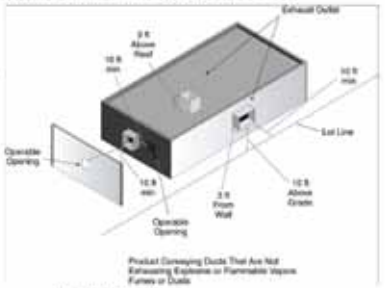
180

Section 501 – General

- **501.2.1 – Location of exhaust outlets**

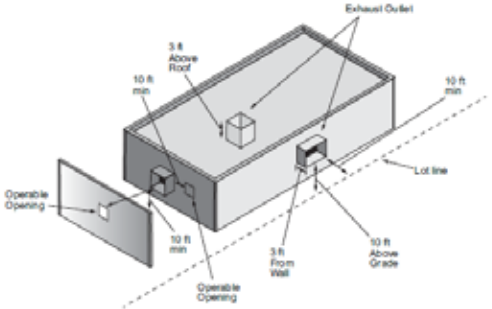
Section provides the minimum distances for the termination point of exhaust outlets and ducts discharging to the outdoors.

Figure 12: Product conveying ducts that are not exhausting explosive or flammable vapors, fumes or dusts



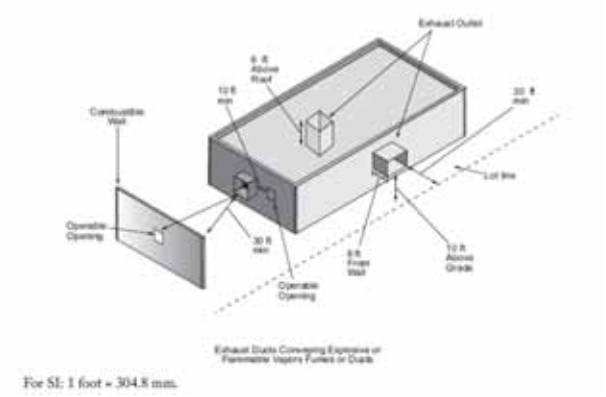
For SI: 1 foot = 304.8 mm.

181



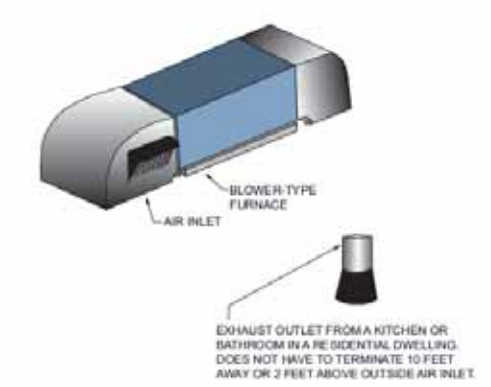
For SI: 1 foot = 304.8 mm.

182



For SI: 1 foot = 304.8 mm.

183



For SI: 1 foot = 304.8 mm

184

Section 501 – General

- **501.4 – Pressure equalization**
  - This section stipulates that make-up air must consist of either supply air, transfer air or outdoor air. Air infiltration alone cannot supply the required make-up air.

185

Section 502 – Required Systems

Contains specific requirements for many operations and processes, such as:

- Fuel-dispensing
- Battery charging
- Dry cleaning
- Painting
- Hazardous storage
- LP gas facilities
- Dipping and coating processes
- Repair garages
- Cryogenic storage

186

Section 502 – Required Systems

- **502.1 – General**
  - Exhaust systems required by this section are independent of, and in addition to, any natural or mechanical ventilation means required by Chapter 4.
  - Exhaust ducts must connect directly to terminals that pass through the building envelope to the outside atmosphere.

187

Battery Cabinets -502.5

- Ventilation shall limit the concentration of hydrogen to 1 % when the cabinet is charging at It's upper limit
- Ventilation must be continuous

188

Section 502.7 – Application of flammable

- Spray rooms and booths
  - Ventilation must limit the concentration of flammables to 25% of the LFL
  - Booths must provide air velocity at not less than 100 ft./m flowing into the opening
  - Mechanical ventilation must be interlocked with the spraying operation

189

502.8 and 502.9 – Hazardous Materials - General and Specific Requirements

- regulates the ventilation and storage required for storage of various hazardous materials such as; compressed gases, medical gases, corrosives, cryogenics, explosives, flammable and combustible liquids.
- All of the allowed concentrations of these chemicals or gases in the rooms is regulated by the IFC, IBC and IMC.

190

502.11 – Motion Picture Projectors

- Movie projectors are moving away from film, that was sometimes combustible, to digital projectors where ventilation is not required. If the movie projectors uses Xeon light bulbs, ventilation may be required.

191

Section 502 – Required Systems

- **502.14 – Motor vehicle operation**
  - To prevent the accumulation of harmful contaminants, all air supplied to the space must be exhausted to the outdoors.
    - Does not apply to repair garages

192

Section 502 – Required Systems

- Repair garages, parking garages, warehouses, vocational shops and similar locations must have mechanical ventilation as prescribed in Section 403.

193

Section 502 – Required Systems

- **502.18 – Specific rooms**
  - Occupancies are followed by Note b &g in Table 403.3. Where Note b& g appears in Table 403.3, the ventilation air to such spaces — both the required air and any excess air quantities — must be exhausted *(a HVAC system dedicated to that space may recirculate the air in the space)*.

194

Motors and Fans—Section 503

- regulates fans and motors used in exhaust systems.
- When the exhaust is flammable, various precautions must be put in place, including keeping the motor out of the airstream. Fans used in flammable exhaust must be non-sparking and if the material is capable of clogging the blades the fan must be of the radial -blade or tube - axial type. Motors must be accessible for servicing and maintenance.

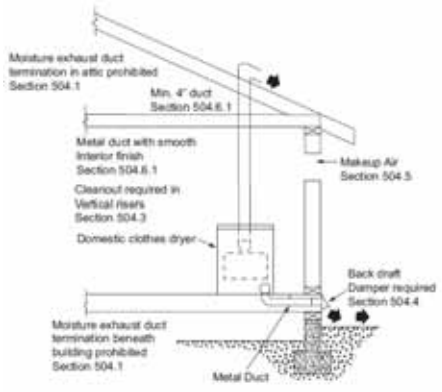
195

Section 504 – Clothes Dryer Exhaust

- Fire protection and life safety issues are the major concerns.

196

Section 504 Clothes Dryer Exhaust



197

Section 504 – Clothes Dryer Exhaust

- **504.1 – Installation**
  - All clothes dryer exhaust systems must convey the moisture and any products of combustion directly to the exterior of the building *(outdoors).*
  - Exception: listed and labeled condensing (ductless) clothes dryers

198

Section 504 – Clothes Dryer Exhaust

- **504.2 – Exhaust penetrations**
  - Penetrations of fire rated assemblies must comply with IBC
  - Fire dampers are not allowed in dryer exhaust ducts.

199

Section 504 – Clothes Dryer Exhaust

- **504.2 Exhaust penetrations**
  - Clothes dryer is exhausted through a duct and not a vent.
  - Must follow the same requirements as any other ducts
  - Where penetrating a fire-resistance-rated assembly, must be protected in accordance with Sections 302.2 and 607

200

Section 504 – Clothes Dryer Exhaust

- **504.4 – Exhaust installation**
  - Exhaust ducts must connect directly to terminals that pass through the building envelope to the outside atmosphere.
- **504.6 – Makeup air**
  - Makeup air is required for clothes dryers that exhaust more than 200 cfm

201

Section 504 – Clothes Dryer Exhaust

- **504.8 – Domestic clothes dryer ducts**
  - Requirements for items addressed in this section, such as material, minimum nominal diameter, support and joint requirements may parallel or exceed the applicable requirements in the manufacturer's installation instructions.

202

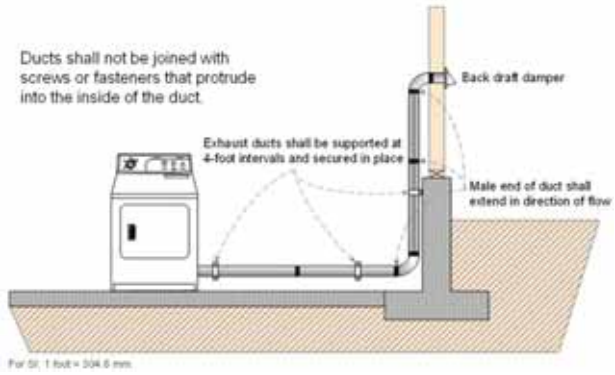
Section 504 – Clothes Dryer Exhaust

- **504.8.1 – Material and size**
  - Clothes dryer exhaust ducts shall have a smooth interior finish, be constructed of metal a minimum of 0.016 inch (0.4 mm) thick and shall be 4 inches (102 mm) in diameter.

(See figure on next slide)

203

Section 504 – Clothes Dryer Exhaust



204

Section 504 – Clothes Dryer Exhaust

- **504.8.2 – Duct installation**
- **504.8.3 – Transition ducts**
- **504.8.4.1 – Specified length**
  - The maximum length of a clothes dryer exhaust duct shall be 35 feet (10 668 mm) unless it complies with Section 504.6.4.2. Where fittings are used, maximum length of the exhaust duct shall be reduced in accordance with Table 504.6.4.1.

205

Section 504 – Clothes Dryer Exhaust

- **504.6.4.1 – Specified length**
  - The maximum length of a clothes dryer exhaust duct shall be 35 feet (10 668 mm) unless it complies with Section 504.6.4.2. Where fittings are used, maximum length of the exhaust duct shall be reduced in accordance with Table 504.6.4.1.

206

Section 504 – Clothes Dryer Exhaust

504.8.4.1 – Specified length

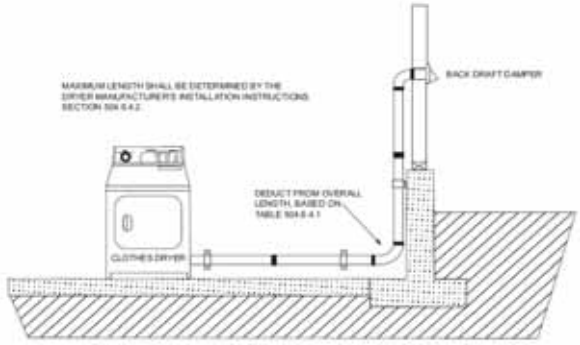
TABLE 504.6.4.1
DRYER EXHAUST DUCT FITTING EQUIVALENT LENGTH

DRYER EXHAUST DUCT FITTING TYPE	EQUIVALENT LENGTH
4″ radius mitered 45-degree elbow	2 feet 6 inches
4″ radius mitered 90-degree elbow	5 feet
6″ radius smooth 45-degree elbow	1 foot
6″ radius smooth 90-degree elbow	1 foot 9 inches
8″ radius smooth 45-degree elbow	1 foot
8″ radius smooth 90-degree elbow	1 foot 7 inches
10″ radius smooth 45-degree elbow	9 inches
10″ radius smooth 90-degree elbow	1 foot 6 inches

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.0175 rad.

207

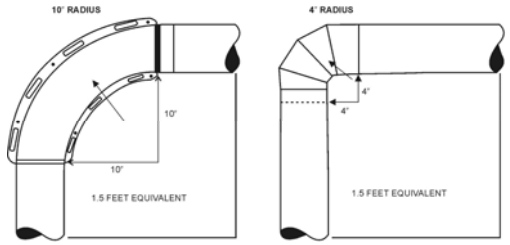
Section 504 – Clothes Dryer Exhaust



208

Section 504 – Clothes Dryer Exhaust

Section 504.8.4.1- Specified length



Elbow Comparison
Exact same starting and ending points

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

209

Section 504 – Clothes Dryer Exhaust

- **504.8.4.2 – Manufacturer's instructions**
  - The maximum length of a clothes dryer exhaust duct may be based on the manufacturer's installation instructions in lieu of what is required in Section 504.6.4.1. The manufacturer's installation instructions shall be provided to the code official before concealment of the duct.

