Fundamentals of the 2012 International Mechanical Code

Utah Chapter ICC
Est. 1967

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IMC 101.2 Scope

This code shall regulate the design, installation, maintenance, alteration and inspection of mechanical systems that are permanently installed and utilized to provide control of environmental conditions and related processes within buildings. This code shall also regulate those mechanical systems, system components, equipment and appliances specifically addressed herein. *The installation of fuel gas distribution piping and equipment, fuel gas-fired appliances and fuel gas-fired appliance venting systems shall be regulated by the International Fuel Gas Code.*

IMC- relationship with IFGC and IRC

- The IFGC regulates the design and installation of fuel gas distribution piping, appliances, venting, combustion air, gaseous hydrogen systems and motor vehicle gaseous-fuel-dispensing stations
  - Fuel gas: Natural, liquefied petroleum and manufactured gases
- IMC is completely developed and maintained by the *ICC* through the *Code Development Process*
- IFGC combined text developed and maintained by both *ICC* and *National Fuel Gas Code*
  - The National Fuel Gas Code is written by the American Gas Association (AGA), through their development process
  - ICC developed sections are noted (IFGC)
  - AGA developed sections are noted (IFGS)
- The IRC includes both portions of the IMC and the IFGC as they relate to one and two family dwellings

ICC/IFGC and AGA/IFGS

ICC developed sections are noted (IFGC)

AGA developed sections are noted (IFGS)

SECTION 401 (IFGC)
GENERAL

401.1 Scope. This chapter shall govern the design, installation, modification and maintenance of *piping* systems. The applicability of this code to *piping* systems extends from the *point of delivery* to the connections with the *appliance*s and includes the design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance of such *piping* systems.

SECTION 402 (IFGS)
PIPE SIZING

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

Definition: ACCESS (TO)

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

Do not confuse with ***Accessible or Accessibility***

Definition: READY ACCESS (TO)

That which enables a device, appliance or equipment to be directly reached, without requiring the removal or movement of any panel, door or similar obstruction [see “Access (to)”].

Do not confuse with ***Accessible or Accessibility***

Definition: APPLIANCE

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

Photo courtesy of Carrier Corporation

Figure 502.1(2)
CATEGORY IV APPLIANCE (FURNACE)

Definition: EQUIPMENT

All piping, ducts, vents, control devices and other components of systems other than appliances which are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

Definition: CONDITIONED SPACE (State Amendment)

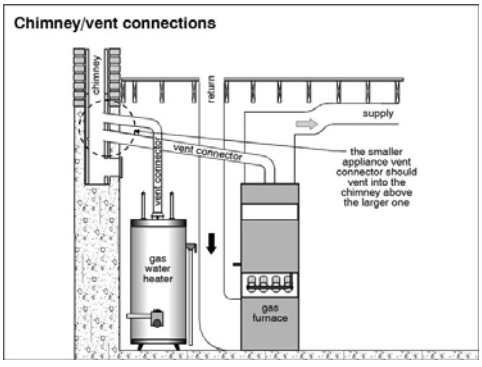
An area, room or space being heated or cooled ~~by any equipment or appliance.~~ enclosed within the building thermal envelope that is directly heated or cooled, or indirectly heated or cooled by any of the following means:

1. Openings directly into an adjacent conditioned space.
2. An un-insulated floor, ceiling or wall adjacent to a conditioned space.
3. Un-insulated duct, piping or other heat or cooling source within the space.

Definition: Connectors

- **CONNECTOR, APPLIANCE (Fuel).** Rigid metallic pipe and fittings, semi-rigid metallic tubing and fittings or a listed and labeled device that connects an appliance to the gas piping system

- **CONNECTOR, CHIMNEY OR VENT.** The pipe that connects an appliance to a chimney or vent



Definition: REGULATOR, MEDIUM-PRESSURE (MP Regulator)

A line pressure regulator that reduces gas pressure from the range of greater than 0.5 psig (3.4 kPa) and less than or equal to 5 psig (34.5 kPa) to a lower pressure.

Greater than 2 psig requires an OPD- over pressure device (5 psi meter sets)

LISTED

- Equipment, appliances or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment, appliances or materials, and whose listing states either that the equipment, appliance or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

Definition: VENTED APPLIANCE CATEGORIES (IFGC)

Appliances that are categorized for the purpose of vent selection are classified into the following four categories:

Category I. An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

Typical 78-80 efficient- furnaces, water heaters, unit heaters- open draft and induced draft

Category II. An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.