210

Section 504 – Clothes Dryer Exhaust

- **504.8.5 Length identification**
  - Original dryer replaced or the original occupant moves out and the new occupant installs a different dryer.
  - Potentially hazardous situation
  - Must be aware of the equivalent length of exhaust ducts

211

504.8.5 Length identification

Figure 19: Example of a Dryer Exhaust Length Label

212

Section 504 – Clothes Dryer Exhaust

- **504.10 - Common exhaust systems for clothes dryers located in multistory structures**
  - Where penetrating a floor/ceiling assembly, the penetration must be protected in accordance with Sections 302.2 and 607

213

Section 504 – Clothes Dryer Exhaust

- **504.10 - Common exhaust systems for clothes dryers located in multistory structures**
  - Section based on use of subducts and continuous vertical airflow within the shaft in lieu of providing fire and smoke dampers.
  - This section expands this concept by requiring compliance with 12 different items.

214

Dryer exhaust duct power ventilator length

- The maximum length of the duct is based on the manufacturer's installation instructions

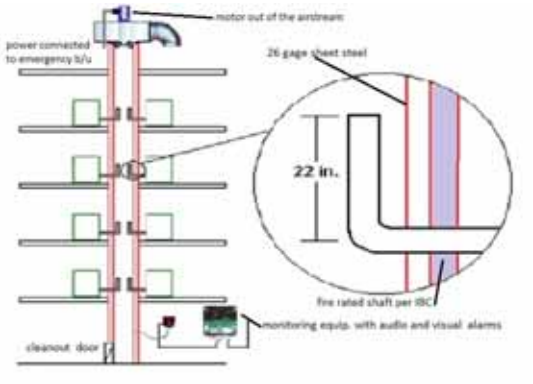
215

Common exhaust systems for clothes dryers located in multi-story structures

- Duct system will be enclosed in a shaft built per the IBC
- Exhaust fan is out of the air stream, runs continuously and must be monitored for failure
- Cleanout required in the bottom of the shaft
- *** look for illustration in SMACNA handbook

it's call a sub-duct system****

216



217

Section 505 – Domestic Kitchen Exhaust Equipment

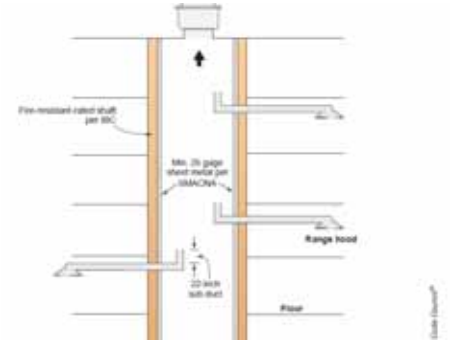
- **505.1 – Domestic systems**
- Domestic kitchen exhaust ducts must:
  - Be constructed of galvanized steel, stainless steel or copper
  - Have a backdraft damper
  - Be installed in accordance with the hood manufacturer's installation instructions.

218

Makeup air required – 505.2

- Exhaust hoods capable of exhausting in excess of 400 CFM shall be provided with makeup air equal to the exhaust

219



Common kitchen exhaust

All the same requirements as clothes dryer exhaust 504.10

220

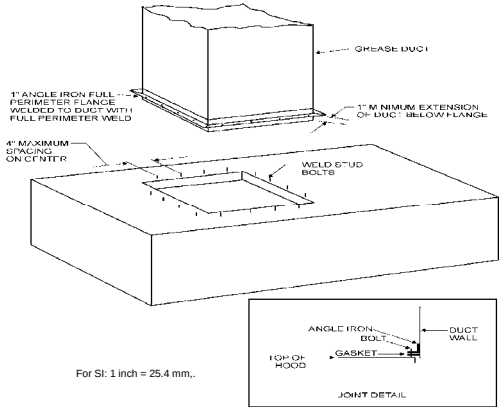
Section 506 – Commercial Kitchen Hood Ventilation System Ducts

Addresses commercial kitchen exhaust systems that include the hood, grease filters, grease duct and exhaust fan.

221

Section 506.3.2.2 – Duct to hood joints

Figure 21: Duct-to-hood Joints



For SI: 1 inch = 25.4 mm,.

222

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **506.3.2.3 – Duct-to-exhaust fan connections**
  - Gasket and sealing materials must be rated for continuous duty at a temperature of not less than 1500°F.
- **506.3.2.5 – Grease duct test**
  - Describes a leakage test that is to be conducted for the entire grease duct system

223

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **506.3.6 – Grease duct clearances**
  - Requires an 18-inch (457 mm) clearance to combustibles and a 3-inch (76 mm) clearance to noncombustible construction
  - kitchen grease ducts installed in accordance with Section 304.1 are not subject to the clearance requirements of this section.

224

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **506.3.7 – Prevention of grease accumulation in grease ducts**
  - Ducts serving Type I hoods must be constructed with the code prescribed slopes and installed without forming any dips, pockets or low points that are capable of collecting grease or residue.

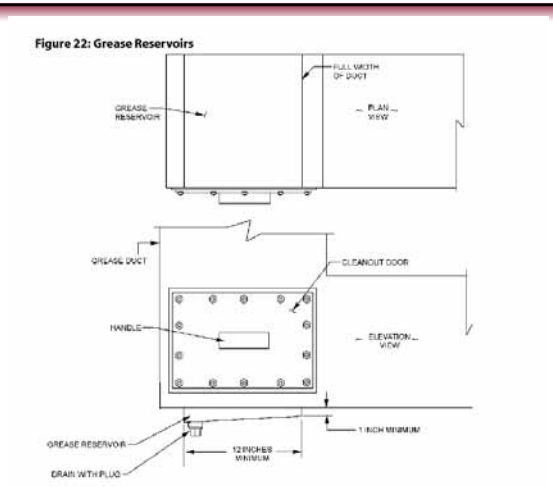
225

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **506.3.7.1 – Grease reservoirs**
  - Provides prescriptive requirements on how to construct a grease reservoir.
  - Seven items provided for construction of grease reservoir

226

506.3.7.1 Grease reservoirs



227

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **506.3.8 – Grease duct cleanouts and openings**
- **506.3.8.1 –Personnel Entry**
  - ductwork is large enough to allow entry of personnel not less than one minimum cleanout opening of 22 inches x 20 inches and must be provided in the horizontal section or in the top of the vertical risers
- **506.3.10 – Underground grease duct installation**
  - The intent behind this section is to provide prescriptive requirements on the installation of the underground grease ducts used for table top cooking.

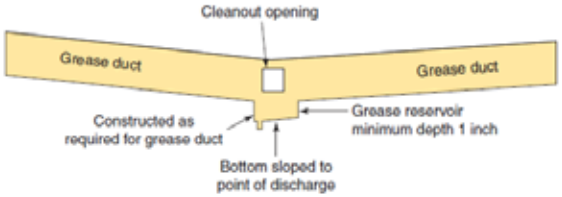
228

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **506.3.10 – Underground grease duct installation**
  - Grease ducts connect to the outlet of the downdraft exhaust system and are routed through the floor and then turn up when they are outside the dining area and go up through the roof.

229

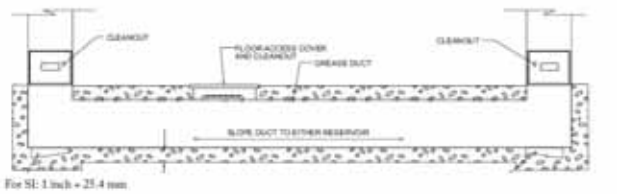
506.3.10 – Underground grease duct installation



For SI: 1 inch = 25.4 mm

230

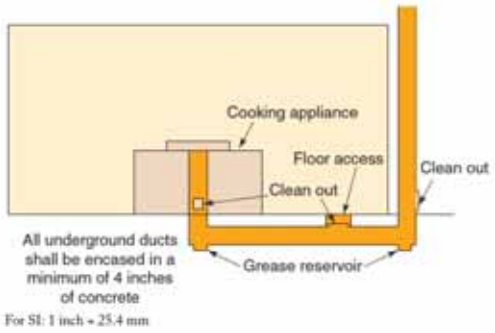
506.3.10 – Underground grease duct installation



For SI: 1 inch = 25.4 mm

231

506.3.10 - Underground grease duct installation



For SI: 1 inch = 25.4 mm

232

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **506.3.11 – Grease duct enclosures**
  - Duct enclosure shall serve a single grease duct.
  - Shall not contain other ducts, piping or wiring systems.
  - Shall be enclosed from the point of penetration to the outlet terminal.
  - Shall be either field applied or factory-built.
  - Shall have a fire-resistance rating not less than that of the floor assembly penetrated but need not exceed 2 hours.

233

Section 506 – Commercial Kitchen Hood Ventilation System Ducts

- **Section 506.4.1 – Ducts**
  - Ducts serving Type II hoods must be joined and sealed to prevent air and moisture leakage.
- **Section 506.4.2 – Type II terminations**
  - There are eight provisions that govern the termination of ducts that are serving a Type II hood.

234

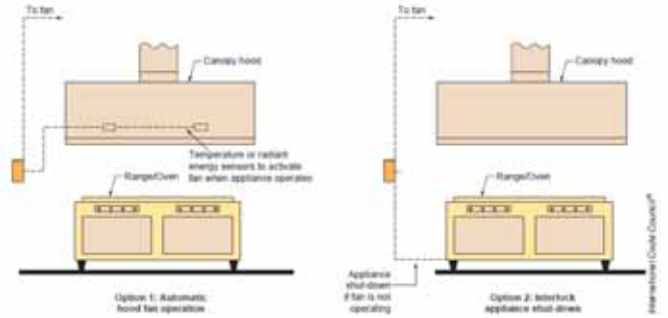
Section 507 – Commercial Kitchen Hoods

- **507.1 – General**
  - Includes requirements for commercial kitchen exhaust hoods, and how they are to be designed, constructed and installed.
  - Hoods Type I and Type II.
  - UL 710—listed and labeled hoods exempted.

235

KEY LEARNING

Hood & Equipment Interlock



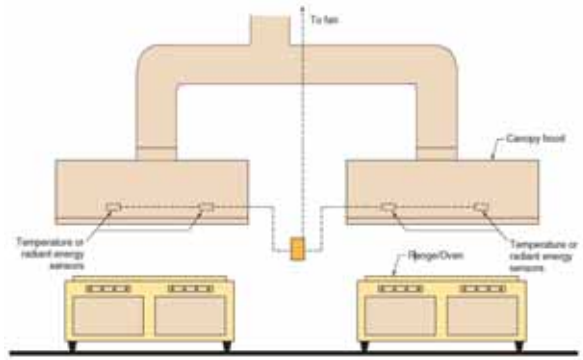
236

Net exhaust can be reduced

- The net exhaust is permitted to be reduced during part – load cooking conditions
- Multispeed or variable speed controls shall automatically operate the exhaust system
- The reduced volume must capture and remove the effluents as required by this code

237

507.1.1.1 Multiple hoods utilizing a single exhaust system



238

Section 507 – Commercial Kitchen Hoods

- **507.2 – Type I hoods**
  - Required for handling grease-laden vapors and smoke, such as produced by ranges, ovens, fryers, griddles and broilers.
  - Installed over medium duty, heavy-duty and extra-heavy-duty cooking appliances

239

Section 507 – Commercial Kitchen Hoods

- **Section 507.2.1 – Type I exhaust flow rate label**
  - A label indicating the minimum exhaust flow in CFM per linear foot shall be affixed to the hood

240

Section 507 – Commercial Kitchen Hoods

- **507.2.1 - Exhaust flow rate label.**

Figure 28: Type I Hood Label

LISTING DESCRIPTION
TESTED, LISTED, AND APPROVED TO EXHAUST A MINIMUM OF 200 CFM PER LINEAR FOOT OVER 600-DEGREE COOKING EQUIPMENT

241

Section 507 – Commercial Kitchen Hoods

- **507.2.2 – Type I extra-heavy-duty**
  - These hoods are dedicated exclusively to extra-heavy-duty cooking appliances (solid-fuel burning)
  - Exhaust system must be exclusive to that hood and cannot be shared

242

Section 507 – Commercial Kitchen Hoods

- **Section 507.2.3 – Type I materials**
  - Type I hoods shall be constructed of steel not less than 18 gage or stainless steel not less than 0.0335 inches in thickness.
- **Section 507.2.4 – Type I supports**
  - Type I hood supports shall be adequate to support the load of the hood, any unsupported ductwork and the weight of maintenance personnel.