None produced at the time of printing of the 2012 codes

Category III. An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

78-83 efficient appliances that are side wall vented, typically stainless steel

Category IV. An appliance that operates with a positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.

Condensing appliances such as 90+% efficient furnaces, boilers and water heaters, usually vented with plastic piping

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APPLIANCE, FAN-ASSISTED COMBUSTION

An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber or heat exchanger.

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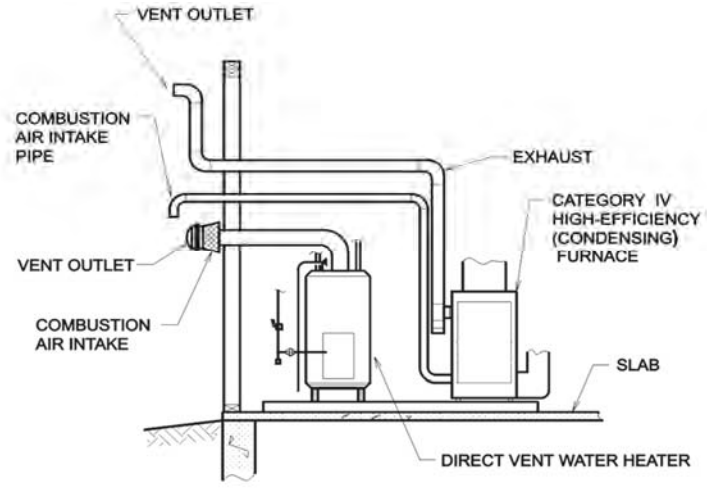
DRAFT HOOD

- A nonadjustable device built into an appliance, or made as part of the vent connector from an appliance, that is designed to (1) provide for ready escape of the flue gases from the appliance in the event of no draft, backdraft or stoppage beyond the draft hood, (2) prevent a backdraft from entering the appliance, and (3) neutralize the effect of stack action of the chimney or gas vent upon operation of the appliance

Definition: DIRECT-VENT APPLIANCES

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



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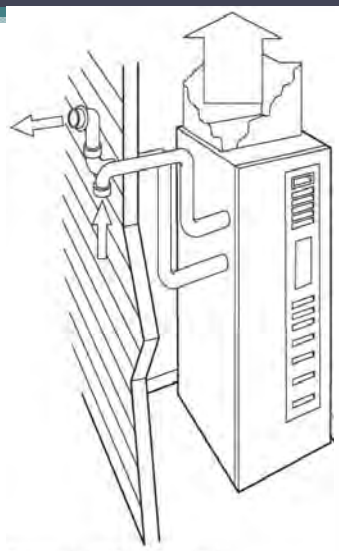

Figure courtesy of Carrier Corporation

Figure 503.2.3(1)
DIRECT-VENT APPLIANCE

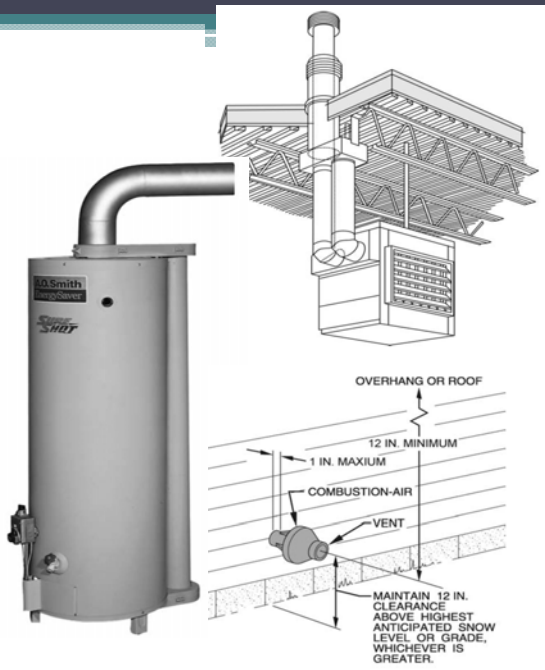

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Figure 502.1(1)
CATEGORY I FAN-ASSISTED FURNACE

Photo courtesy of Carrier Corporation

Figure 502.1(2)
CATEGORY IV APPLIANCE (FURNACE)