243

Section 507 – Commercial Kitchen Hoods

- **Section 507.2.5 – Type I hoods**
- External hood joints seams and penetrations for type I hoods shall be made with external liquid tight weld or braze. Internal hood parts shall not be required to be welded, but shall be sealed to be grease tight

244

Section 507 – Commercial Kitchen Hoods

- **Section 507.2.6 – Clearances for Type I hood**
  - 18 inches to combustibles.
  - Exception clearance is not required from gypsum wallboard or half inch or thicker cementitious wallboard when covered with a noncombustible, nonabsorbent material.
  - Note: that gypsum board would have to be mounted on a noncombustible structure in order to take advantage of the exception.

245

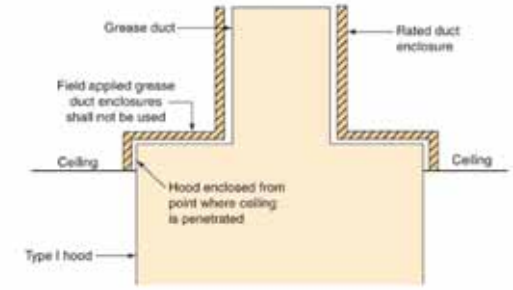
Section 507 – Commercial Kitchen Hoods

- **507.2.7 – Hoods penetrating a ceiling**
  - This section applies where any part of the "shell" of the hood structure penetrates a ceiling or wall.
  - Field-applied grease duct enclosure systems, as addressed in Section 506.3.11.2, can not be used to satisfy the requirements of this section.

246

507.2.7 – Hoods penetrating a ceiling

Figure 29: Hood Enclosure



247

Section 507 – Commercial Kitchen Hoods

- **Section 507.2.8 Grease filters**
  - Type I hoods must be equipped with a listed grease filter designed for this purpose.

TABLE 507.11
MINIMUM DISTANCE BETWEEN THE LOWEST EDGE OF A GREASE FILTER AND THE COOKING SURFACE OR THE HEATING SURFACE

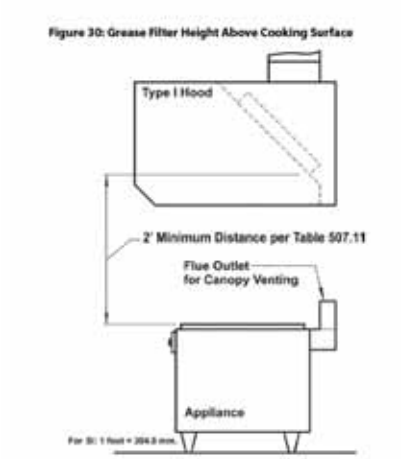
TYPE OF COOKING APPLIANCES	HEIGHT ABOVE COOKING SURFACE (feet)
Without exposed flame	0.5
Exposed flame and burners	2
Exposed charcoal and charbroil type	3.5

For SI: 1 foot = 304.8 mm.

248

Section 507.2.8 Grease filters

The lowest edge of the grease filter located above the cooking surface must be not less than the height specified in Table 507.2.8



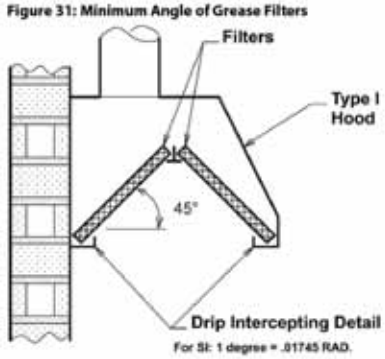
249

Section 507 – Commercial Kitchen Hoods

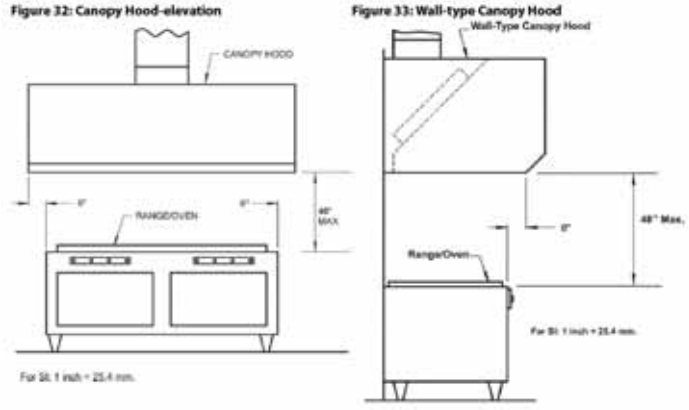
- **507.2.8.2 – Mounting position**
  - Filters must be installed at an angle of not less than 45 degrees (0.79 rad) from the horizontal, and must be equipped with a drip tray beneath the lower edge of the filters.

250

507.2.8.2 – Mounting position



251



252

Figure 34: Island-type Canopy Hood

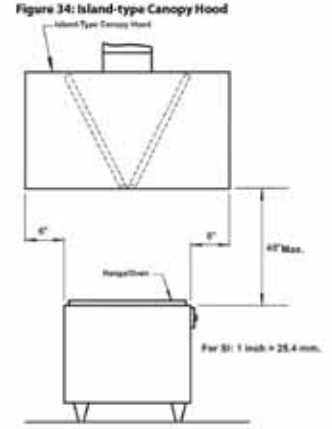
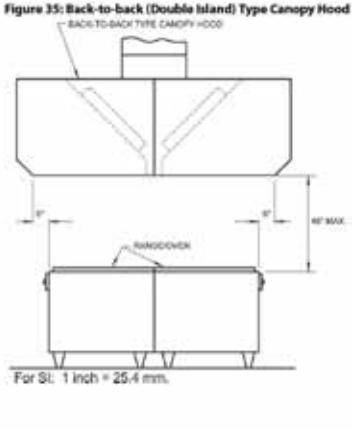


Figure 35: Back-to-back (Double Island) Type Canopy Hood



253

Canopy Hoods

Figure 36: Island-type Canopy Hood

Figure 37: Double Island-type Canopy Hood

254

Type II Hood - 507.3

255

Type II Hood - 507.3

- **Section 507.3.1 – Type II hood materials**
- **Section 507.3.2 – Type II supports**
- **Section 507.3.3 – Type II hood joints, seams and penetrations**

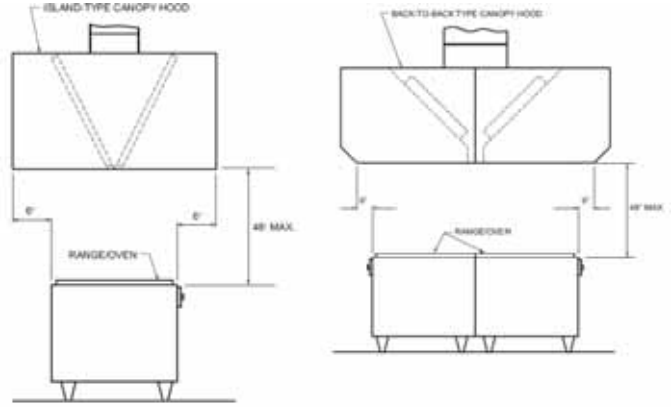
256

Section 507 – Commercial Kitchen Hoods

- **507.4 – Canopy size and location**
- Canopy-type hoods fall into three basic categories:
  - wall
  - island
  - double-island

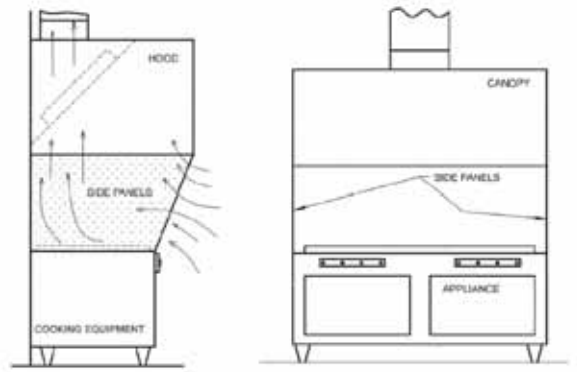
Exception allows elimination of the overhang beyond the cooking surface where the cooking appliance is placed against a noncombustible wall or the hood has side panels.

257



258

259

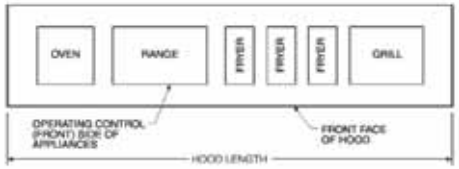


260

Figure 40: Canopy Hood Serving Multiple Appliances
Photo courtesy of Carroll Manufacturing

507.4.1 – Canopy size and location
***Exception*

Figure 41: Plan View of Multiple Appliances under a Hood



261

Section 507 – Commercial Kitchen Hoods

- **507.5 – Capacity of hoods**
  - This section specifies the minimum quantity of exhaust air necessary for effective removal of cooking effluent, and
  - Approximate amount of makeup air necessary for proper operation of four types of cooking appliances.

262

Section 507 – Commercial Kitchen Hoods

- **507.5.1 – Extra-heavy-duty cooking appliances**
  - The quantity of exhaust required for Type I hoods serving solid fuel-burning cooking appliances must be provided in accordance with this section.
  - Backshelf/pass-over and eyebrow hoods are not allowed

263

Performance Test of system – 507.6

- The rate of exhaust and corresponding makeup air of the hood system shall be tested prior to final approval

264

Section 507 – Commercial Kitchen Hoods

- **Section 507.6.1 – Capture and containment test**
  - Field tests must be performed by the permit holder with all appliances under the hood operating.
  - Actual or simulated smoke or steam may be used for visual verification.

265

Section 508 Commercial Kitchen Makeup Air

- Air exhausted from commercial kitchen exhaust system must be replaced with air in such quantities to allow the exhaust system to perform as designed and to prevent excessive negative pressure in commercial kitchen areas.
- Makeup air is critical to proper operation of all commercial kitchen exhaust systems and commercial cooking appliances located in such areas.

266

Section 508 – Commercial Kitchen Makeup Air

- **508.1 – Makeup air**
  - Mechanical makeup air systems shall be automatically controlled to start and operate when the exhaust system is activated. The makeup air openings shall be located to comply with Section 401.4.The makeup air temperature shall be within 10 degrees of the air in the kitchen. An air balance report showing the design and airflow of the building is required.
- **508.2 – Compensating hoods**
  - These hood systems provide exhaust and makeup air within the hood construction

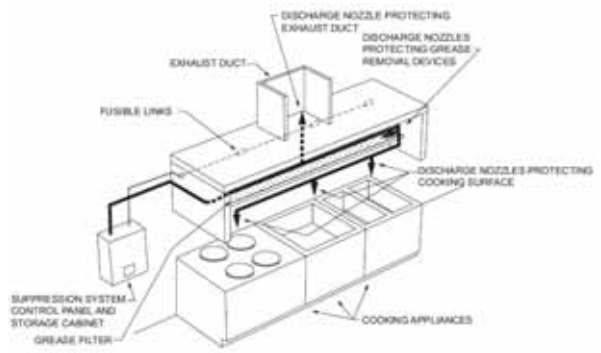
267

Section 509 – Fire Suppression Systems

Requires an approved fire suppression system to combat fire on the grease-producing cooking appliances, and within commercial kitchen exhaust system.

- **509.1 – Where required**
  - Installed in accordance with the IBC and the IFC.

268



269

Section 510 – Hazardous Exhaust Systems

- Governs the design and construction of exhaust systems that handle flammable vapors, corrosive fumes, combustible dusts and similar hazardous materials.
- Important issues include occupant life safety, fire protection, exhaust containment, duct system structural integrity and protection from explosion damage.

270

Section 510 – Hazardous Exhaust Systems

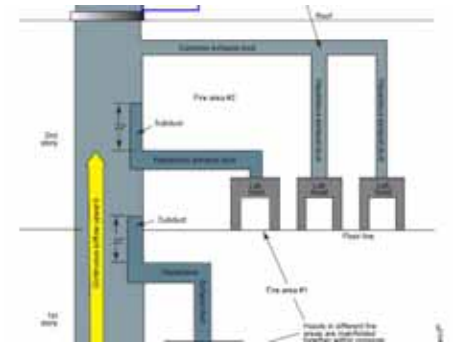
- **510.2 – Where required**
  - Concentration that exceed 25% of LFL.
  - Health hazard rating of 4.
  - Concentrations greater that 1% of the median lethal concentration of any materials with health hazard ratings of 1,2 or 3 for acute inhalation toxicity.