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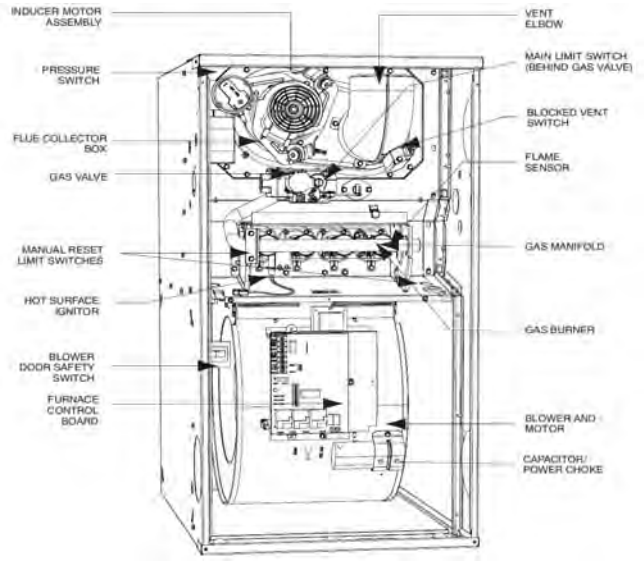
80 % Efficient Gas Furnace



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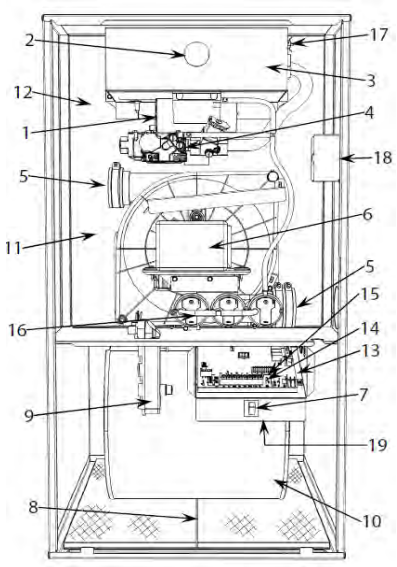
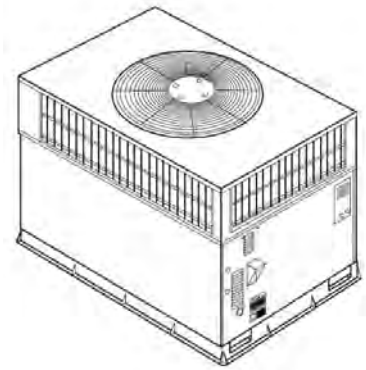
95% Efficient Gas Furnace



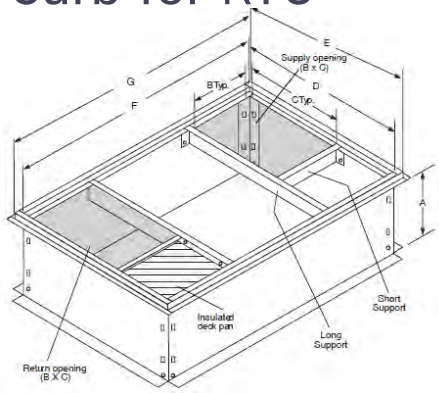
1. Combustion--air intake connection
2. Burner sight glass
3. Burner assembly (inside)
4. VariPhaset multi--stage redundant valve assembly
5. Vent outlet
6. Inducer motor
7. Blower access panel safety interlock switch.
8. Air filter and retainer (location in furnace may vary).
9. Condensate drain connection
10. Heavy--duty blower
11. Secondary condensing heat exchanger (inside).
12. Primary serpentine heat exchanger (inside)
13. Furnace control board.
14. 3--amp fuse
15. Light emitting diode (LED) on furnace control board.
16. Pressure switches
17. Rollout switch (manual reset)
19. Transformer (24v) behind furnace control board

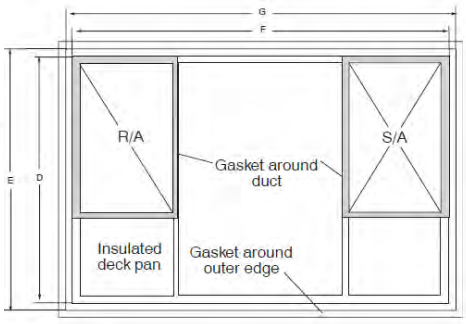
RTU's - Roof Top Units

- Package gas furnace and electric A/C
- 80% AFUE typical efficiency
- High SEER/EER cooling efficiency available
- Bottom or side discharge
- Simple to add OA or economizer



Roof Curb for RTU





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VENT

- A pipe or other conduit composed of factory-made components, containing a passageway for conveying combustion products and air to the atmosphere, listed and labeled for use with a specific type or class of appliance

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VENT- cont.