271

Section 510 – Hazardous Exhaust Systems

- **510.3 – Design and operation**
  - By managing the contaminant(s) in a diluted state, there is less chance of catastrophic flame propagation, ignition or explosion.
- **510.8 – Suppression required**
  - Provides protection against the spread of fire within a hazardous exhaust system

272



510.5 incompatible materials and common shafts

273

510.6 – Design

- Design of the system should confine the admissions to the area where there generated, hoods or enclosures may be used where the space is a limited area.
- Makeup air shall equal the exhaust. Hazardous exhaust ducts shall extend directly to the exterior the building.

274

510.9 – Duct construction

- Ducts used to convey hazardous exhaust shall be constructed of materials approved for installation in such an exhaust system and be of the minimum duct thickness determined by table 510.9. Clearance from combustible shall be as outlined in table 510.9.2. Systems exhausting potentially explosive mixtures shall be protected with an approved explosion relief system installed in accordance with NFPA 69.

275

Section 511 – Dust, Stock and Refuse Conveying Systems

Provisions are intended to minimize the fire and explosion hazards associated with the blowers, separators, collectors and piping that are components of hazardous exhaust systems used to convey combustible and flammable dusts and waste products.

276

Section 511 – Dust, Stock and Refuse Conveying Systems

- **511.1.3 – Conveying system exhaust discharge**
  - This section allows recirculation of exhausted air from dust, stock and refuse systems if the particulates have been removed to specified parameters and monitored.

277

Section 512 subslab soil exhaust systems (radon)

- Materials: Listed and labeled class 0 air ducts or any of the materials approved for drainage and vents in the IPC
- Systems shall slope 1/8 per foot
- Terminate 6 inches above the roof and not less than10 feet from any opening

278

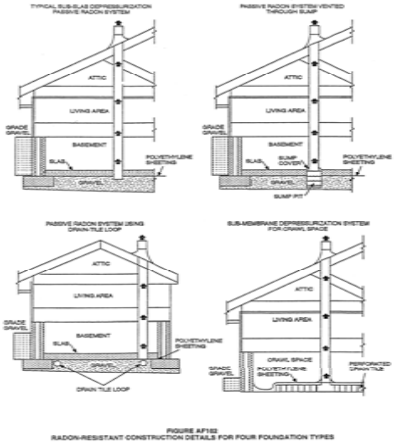


FIGURE AF102
RADON-RESISTANT CONSTRUCTION DETAILS FOR FOUR FOUNDATION TYPES

279

Section 513 smoke control systems

- This section applies to passive and mechanical smoke control systems
- Design is per the IBC and the IFC
- Special inspection and verification is required
- Systems shall be connected to standby power

280

Section 514 Energy Recovery Ventilation Systems

- Includes requirements for systems installed to capture and reuse energy from ventilation systems that would otherwise be discharged to the atmosphere and wasted.
- Must comply with IECC requirements.

281

Section 514 – Energy Recovery Ventilation Systems

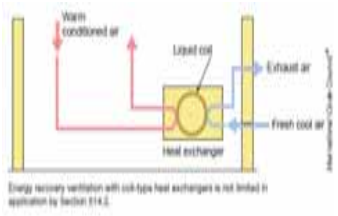
Because of cross leakage and equipment incompatibility, energy recovery systems are not allowed to be installed in the following:

- Hazardous exhaust systems
- Dust, stock and refuse systems that convey explosive vapors or fumes
- Smoke control systems
- Commercial kitchen exhaust systems
- Clothes dryer exhaust systems

282

514.2 Energy Recovery Ventilation Systems: Exception

- The application of ERV equipment that recovers sensible heat utilizing coil-type heat exchangers
- No air or pollutants are exchanged



283

Section 514 – Energy Recovery Ventilation Systems

- **Section 514.4 - Recirculated air**
  - Air conveyed within energy recovery systems must not be considered as recirculated air where the energy recovery ventilation system is constructed to limit cross-leakage between air streams to less than 10 percent of the total airflow design capacity.

284

Chapter 5 Review

Follow the directions in your workbook on page 96 and complete the worksheet.

285

2015 IMC Chapter 6: Duct Systems

286

Chapter 6: Introduction

This chapter regulates the materials and methods used for the construction and installation of the following:

- Ducts
- System controls
- Exhausts
- Fire protection systems
- Related components that affect the overall performance of a building's air distribution system

287

Chapter 6: Introduction

The building code is referenced repeatedly for requirements pertaining to fire protection measures, such as fireblocking, draftstopping, fire-resistance-rated assemblies, penetration protection and fire protection and suppression systems.

288

Section 601 – General

Section 601 states that Chapter 6 governs duct systems used for the movement of environmental air and exhaust air except as otherwise specified in Chapters 5 and 7.

- **601.2 – Air movement in egress elements**
  - This section prohibits exits and exit access corridors from being used as air distribution system ducts because of the potential for spreading smoke and fire into elements of the building's required means of egress.

289

Corridor ceiling

- The corridor ceiling can be used as a plenum when one or more of the following conditions apply
  - The corridor is not required to be of fire resistant construction
  - The corridor is separated from the plenum by fire resistance rated construction
  - The HVAC system is connected to a smoke detector that will shut down the system

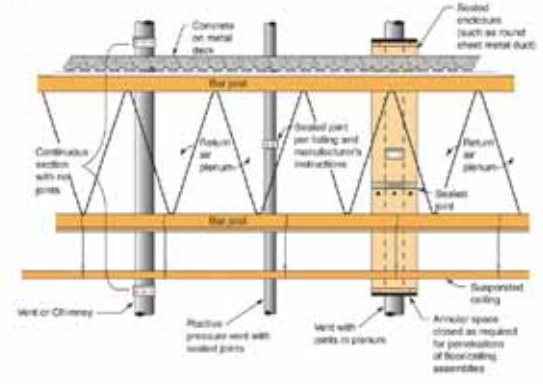
290

Section 601 – General

- **601.4 - Contamination prevention**
- To prevent cross contamination:
  - Exhaust ducts under positive pressure **and** chimneys and vents are **not permitted** to extend into or pass through ducts or plenums.

291

Figure 43: Contamination Prevention



292

Return air openings – 601.5

- Openings shall not be less than 10 feet from draft hoods or open combustion chambers
- Return air may not be taken from hazardous or insanitary locations and refrigeration rooms
- Return air cannot be taken from one dwelling and returned to another
- Return air cannot be taken directly from a crawlspace

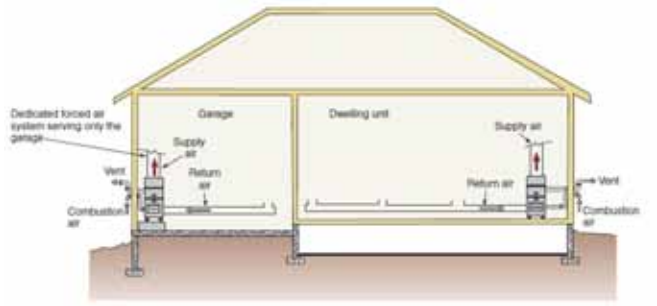
293

Return air openings, continued

- Return air shall not be taken from a closet, bathroom, toilet room, kitchen, garage, boiler room, furnace room or unconditioned attic
- Exceptions:
  - Return air in the kitchen may be allowed if it's not less than 10 feet from the cooking appliances
  - Return air in the garage is allowed when it has a dedicated forced air system

294

Return air openings – 601.5



295

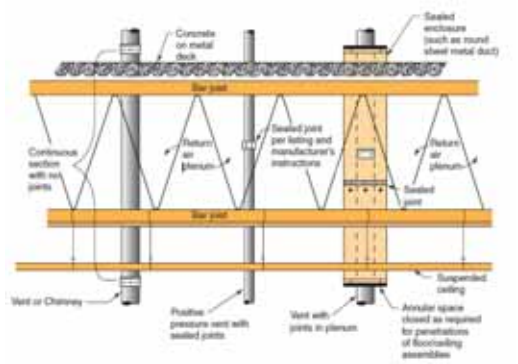
Section 602 – Plenums

Air plenum spaces are restricted to:

- uninhabitable
- unoccupiable
- interstitial spaces
- Cavities

- Plenums are restricted to one fire area as defined by the international building code. This would require dedicated HVAC systems for each fire area. Fuel fired appliances shall not be installed in plenums

296



297

Section 602 – Plenums

- **602.2 – Construction**
  - Requires the plenum to be constructed of or formed by materials that are consistent with the materials allowed for the building's construction type.

298

Section 602 – Plenums

- **602.2.1 – Materials exposed within plenums**
  - Materials located within a plenum must be noncombustible or must have a flame spread index of 25 or less and a smoke developed index of 50 or less when tested in accordance with ASTM E 84 or UL 723.

Regardless of whether the plenum is constructed of or bounded by combustible or noncombustible materials

299

300

Materials Within a Plenum

All material within a plenum shall be noncombustible or shall be listed and labeled as having a flame spread rating of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E-84 or UL 723

301

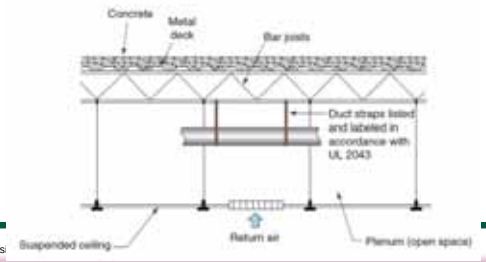
Section 602 – Plenums

- **602.2.1 – Materials exposed within plenums**
  - Code has exceptions that permit exposure of limited types of combustible materials used for these systems within the plenum.
  - Code permits combustible materials that are fully enclosed with materials that are listed and labeled for installation in a plenum.

302

Section 602 – Plenums

- **602.2.1.5 – Foam plastic insulation**
  - Used as wall or ceiling finish in plenums must exhibit a flame spread index of 75 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E 84.



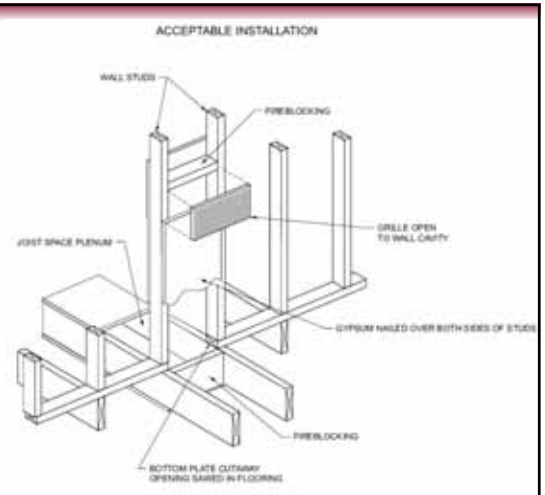
303

Section 602 – Plenums

- **Section 602.2.1.6 – Foam plastic insulation**
  - Foam plastic insulation used as wall or ceiling finish in plenums must exhibit a flame spread index of 75 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E 84..
- **602.3 – Stud cavity and joist space plenums**
  - Use of this type of plenum is limited to return air from one floor level only for each independent stud cavity.

304

The IECC does not allow this method of ducting.



305

Section 603 – Duct Construction and Installation

Ducts are constructed, braced, reinforced and installed such that they provide structural strength and durability, and do not affect fire protection requirements.

306

Section 603 – Duct Construction and Installation

- **603.2 – Duct sizing**
  - Sized in accordance with ACCA Manual D or other approved methods.
- **603.4 – Metallic ducts.**
  - **Constructed per SMACNA**
  - this section permits ducts, installed within a single dwelling unit, to be constructed with the minimum thickness as specified in Table 603.4.

307

Section 603 Duct Construction and Installation

- **603.5 – Nonmetallic ducts**
- **603.5.1 – Gypsum ducts**
- **603.6 – Flexible air ducts and flexible air connectors**

308

Section 603 Duct Construction and Installation

- **603.6.1 – Flexible air ducts**
  - Flexible air duct labels are rectangular in shape. Flexible air ducts are not limited in length.

309

Section 603 Duct Construction and Installation

- **603.6.2 – Flexible air connectors**
  - Current air connector labels are oval in shape, thereby being readily distinguishable from flexible air duct labels.

310

Section 603 Duct Construction and Installation

- **603.6.2.1 – Connector length**
- **603.6.3 – Air temperature**
- **603.7 – Rigid duct penetrations**
  - Ducts in a private garage that penetrate a wall or ceiling that separates a dwelling from a private garage must be continuous and constructed of sheet steel having a thickness of not less than 0.0187 inch (No. 26 gage). The duct must not have openings into the garage.