- **Special gas vent.** A vent listed and labeled for use with listed Category II, III and IV appliances
  - *Includes high temp plastic, stainless, PVC and CPVC pipes*
- **Type B vent.** A vent listed and labeled for use with appliances with draft hoods and other Category I appliances that are listed for use with Type B vents

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B-VENT

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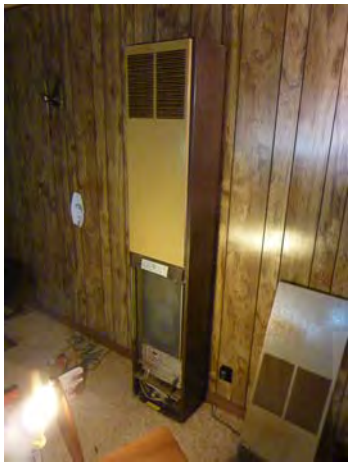
VENT- cont.

- **Type BW vent**
  A vent listed and labeled for use with wall furnaces



- **Type L vent.** A vent listed and labeled for use with appliances that are listed for use with Type L or Type B vents

  - *Type L vents are typically constructed of sheet steel and stainless steel*
  - *Type B vent cannot be used on appliance requiring type L vents*

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Induced draft venting system

- A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under non-positive static vent pressure

➢ *80% furnace currently produced are induced draft*

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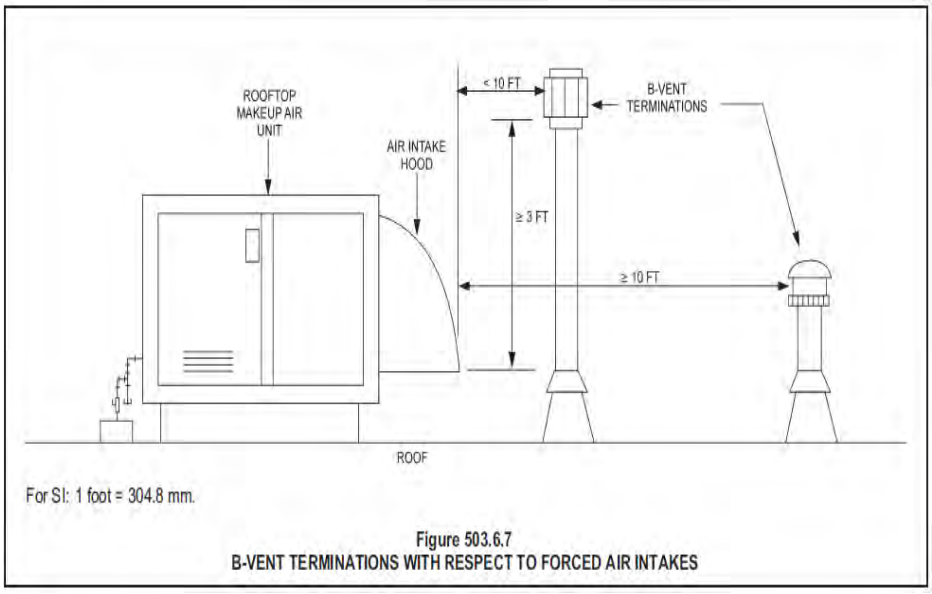

Figure 503.6.7
B-VENT TERMINATIONS WITH RESPECT TO FORCED AIR INTAKES

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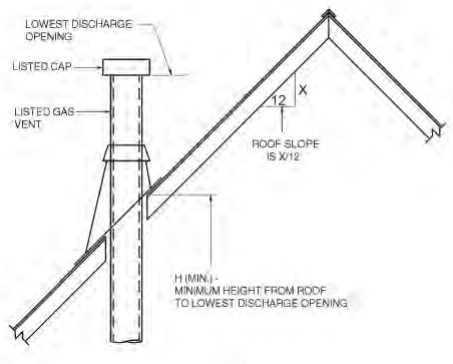

ROOF SLOPE	H (min) ft
Flat to 6/12	1.0
Over 6/12 to 7/12	1.25
Over 7/12 to 8/12	1.5
Over 8/12 to 9/12	2.0
Over 9/12 to 10/12	2.5
Over 10/12 to 11/12	3.25
Over 11/12 to 12/12	4.0
Over 12/12 to 14/12	5.0
Over 14/12 to 16/12	6.0
Over 16/12 to 18/12	7.0
Over 18/12 to 20/12	7.5
Over 20/12 to 21/12	8.0

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

FIGURE 503.6.4
TERMINATION LOCATIONS FOR GAS VENTS WITH LISTED CAPS 12 INCHES OR LESS IN SIZE AT LEAST 8 FEET FROM A VERTICAL WALL

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Manufacturer's Instructions are Important / Mandatory

- IMC 304.1- Equipment and appliances shall be installed as required by the terms of their approval, *in accordance with the conditions of the listing, the manufacturer's installation and this code.* Manufacturer's installation instructions shall be available on the job site at the time of inspection
- IRC M1307.1- Installation of appliances shall *conform to the conditions of their listing and label and the manufacturer's installation instructions*

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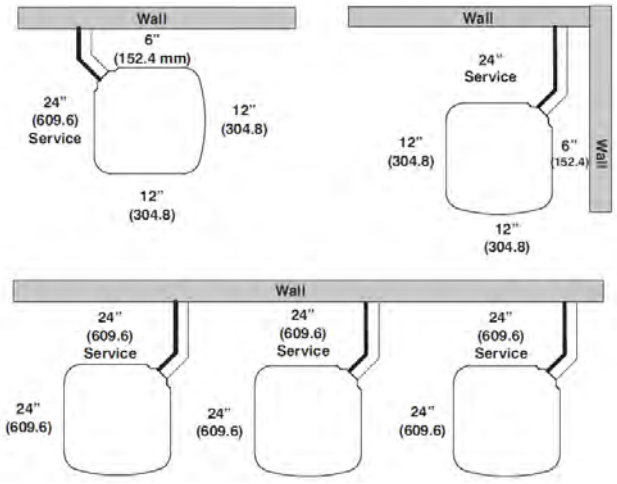
Installation Instructions include clearances for airflow and service



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-Clearance required above unit- typically 6’ to 8’ above the unit -Do not want to re-circulate air

Single Dwelling Unit Sheet Metal Gages

TABLE 603.4
DUCT CONSTRUCTION MINIMUM SHEET METAL THICKNESSES FOR SINGLE DWELLING UNITS

DUCT SIZE	GALVANIZED		ALUMINUM
	Minimum thickness (in.)	Equivalent galvanized gage no.	MINIMUM THICKNESS (in.)
Round ducts and enclosed rectangular ducts			
14 inches or less	0.0157	28	0.0175
16 and 18 inches	0.0187	26	0.018
20 inches and over	0.0236	24	0.023
Exposed rectangular ducts			
14 inches or less	0.0157	28	0.0175
Over 14 inches[a]	0.0187	26	0.018

For SI: 1 inch = 25.4 mm, 1 inch water gage = 249 Pa.

a. For duct gages and reinforcement requirements at static pressures of $^{1}/_{2}$-inch, 1-inch and 2-inch w.g., SMACNA *HVAC Duct Construction Standards*, Tables 2-1, 2-2 and 2-3, shall apply.

State Amendment - 15A-3-401

- Up to and including 8" – 30 gage galvanized allowed
- 8" through 14"- 28 gage galvanized allowed

DRYER VENTS- RESIDENTIAL

- If a space is provide for a dryer, dryer vent must be installed
- Must be independent and convey moisture to outside (exception- listed, labeled condensing)
- Manufacturers instructions
- Terminate 3' from openings- backdraft damper required
- Screen are not allowed

Dryer vents- ducts

- 4” diameter, supported every 4’
- No screw protruding into the interior
- This changes in 2012 code where mechanical fastening is required- screw if used cannot protrude more than 1/8” into the inside of the duct
- Crimps ran in the direction of flow
- Transition duct listed and labeled in accordance with UL 2158A

Dryer Vents- ducts- cont.

- Maximum length 35’ (by State Amendment in the IRC)
- Length reduced for fittings per Table M1502.4.4.1- (next slide)
- Option- per manufacturer’s instructions
- Length must be identified with a permanent tag if duct is concealed within building construction

TABLE M1502.4.4.1

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.