311

Section 603 Duct Construction and Installation

- **603.8 – Underground ducts**
- Ducts installed underground must be able to resist the following:
  - Forces imposed on them by materials that surround them
  - Forces created by floodwaters
  - Corrosion
- **603.8.3 – Plastic ducts and fittings**
  - Allowed underground only and are used for their corrosion and moisture resistant properties.

312

Section 603 Duct Construction and Installation

- **Section 603.9 Joints, seams and connections**
- Shall be constructed as specified in:
  - SMACNA HVAC Duct Construction Standards.
  - NAIMA Fibrous Glass Duct Construction Standards.
  - Ducts listed to UL 181 and metallic ducts shall have closure systems that comply with UL 181A or UL 181B.

313

Section 603 Duct Construction and Installation

- **603.10 – Supports**
  - Ducts must be supported with approved hangers at a maximum spacing of 12 feet or by the approved system designed to meet the building code.
- **603.14 – Location**
  - Unless a duct is approved for underground installation, it must not be located within 4 inches (102 mm) of grade level.

314

Section 603 – Duct Construction and Installation

- **603.17 - Air dispersion systems**
- Air dispersion systems must:
  1. Be installed entirely in exposed locations.
  2. Be used in systems under positive pressure.
  3. Not pass through or penetrate fire-resistant-rated construction.
  4. Be listed and labeled in compliance with UL 2518.

315

603.17 - Air dispersion systems

Figure 49: Air Dispersion System

316

Section 603 – Duct Construction and Installation

An air dispersion system is a tubular-shaped exposed supply air system that is made of air impermeable fabric material. The system is:

- Fitted with air holes or nozzles to direct air into the area served by the duct
- Generally used in open ceiling installations where the floor or roof deck is visible
- Can be thought of as a duct and a diffuser all in one

317

Section 604 – Insulation

Materials used for covering and lining ducts must meet code requirements concerning flame spread and smoke-developed properties and minimum required thermal resistance of insulation.

318

Section 604 – Insulation

- **604.1 – General**
  - Duct insulation must conform to the requirements of Sections 604.2 through 604.13 and the IECC.
  - The IECC determines where insulation is required and what minimum thermal resistance R-value is required.

319

Section 604 – Insulation

- **604.3 – Coverings and linings**
  - Must have a flame spread index not more than 25 and a smoke-developed index not more than 50, when tested in accordance with ASTM E 84. *(Adhesives included)*
  - Section is revised to include the specimen preparation and mounting procedures of ASTM E 2231 when materials are tested in accordance with ASTM E 84.

320

Section 604 – Insulation

- **Section 604.7 – Identification**
  - Ducts insulated with spray polyurethane foam are not required to be marked with the *R*-value, flame spread index, smoke-developed index and manufacturer's name every 36 inches (914.4 mm). Such information must be provided to the customer in writing.

321

Air filters—Section 605

- This section covers the placement, construction and air flow of filters. Filters shall be listed and labeled for commercial purposes. Electrostatic filters shall meet UL 867.

322

Section 606 – Smoke Detection Systems Control

Provisions apply to ducted air distribution systems that are capable of spreading smoke from the area of fire origin to any other area of the building.

323

Section 606 – Smoke Detection Systems Control

The intent of these provisions is to prevent ducted air distribution systems from distributing smoke from the area of origin to other areas or spaces in a building.

- For these reasons, duct system smoke detectors are used to shut down a ducted air distribution system before it can threaten the building occupants by spreading smoke.

324

Section 606 – Smoke Detection Systems Control

- **606.2 Where required - smoke detectors**
  - The intent of this section is to prevent air distribution systems from distributing smoke to areas where the occupants might not be aware of the fire.
  - Requiring smoke detectors to be located in air distribution systems the hope is that the detector will sense any smoke and shut down the system before the smoke can be spread beyond the room of origin.

325

Section 606 – Smoke Detection Systems Control

- **606.2.1 – Return air systems**
  - The detectors must be installed in the path of airflow before (upstream of) any filters, exhaust air connections, outdoor air connections or decontamination equipment that occur in the system.

326

Section 606 – Smoke Detection Systems Control

- **606.2.2 – Common supply and return air systems**
  - When the combined design capacity of all air-handling systems sharing a common duct or plenum is greater than 2,000 cfm (0.9 m3/s), a smoke detector must be provided in accordance with Section 606.2.1.

327

Section 606 – Smoke Detection Systems Control

- **606.2.3 – Return air risers**
  - This provides for early smoke detection and permits a means for determining on which story a fire has occurred.

328

Section 606 – Smoke Detection Systems Control

- **606.4.1 – Supervision**
  - This section requires a supervisory signal to be sent to a constantly attended location to note the status of the air distribution system.

329

Section 607 – Duct and Transfer Openings

- Penetrations of fire-resistance-rated assemblies must be protected to maintain the fire resistance integrity of the penetrated assembly.
- This section provides for the installation of dampers within air distribution systems and the requirements for the dampers installed to provide such protection.

330

Section 607 – Duct and Transfer Openings

- **607.1 .1 – Ducts and air transfer openings**
- Ducts traveling horizontally between shafts do not require shaft enclosures, if they are protected by dampers of the appropriate type.

331

Section 607 – Duct and Transfer Openings

- **607.2 – Installation**
  - Dampers must be installed in accordance with the manufacturer's installation instructions and listing.
- **607.3 – Damper testing, ratings and actuation**
  - Designed to automatically close upon the detection of a specific level of heat within the air-handling system at the damper location.

332

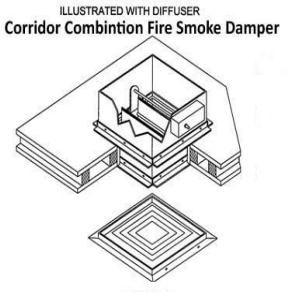
Section 607 – Duct and Transfer Openings

- **607.3.2.2 - Smoke damper ratings**
  - Smoke damper leakage ratings must be Class I or II. Elevated temperature ratings must not be less than 250°F (121°C).
- **607.3.2.3 - Combination fire/smoke damper ratings**
  - Provides protection against flame spread, as well as the passage of smoke past a point in the duct or air transfer opening.

333

60 7.3.2.4 Corridor Damper Ratings

- A minimum one hour fire resistance rating
- Class I or class II leakage rating required



334

607.3.3.2 - Smoke Damper Actuation

- When the smoke damper is actuated by a smoke detector the detector shall be within 5 feet of the damper in the duct.
- Corridor dampers may be controlled by the smoke detection system installed in the corridor

335

607.4 - Access and Identification.

- Fire dampers must have a means of access large enough to inspect and maintain the damper
- Access points/doors shall be labeled: fire smoke damper, smoke damper or fire damper in letters at least a half inch high

336

Section 607 – Duct and Transfer Openings

- **607.5 – Where required**
  - To maintain the fire-resistance rating, fire walls, barriers, partitions and floor/ceiling and roof/ceiling assemblies, fire/smoke dampers must be installed for all duct penetrations as dictated by Sections 607.5.1 through 607.5.7.
- **607.5.3 - Fire partitions**
  - Ducts and air transfer openings that penetrate fire partitions must be protected with listed fire dampers installed in accordance with their listing.

337

Section 607 – Duct and Transfer Openings

- **607.5.5 Shaft enclosures.**
  - Requires both fire and smoke dampers at duct and air transfer openings in the shaft wall.
    - **Exception 1:** Allows omission of the fire damper only; the smoke damper is still required.
    - **Exceptions 2, 3 and 4:** Allow omission of smoke dampers only; the fire dampers are still required.

338

Section 607 – Duct and Transfer Openings

- **607.5.5.1 Enclosure at the bottom**
  - It should be noted that this section requires shaft enclosures that do not extend to the bottom of the building or structure to be protected in accordance with Section 713.11 of the IBC.

339

Section 607 – Duct and Transfer Openings

- **607.6 – Horizontal assemblies**
  - Fire dampers must be labeled in accordance with the requirements of Section 301.4 and installed in accordance with the manufacturer's installation instructions.
  - Fire dampers installed in systems that do not shut down upon detection of heat or smoke will be required to close against airflow.

340

Section 607 – Duct and Transfer Openings

- **607.6.2 – Membrane penetrations**
  - Ceiling dampers must be labeled and installed in accordance with the requirements of Section 301.4 and the manufacturer's installation instructions.

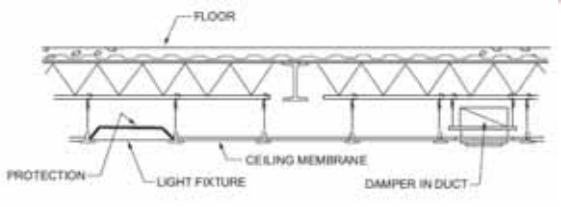
341

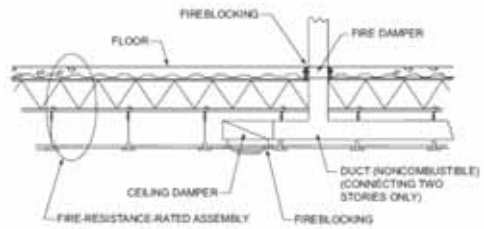
Section 607 – Duct and Transfer Openings

- **607.7 – Flexible ducts and air connectors**
  - Flexible air ducts and connectors must not pass through rated assemblies.
  - Flexible air connectors are also prohibited from passing through any wall, floor or ceiling.

342

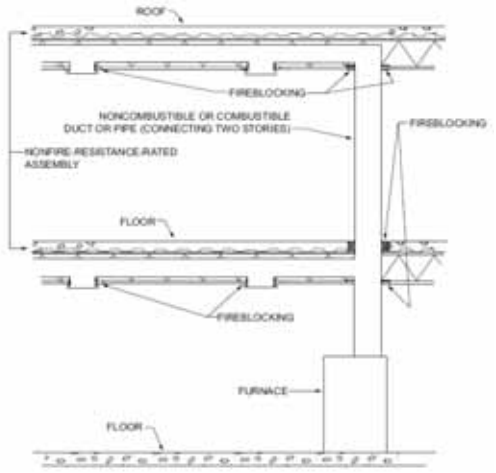
607.7 – Flexible ducts and air connectors





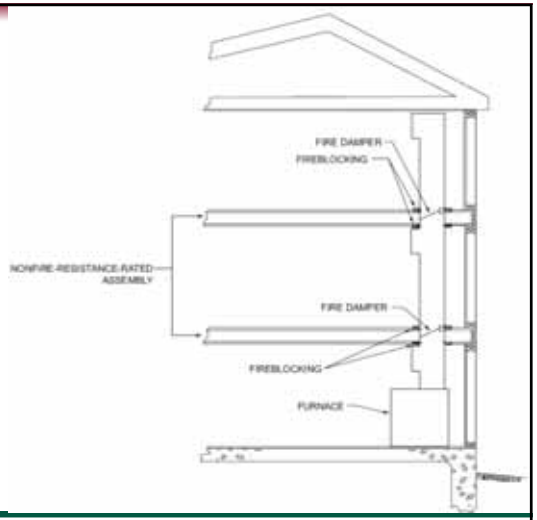
343

607.7 – Flexible ducts and air connectors



344

607.7 – Flexible ducts and air connectors



345

ACTIVITY

Chapter 6 Review

Follow the directions in your workbook on page 118 and complete the worksheet.