2009 INTERNATIONAL RESIDENTIAL CODE®

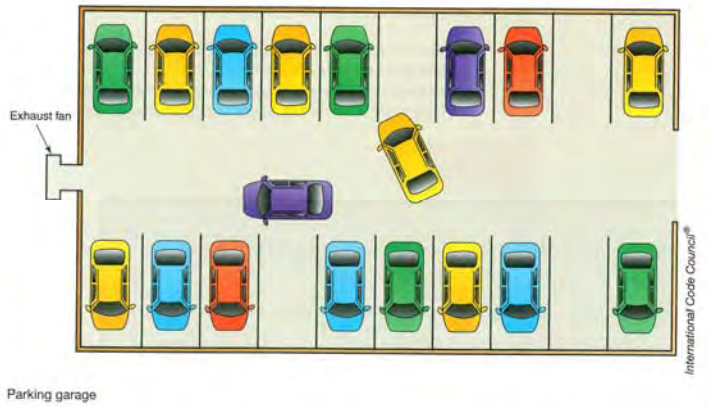
Permanent Label

Significant Changes in 2012 Code

(with discussion on the existing, unchanged code)

Definition: Environmental Air

2012 CODE: 202 Environmental Air: Air that is conveyed to or from occupied areas through ducts which are not part of the heating or air-conditioning system, such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust, ~~and~~ domestic clothes dryer exhaust and parking garage exhaust.



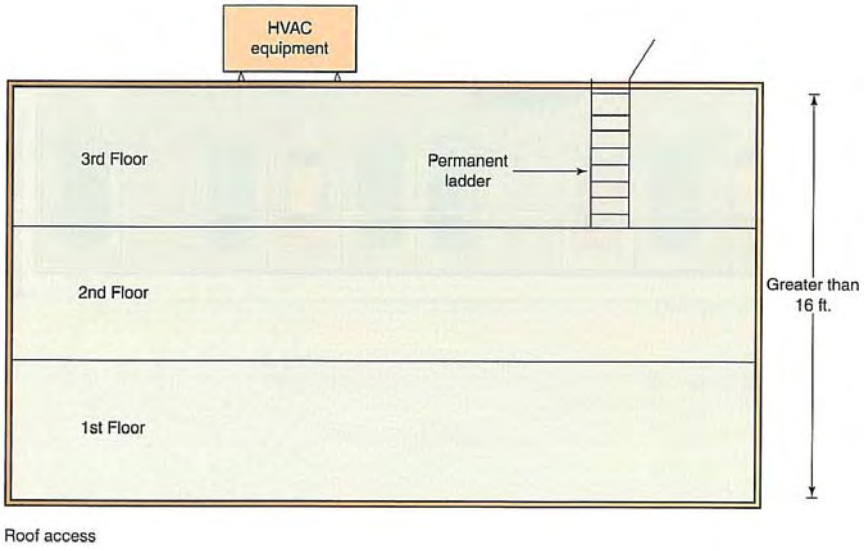
Equipment & Appliances on Roofs or Elevated Structures

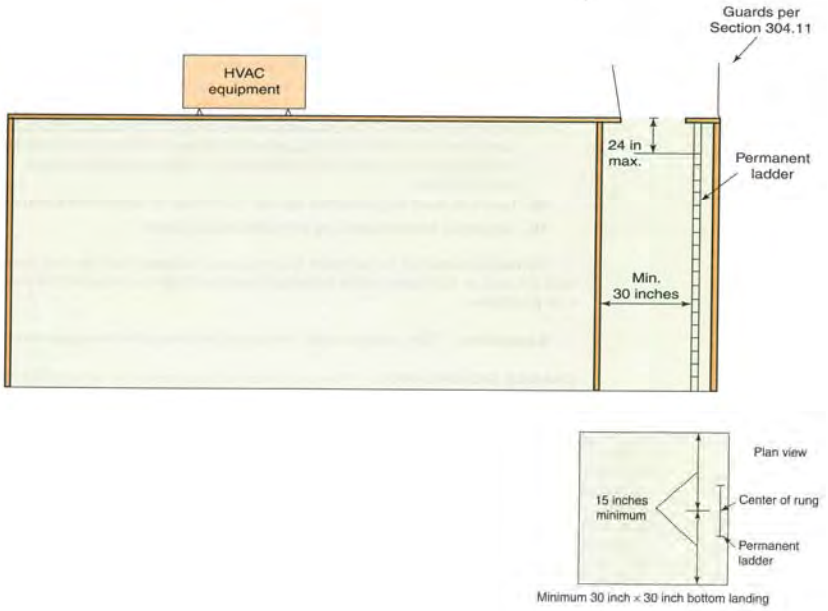
2012 CODE: 306.5 Equipment and Appliances on Roofs or Elevated Structures. Where equipment requiring access ~~and~~ or appliances are ~~installed on roofs or elevated structures at a height exceeding 16 feet (4877 mm), such access shall be provided by a permanent approved means of access, the extent of which shall be from grade or floor level to the equipment and appliances' level service space~~ located on an elevated structure or the roof of a building such that personnel will have to climb higher than 16 feet (4877 mm) above grade to access such equipment or appliances, an interior or exterior means of access shall be provided. Such access shall not require climbing over obstructions greater than 30 inches (762 mm) in height or walking on roofs having a slope greater than 4 units vertical in 12 units horizontal (33-percent slope). Such access shall not require the use of portable ladders. Where access involves climbing over parapet walls, the height shall be measured to the top of the parapet wall.