346

Module 3

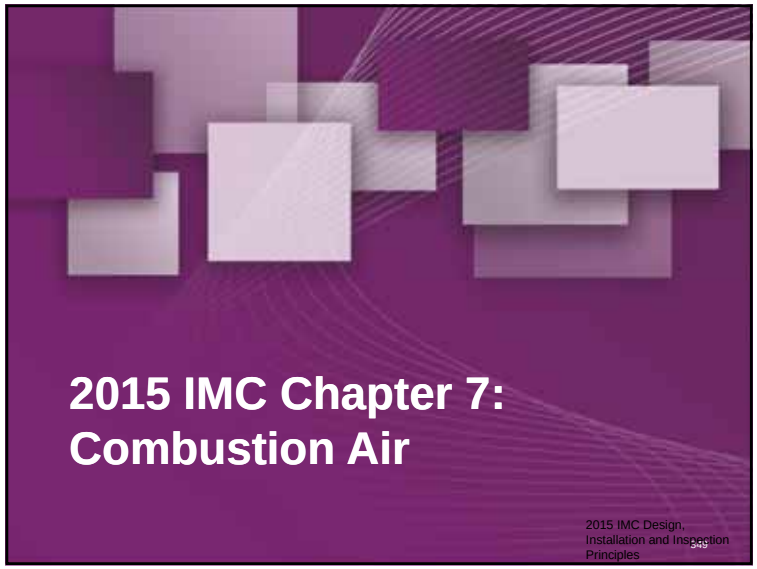
Venting

347

Module Introduction

- Module 3 addresses the requirements for the combustion of fuels and the conveyance of combustion byproducts.
- Chapters 7 and 8 are related insofar as combustion air provisions can affect appliance venting and vice versa.
- In the case of direct vent equipment, the combustion air and venting systems are integrated into a single system.
- Incomplete combustion air provisions and improperly designed or installed venting systems can create serious life safety hazards.

348

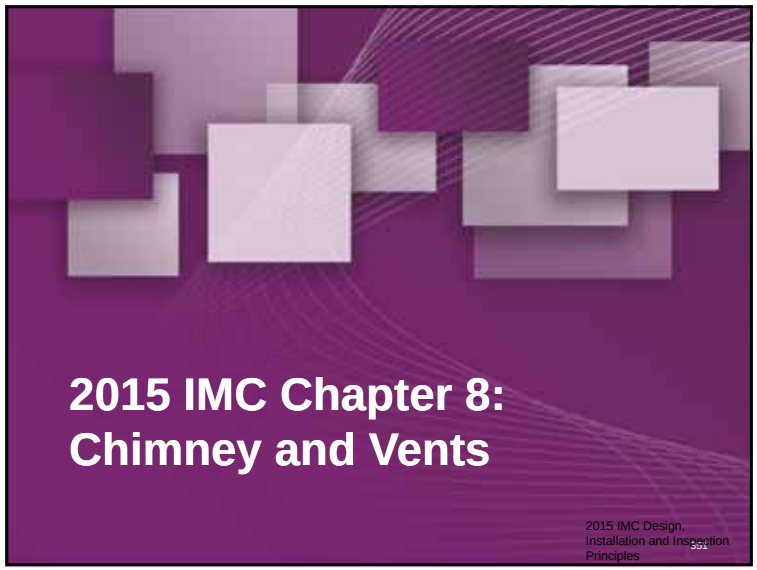


349

Chapter 7: Combustion Air

- Section 701.1 refers the users to: NFPA 31 for oil-fired appliance combustion air requirements, the manufacturer's installation instructions for solid fuel burning appliances and the IFGC for gas appliances.
- Dampered openings shall be interlocked with the equipment served.

350



351

Chapter 8 – Chimneys and Vents

Regulates the design, construction, installation, maintenance, repair and approval of chimneys, chimney lines, vents and their associated connections to fuel-burning appliances.

352

Section 801 General

The installation, maintenance, repair and approval of factory-built chimneys, chimney liners, vents and connectors is addressed throughout.

353

Section 801 General

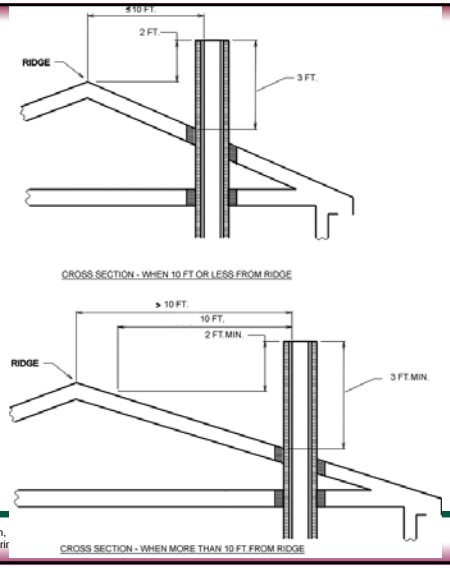
- **801.2.1 – Oil-fired appliances**
  - NFPA 31 contains venting requirements for oil-fired appliances that rely on NFPA 211 and Type “L” vent manufacturer’s instructions.
- **801.3 – Masonry chimneys**
  - The IBC contains requirements for the construction of masonry chimneys whereas the IMC contains the requirements for the sizing and utilization of masonry chimneys.

354

Section 801 General

- **801.11 – Multiple solid fuel prohibited**
- Each solid fuel-burning appliance or fireplace must be:
  - Provided with a dedicated independent chimney
  - A dedicated independent flue in multiple-flue chimney constructions
  - Cannot share a common chimney or flue-way with any other appliance or fireplace

355



356

Section 801 General

- **801.18 – Existing chimneys and vents**
  - Combined input from multiple appliances can maintain sufficiently high chimney or vent temperatures to provide the necessary draft and to avoid condensation.
  - Changing an existing configuration by disconnecting and eliminating an appliance or by substituting a higher efficiency appliance can cause a decrease in flue gas temperature resulting in poor draft and/or condensation.

357

Section 801 General

- **801.18.2 – Flue passageways**
  - Where a chimney is in less than good condition, it must be repaired or relined in accordance with NFPA 31 as necessary before an appliance is connected to such chimney.

358

Section 801 General

- **801.19 – Multistory prohibited**
  - Section addresses chimneys or vents that serve multiple appliances located on different floor levels.
- **801.20 – Plastic vents joints**
  - PVC, CPVC and ABS are specifically identified in this section. The installation must meet the pipe and appliance manufacturer's installation instructions.

359

Section 801 General

- **Section 802.2 Vent application**

VENT TYPES	APPLIANCE TYPES
Type L oil vents	Oil-burning appliances listed and labeled for venting with Type L vents; gas appliances listed and labeled for venting with Type B vents.
Pellet vents	Pellet fuel-burning appliances listed and labeled for venting with pellet vents.

360

802.9 Door Swing

- Doors cannot swing within 12” of a vent terminal
- Doors stops or closers cannot be used to limit the swing

361

Section 801 General

- **Section 803 Connectors**
  - Establishes the minimum requirements for the design, construction and installation of chimney and vent connectors.

362

Section 801 General

- **803.2 – Location**
  - Connectors must be located entirely within the room in which the connecting appliance is located except as provided for in Section 803.10.4.

363

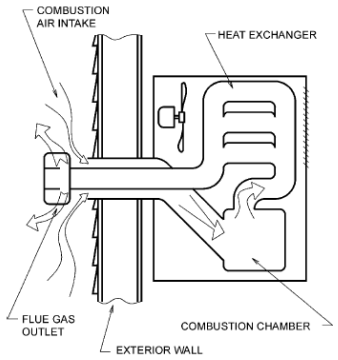
Section 801 General

- **803.7 – Connectors serving two or more appliances**
  - Placing the smallest appliance connection at the highest elevation in the common vent or chimney will allow the greatest connector rise for the smaller appliance connector and will take advantage of any draft priming effect caused by the lower connector
- **803.10.2 – Length**
  - The horizontal length limitations of this section are based on total vertical rise of the chimney or vent system.

364

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

Addresses venting of fuel-burning appliances or equipment by means other than natural draft or by a means integral to the appliance.



365

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.1 – Direct-vent terminations**
  - Direct-vent appliances include those appliances having a sealed combustion chamber and a conduit for bringing all combustion air directly from the outdoors.
- **804.2 – Appliances with integral vents**
  - Refers to appliances, such as outdoor furnaces and outdoor swimming pool heaters that have built-in gravity or power venting means.

366

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.3 - Mechanical draft systems**
  - Appliance installations addressed in this section use auxiliary or integral fans and blowers to force the flow of combustion products to the outdoors.
  - Applies to externally installed power exhausters, integrally power-exhausted appliances and venting systems equipped with draft inducers.
  - Section does not address direct-vent appliances.

367

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.3.4 – Horizontal terminations**
  - Section establishes the requirements for mechanical draft systems and power exhausters that terminate horizontally or through a side wall.
- ***This section does not apply to direct-vent appliances.***

368

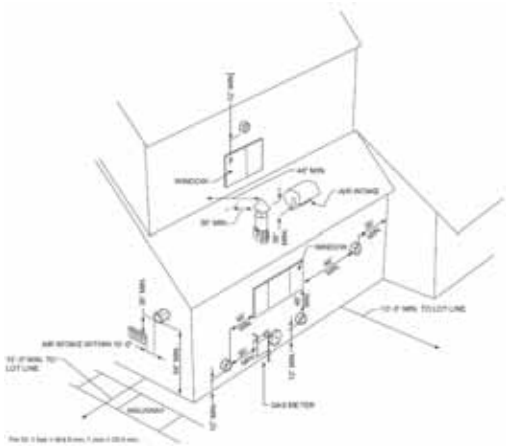
Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.3.4 – Horizontal terminations**
- The following requirements are for horizontal terminations. They must be:
  - Located a minimum of 7 feet above the level of adjacent walkways.
  - 3 feet higher than any forced air intake area within 10 feet

369

The vent system must terminate:

- *4 feet below;*
- *4 feet horizontally from; or*
- *1 foot above any door, window or gravity air intake area.*



370

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.3.5 – Vertical terminations**
  - Section establishes the requirements for exhaust pipes and power exhausters that terminate vertically.
- ***This section does not apply to direct-vent appliances.***

371

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.3.5 – Vertical terminations**
- The following requirements apply to vertical terminations:
  - Must be located a minimum of 7 feet above the level of adjacent walkways.
  - Must be 3 feet higher than any forced air intake area within 10 feet
  - If below an adjacent roof, it must terminate 3 feet from that roof structure.

372

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.3.5 – Vertical terminations**
- The vent system must terminate:
  - 4 feet below; or
  - 4 feet horizontally from; or
  - 1 foot above any door, window or gravity air intake area.
- The vent cap must be installed.
- Must be a minimum of 3 feet horizontally from any portion of the roof structure that the vent penetrates.

373

Section 804 – Direct-vent, Integral Vent and Mechanical Draft Systems

- **804.3.8 – Mechanical draft systems for manually fired appliances and fireplaces**
- Section allows the use of mechanical draft systems with manually fired appliances and fireplaces if:
  - The draft device is listed
  - A smoke detector is installed in the room with the appliance
  - A visible and audible alarm is provided to warn occupants upon failure of the mechanical draft device or loss of electrical power.

374

Section 805 – Factory-built Chimneys

- Contains requirements for all types of factory-built chimney systems including:
  - Component assembly
  - Clearances to combustibles
  - Support
  - Terminations
  - Connections
  - Protection from damage
  - Fireblocking.

375

Section 805 – Factory-built Chimneys

- **805.2 – Solid fuel appliances**
  - Revised to prescribe the markings required for factory-built chimneys installed in dwelling units
  - Exceptions for chimneys used with open combustion chamber fireplaces in both residential and nonresidential occupancies

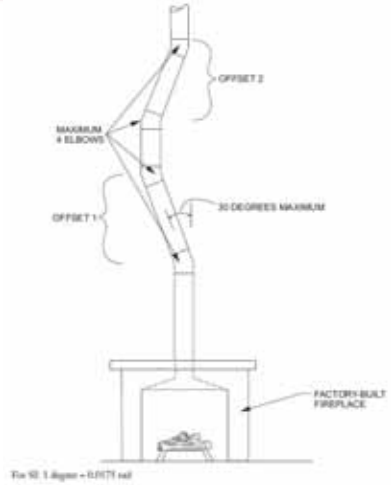
376

Section 805 – Factory-built Chimneys

- **805.3 - Factory-built chimney offsets**
  - Offsets in factory-built chimneys are limited to not more than 30 degrees (0.52 rad) from vertical at any point in the assembly.
  - The chimney assembly must not have more than four elbows.

377

- **805.3 - Factory-built chimney offsets**
  - The chimney assembly must not have more than four elbows.



378

Section 805 – Factory-built Chimneys

- **805.6 – Decorative shrouds**
  - Section prohibits the practice of installing decorative shrouds over the termination of factory-built chimneys, except where such shrouds are listed for the specific application and installed in strict accordance with the manufacturer's installation instructions

379

805.6 – Decorative shrouds

380

Chapter 8 Review

Follow the directions in your workbook on page 132 and complete the worksheet.

381

Module 4

Appliances, Fireplaces, Refrigeration and Piping Systems

382

Module Introduction

Module 4 focuses on the design and installation of specific appliances, fireplaces, pressure vessels, refrigeration equipment, hydronic piping, fuel-oil piping and solar equipment.

- **Chapter 9**: Specific Appliances, Fireplaces and Solid Fuel-burning Equipment
- **Chapter 10**: Boilers, Water Heaters and Pressure Vessels
- **Chapter 11**: Refrigeration
- **Chapter 12**: Hydronic Piping
- **Chapter 13**: Fuel Oil Piping and Storage,
- **Chapter 14**: Solar Systems,

383

2015 IMC Chapter 9: Specific Appliances, Fireplaces and Solid Fuel-burning Equipment

384

Chapter 9: Specific Appliances, Fireplaces and Solid Fuel-burning Equipment

- In Chapter 9, the term *fireplace* refers to solid fuel-burning fireplaces, not gas-fired appliances that are marketed as gas fireplaces.
- Fireplaces are principally used as decorative features, energy-efficient fireplaces and solid fuel-burning stoves and heaters are often used to supplement the primary heating system in dwelling units.
- Other regulations affecting the installation of solid fuel-burning fireplaces, appliances and accessory appliances are found in Chapters 3, 6, 7, 8, 10, 11, 12, 13 and 14.

385

Section 902 – Masonry Fireplaces

- The building code contains construction and chimney sizing requirements for masonry fireplaces.
- **902.2 - Fireplace accessories**

Listed and labeled fireplace accessories must be installed in accordance with the conditions of the listing and the manufacturer's instructions. Fireplace accessories must comply with UL 907.

386

Section 903 – Factory-built Fireplaces

Factory-built fireplaces are solid fuel-burning units having a fire chamber that is intended to be either open to the room or, if equipped with doors, operated with the doors either open or closed.

- *Note: Fireplaces are not referred to as appliances. The term fireplace describes a complete assembly that includes the hearth, fire chamber and a chimney.*

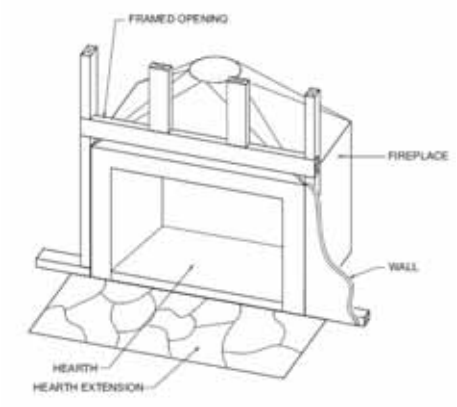
387

Section 903 – Factory-built Fireplaces

- **903.2 – Hearth extensions**
  - Factory-built fireplaces must be installed in strict accordance with the manufacturer's installation instructions.
  - Instructions include specifications for the materials, dimensions and installation of hearth extensions.
  - Listed and labeled hearth extension must comply with UL 1618.

388

903.2 – Hearth extensions



389

Section 903 – Factory-built Fireplaces

- **903.3 – Unvented gas log heaters**
  - Unvented gas log heater must 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.
  - If the fireplace manufacturer's instructions do not state that the fireplace has been tested for use with unvented gas logs, such gas appliance must not be installed in the fireplace.

390

Section 903.4 Gasketed Doors

- Gasketed doors for fireplaces shall only be allowed on fireplaces listed for the use of these doors

391

Section 904 – Pellet Fuel-burning Appliances

Pellet fuel-burning appliances, as defined in Chapter 2, are a relatively new technology and allow the use of waste products that have been converted to a usable fuel.

392

Section 906 – Factory-built Barbecue Appliances

This section addresses factory-constructed appliances designed to burn wood or charcoal with or without an auxiliary fuel.

393

Section 908 – Cooling Towers, Evaporative Condensers And Fluid Coolers

Cooling towers are the heat rejection portion of a condenser circuit and operate by creating a large surface area over which the condenser cooling water flows.

- Factory-built cooling towers must be listed in accordance with UL 1995.

394

Cooling towers 908.5 & 8

- Water supplied to cooling towers may be other than potable water, if the quality meets the cooling tower manufacturer's recommendations
- Concentrations in the cooling water used may be controlled by a number of methods of bleed off
- Strict limitations on drift rate must be part of the manufacturer's design

395

Chapter 9 – Specific Appliances *(Continued)*

- Vented Wall Furnaces (Section 909)
- Floor Furnaces (Section 910)
- Duct Furnaces (Section 911)
- Infrared Radiant Heaters (Section 912)
- Clothes Dryers (Section 913)

396

Chapter 9 – Specific Appliances *(Continued)*

- Sauna Heaters (Section 914)
- Engine And Gas Turbine-Powered Equipment And Appliances (Section 915)
- Pool And Spa Heaters (Section 916)
- Cooking appliances (Section 917)

397

Section 918 – Forced-air Warm-air Furnaces

- These types of furnaces are intended to be central heating appliances. The types of furnaces include the following:
  - Upflow.
  - Counterflow.
  - Horizontal flow.
  - Indoor unit.
  - Outdoor unit.

398

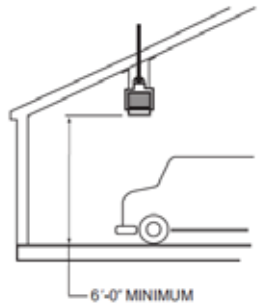
Section 920 – Unit Heaters

- This section addresses self-contained space heating appliances including forced-air types.
- Commonly located in garages, workshops, warehouses, factories, mercantile spaces and similar types of large open buildings.

399

Section 920 – Unit Heaters

- Unit heaters are ductless warm-air space heaters that are self-contained and usually suspended from a ceiling or roof structure.



For SI: 1 foot = 304.8 mm.

400

Small Ceramic Kilns—Section 923

- Kilns shall be listed and labeled. Approval of unlisted kilns shall be based on an engineer's evaluation.

401

Section 924 – Stationary Fuel Power Systems

These alternative power sources are required to be tested to CSA America FC 1 and installed in accordance with NFPA 853 and the manufacturer's installation instructions.

402

Section 927 – Radiant Heating Systems

Electric radiant heating systems must be installed in accordance with the manufacturer's instructions and must be listed for the application.

403

Section 928 – Evaporative Cooling Equipment

Evaporative cooling equipment must:

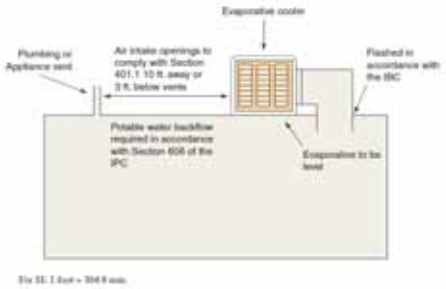
- Be installed in accordance with the manufacturer's instructions and on level platforms in accordance with Section 304.10

404

Evaporative cooling equipment must:

Be provided with potable water backflow protection in accordance with Section 608 of the IPC.

Have openings in exterior walls or roofs flashed in accordance with the IBC.



Have air intake opening locations in accordance with Section 401.4.

405

ACTIVITY

Chapter 9 Review

Follow the directions in your workbook on page 141 and complete the worksheet.

406

2015 IMC Chapter 10: Boilers, Water Heaters and Pressure Vessels

407

Chapter 10 - Boilers, Water Heaters and Pressure Vessels

Boilers and water heaters are pressurized vessels

- A water heater is defined as any appliance that heats potable water and then supplies it to the plumbing hot water distribution system.
- A boiler either heats water or generates steam for space heating, processing or developing power, and is generally a closed system.

408

Section 1002 – Water Heaters

- Potable water heaters and hot water storage tanks must be listed, labeled and installed in accordance with the following:
  - Manufacturer's installation instructions.
  - The IPC.
  - The IMC.

409

Section 1002 – Water Heaters

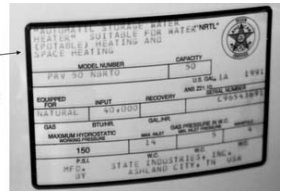
- **1002.2 – Water heaters utilized for space heating**
  - This section does not address water heaters used solely for space heating applications, but rather addresses water heaters that serve a secondary purpose of space heating.

410

1002.2 – Water heaters utilized for space heating

Water heaters serving the dual purpose of supplying potable hot water and serving as a heat source for a hot water space-heating system must be listed and labeled for that dual application.

"...Suitable for water (potable) heating and space heating"



411

Section 1003 – Pressure Vessels

- Section intended to place in the scope of the code pressure equipment such as: air compressor tanks, expansion tanks, hydro-pneumatic tanks, accumulators, steam generators and containment vessels associated with the mechanical systems.
- The appropriate standard for pressure vessels is ASME Boiler and Pressure Vessel Code.

412

Section 1004 – Boilers

- Requires that all boilers and their control systems comply with:
  - Specified national standards.
  - IMC requirements.
  - Manufacturer's installation instructions.

413

Section 1004 – Boilers

- **1004.2 – Installation**
  - The mechanical equipment requirements for approval, labeling, installation, maintenance, repair and alteration are regulated by Chapters 1 and 3.
  - Applicable installation requirements are also located in Chapters 7, 8, 12 and 13.

414

Section 1004 – Boilers

- **1004.3 - Working clearance**
  - Clearances must be maintained around boilers, generators, heaters, tanks and related equipment and appliances so as to permit inspection, servicing, repair, replacement and visibility of all gauges.

415

Section 1004 – Boilers

- **1004.6 – Boiler rooms and enclosures**
  - See the building code for specific details on boiler room enclosures and fire suppression systems.
  - A floor drain conveniently permits the disposal of standing water or the liquid waste that can be expected from the operation and maintenance of boilers (i.e., blowdowns, skimmers and relief valves (see definition of "Boiler room").

416

Section 1006 – Safety and Pressure Relief Valves and Controls

Prevents vessels and boilers from failing as the result of abnormal conditions.

- **1006.4 – Approval of safety and safety relief valves**
- **1006.5 – Installation**
- **1006.8 – Electrical requirements**

417

Section 1007 – Boiler Low-water Cutoff

A low-water cutoff is an essential control device designed to prevent boiler operation when the water is too low.

418

Section 1008 – Steam Blowoff Valve

- A valve shall be installed in the bottom of the boiler
- On boilers operating at >100 psi, two valves shall be installed

419

Closed-type expansion tanks

REFER TO CODE BOOK

2015 IMC Table 1009.2 Page 97

TABLE 1009.2
CLOSED-TYPE EXPANSION TANK SIZING

SYSTEM VOLUME IN GALLONS	TANK CAPACITIES IN GALLONS	
	Pressurized Diaphragm Type	Nonpressurized Type
100	9	15
200	17	30
300	25	45
400	33	60
500	42	75
1,000	83	150
2,000	165	300

For SI: 1 gallon = 3.795 L.

420

Chapter 10 Review

Follow the directions in your workbook on page 147 and complete the worksheet.

421

2015 IMC Chapter 11: Refrigeration

422

Chapter 11 – Refrigeration

There is a serious concern over the effect of chlorofluorocarbon (CFC) refrigerants and their contribution to the depletion of the earth's ozone layer.

- Substitute refrigerants currently permitted by the code include the following:
  - R-134a (HFC).
  - 400 Series Blends.
  - R-123 (HCFC).

423

Section 1101 - General

- Requires full compliance with ASHRAE 15 and IIAR 2, except where the code has intentionally modified or exceeded the requirements of the standards.

424

Section 1101 - General

- **1101.8 – Change in refrigerant type**
  - This section requires that the code official be notified before the type of refrigerant is changed in large systems.
- **1101.10 - Locking access port caps**
  - Refrigerant circuit access ports located outdoors must be fitted with locking-type tamper-resistant caps or otherwise secured to prevent unauthorized access.

425

Section 1101.10 – Locking access port caps

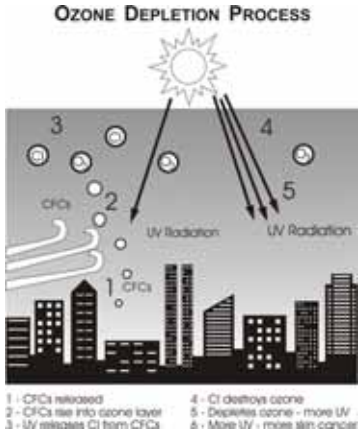
Installation of Locking Caps for Refrigerant Access Port

426

CFC Refrigerants

CFC molecules deplete the ozone layer when they reach the stratosphere

Some of the consequences from ozone layer depletion include deleterious effect on earth's vegetation, increase in skin cancer and increase in the severity of HIV, herpes infections and other autoimmune system deficiencies.



427

Section 1102.1 - General

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

- **Step 1.**Determine the refrigeration system's classification in accordance with Section 1103.3.
- **Step 2.** Determine the refrigerant classification in accordance with Section 1103.1.

428

Section 1102.1 - General

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

429

Chapter 11 – Refrigeration

- **1102.2 – Refrigerants**
- **1102.2.2.2 – Recovered refrigerants**
- **1102.2.2.3 – Reclaimed refrigerants**

430

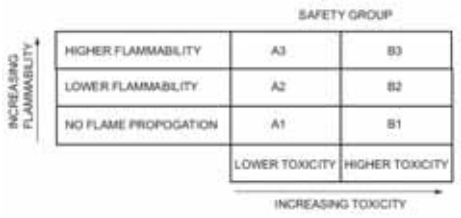
Section 1103 – Refrigeration System Classification

Classifies refrigeration systems as high- or low-probability, based on the potential for the system to leak refrigerant into an occupancy classified area.

431

Section 1103.1 – Refrigerant classification

- Classified in accordance with ASHRAE 34.
- Each refrigerant is classified into a safety group that is based on two factors:
  - Flammability
  - Toxicity



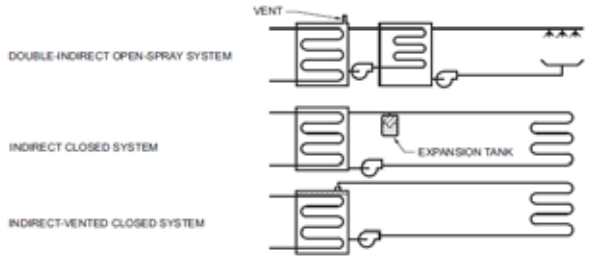
432

Section 1103 – Refrigeration System Classification

- **1103.2 – Occupancy classification**
  - Building occupancy classification is one of the three main factors that determine the quantity and application limits for refrigerants.
- **1103.3.1 – Low-probability systems**
  - Low-probability systems include the following:
    - Double-indirect open spray systems.
    - Indirect closed systems.
    - Indirect-vented closed systems.

433

1103.3.1 – Low-probability systems



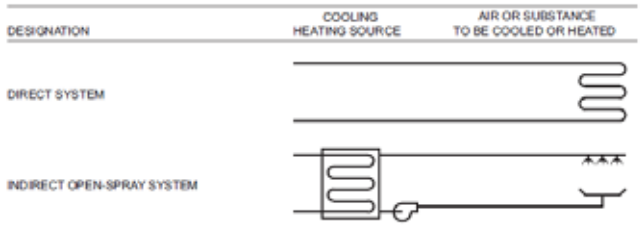
434

Section 1103 – Refrigeration System Classification

- **1103.3.2 – High-probability systems**
  - In a high-probability system, chances are good that system leakage will expose building occupants to refrigerant. High-probability systems include the following:
    - Direct systems
    - Indirect open-spray systems

435

1103.3.2 – High-probability systems



436

Section 1104 – System Application Requirements

- **1104.2 Machinery room**
  - Section establishes when a machinery room is required to house refrigeration systems if the amount of refrigerant in the system exceeds the amount indicated in Table 1103.1.
- **1104.4.1 – Noncommunicating spaces**
  - This section bases the allowed refrigerant amount on the worst case condition that
  - would result from a system leak (see Section 1104.4.2).

437

Section 1105 – Machinery Room, General Requirements

- **1105.3 – Refrigerant detector**
- **1105.5 – Fuel-burning appliances**
- **1105.6.3 - Ventilation rate**
- **1105.6.3 – Quantity—normal ventilation**
- **1105.6.4 – Quantity—emergency conditions**
- **1105.8 – Emergency pressure control system**

438

Section 1106 – Machinery Room, Special Requirements

This section provides specifications for machinery rooms as required by Section 1104.2. A machinery room must comply with Section 1105 and this section and is associated with the higher risk refrigerant Groups A2, A3, B2 and B3.

439

Section 1107 – Refrigerant Piping

This section has requirements for refrigerant piping that is located in open spaces, enclosed public stairways, stairway landings, means of egress and concrete floors. There are also requirements for refrigerant piping penetrations.

440

Section 1108 – Field Test

Mechanical refrigeration systems that are field constructed must be pressure tested. After a refrigeration system is assembled, a pressure test using air or an inert gas is required to determine if there are any leaks within the system. Dry nitrogen and carbon dioxide are suitable for testing of refrigeration equipment.

441

Section 1108 – Field Test

- **1108.2 – Test gases**
  - Dry nitrogen is the most commonly used test medium. Oxygen, air, combustible gases and mixtures containing these gases cannot be used.
- **1108.4 – Declaration**
  - Certificate can be in a form that is acceptable to the code official, documentation must be filed with the permit and inspection records.

442

Section 1109 – Periodic Testing

This section requires periodic testing of devices and systems. Frequency of testing is done in accordance with the manufacturer's instructions or as required by the code official if the frequency is not addressed by the manufacturer.

443

Chapter 11 Review

Follow the directions in your workbook on page 175 and complete the worksheet.

444

2015 IMC Chapter 12: Hydronic Piping

445

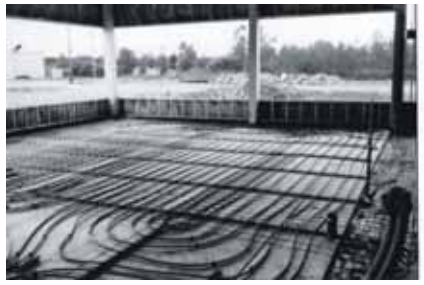
Chapter 12 – Hydronic Piping

- Includes piping, fittings and valves used in building space conditioning systems.
- Applications include hot water, chilled water, steam, steam condensate, brines and water/antifreeze mixtures.

446

Section 1202 – Material

Regulates the type and quality of materials that can be used in hydronic piping systems.



447

Section 1202 – Material

- **1202.1 – Piping**
  - The piping materials that are permitted for use in hydronic systems are listed in Section 1202.4 along with the applicable referenced standards.
- **1203.15 – Polyethylene plastic pipes and tubing for ground source heat pump loop systems**
  - Such systems use the earth as a heat source and utilize large circuits of buried piping.

448

Section 1204 – Pipe Insulation

Conserves energy by controlling heat gain and loss in hydronic piping systems.

449

Section 1206 – Piping Installation

Piping, valves, fittings and connections must be installed in accordance with:

- Manufacturer's installation instructions.
- Approved by code official

- **1206.3 – Protection of potable water**
  - Where direct connections are made to the potable water supply, such connections are required to be isolated from the potable water source in accordance with the IPC.

450

Section 1208 – Tests

Specifies hydronic system testing.

- **1208.1 – General**
  - All hydronic piping systems must be tested to determine that they are leak free and capable of withstanding the pressures to which they will be subjected.

451

Plastic pipe ground – source heat pump loop systems

- Water-based central heating and cooling systems utilizing the ambient temperatures of buried piping
- Materials, installation practices and testing shall be per this section

452

453

Chapter 12 Review

Follow the directions in your workbook on page 175 and complete the worksheet.

454

2015 IMC Chapter 13: Fuel Oil Piping and Storage

455

Chapter 13: Introduction

- Explains hazardous characteristics and physical characteristics of fuel oil and combustible liquids.
- Regulates the design, installation, construction and repair of fuel oil storage and piping systems.

456

Section 1301 - General

- **1301.2 – Storage and piping systems**
  - Storage systems must comply with the provisions of the IFC.
- **1301.5 – Tanks abandoned or removed**
  - This section is included for a new requirement to remove exterior above-grade piping when an oil tank is abandoned or removed.

457

Section – 1302 Material

2015 IMC, Table 1302.3 Page 119

Piping system materials must conform to standards listed in Table 1302.3.

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

458

Section 1303 – Joints and Connectors

Establishes requirements for brazed, mechanical, threaded and welded joints and connections in flammable and combustible liquid piping systems.

459

Section 1305 – Fuel Oil Installation

- Sets forth requirements that establish minimum sizing and physical protection for fuel oil systems.

460

Section 1305 – Fuel Oil Installation

- **1305.1 – Size**
  - Minimum size is required for fuel lines such that they are able to accommodate the maximum capacity of fuel required for the system.
- **1305.2 - Protection of pipe, equipment and appliances**
  - All fuel oil pipe, equipment and appliances must be protected from physical damage.

461

Section 1305 – Fuel Oil Installation

- **1305.2.1 - Flood hazard**
  - Fuel oil pipe, equipment and appliances located in flood hazard areas must be located above the elevation required by Section 1612 of the IBC for utilities and attendant equipment
  - Be capable of resisting hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding up to such elevation.

462

Section 1305 – Fuel Oil Installation

- **1305.6 – Fill piping**
- Requirements address:
  - Termination
  - Tamper prevention

463

Section 1305 – Fuel Oil Installation

- **Section 1305.7 – Vent piping**
- Requirements are related to:
  - Termination.
  - Vent caps.
  - Vent pipe height.
  - Purpose of vent pipe.

464

Chapter 13 Review

Follow the directions in your workbook on page 166 and complete the worksheet.

465

2015 IMC Chapter 14: Solar Systems

466

Chapter 14 – Solar Systems

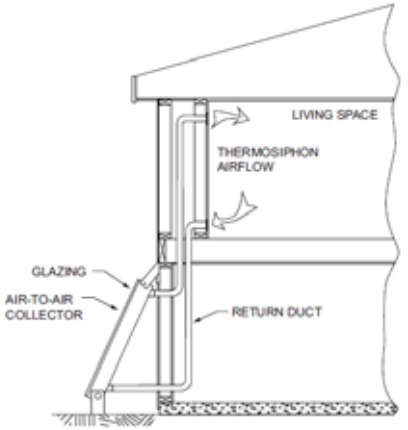
Commonly enhance the performance of, and work in conjunction with, conventional space heating systems.

- Solar heating and cooling systems are classified as either passive or active systems.

467

Chapter 14 – Solar Systems

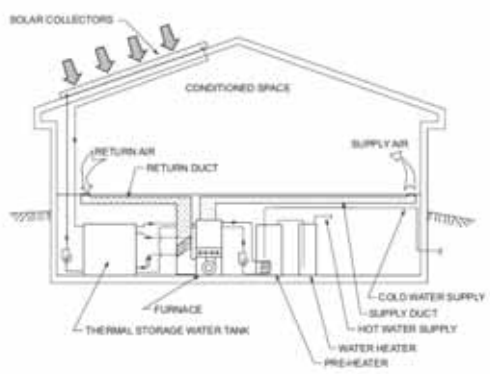
A passive solar energy system does not employ circulators or fans but relies on natural (gravity) flow.



468

Chapter 14 – Solar Systems

A complete active solar energy system includes circulators, fans and controls to move the heat transfer medium to the load or to an energy storage system.



469

Section 1401 – General

Encompasses all solar energy applications and includes the construction, installation, alteration and repair of all systems and equipment.

470

Section 1402 – Installation

Contains provisions to safeguard the building, building occupants and solar system equipment.

471

Section 1403 – Heat Transfer Fluids

- Criteria is established for flammable and combustible heat transfer liquids in the solar collection system
- Addresses the minimum temperature at which the liquid gives off sufficient vapor to form an ignitable mixture with air near the surface of the liquid (flashpoint).

472

Section 1404 – Materials

- Includes clarification that the items shown on the label are specific to the device on which the label is attached.

473

Chapter 14 Review

Follow the directions in your workbook on page 175 and complete the worksheet.

474

Final Reflection

This slide will help the learner to reflect on the day and what they will take back to the job and apply.

- **What?** What happened and what was observed in the training?
- **So what?** What did you learn? What difference did this training make?
- **Now what?** How will you do things differently back on the job as a result of this training?

475

International Code Council is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

476

Copyright Materials

477

Thank you for participating

To schedule a seminar, contact:

The ICC Training & Education Department
1-888-ICC-SAFE (422-7233) Ext. 33821
or
E-mail: learn@iccsafe.org

478