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

1. The side railing shall extend above the parapet or roof edge not less than 30 inches (762 mm).
2. Ladders shall have rung spacing not to exceed 14 inches (356 mm) on center. The upper-most rung shall be a maximum of 24 inches (610 mm) below the upper edge of the roof hatch, roof or parapet, as applicable.
3. Ladders shall have a toe spacing not less than 6 inches (152 mm) deep.
4. There shall be a minimum of 18 inches (457 mm) between rails.
5. Rungs shall have a minimum 0.75-inch (19 mm) diameter and be capable of withstanding a 300-pound (136.1kg) load.
6. Ladders over 30 feet (9144 mm) in height shall be provided with offset sections and landings capable of withstanding 100 pounds per square foot (488.2 kg/m2). Landing dimensions shall be not less than 18 inches (457 mm) and not less than the width of the ladder served. A guard rail shall be provided on all open sides of the landing.

7. Climbing clearance. The distance from the centerline of the rungs to the nearest permanent object on the climbing side of the ladder shall be a minimum of 30 inches (762 mm) measured perpendicular to the rungs. This distance shall be maintained from the point of ladder access to the bottom of the roof hatch. A minimum clear width of 15-inches (381 mm) shall be provided on both sides of the ladder measured from the midpoint of and parallel with the rungs except where cages or wells are installed.
8. Landing required. The ladder shall be provided with a clear and unobstructed bottom landing area having a minimum dimension of 30 inches (762 mm) by 30 inches (762 mm) centered in front of the ladder.
~~7~~9. Ladders shall be protected against corrosion by approved means.
10. Access to ladders shall be provided at all times.

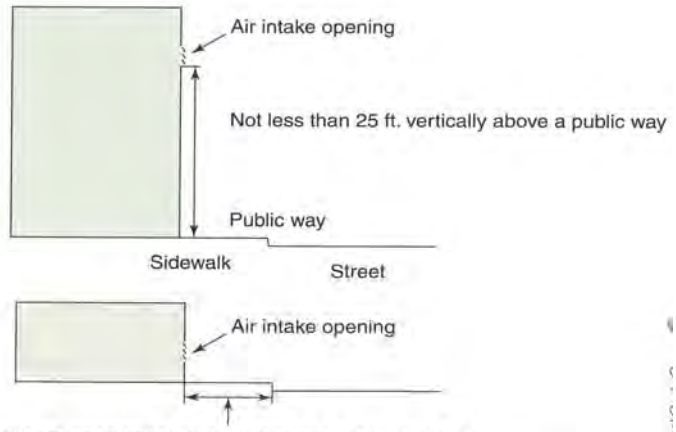




2012 CODE: 401.4 Intake Opening Location. Air intake openings shall comply with all of the following:

1. Intake openings shall be located a minimum of 10 feet (3048 mm) from lot lines or buildings on the same lot. ~~Where openings front on a street or public way, the distance shall be measured to the centerline of the street or public way.~~
2. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.2.1. Outdoor air intake openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such locations. Where openings front on a street or public way the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening.
4. Intake openings on structures in flood hazard areas shall be at or above the ~~design flood level~~ elevation required by Section 1612 of the *International Building Code* for utilities and attendant equipment.

Intake Opening Location



Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way

TABLE 403.3 Minimum Ventilation Rates

Occupancy Classification	~~People Outdoor Airflow Rate In Breathing Zone R_p CFM/Person~~ Occupant Density #/1000 ft² [2a]	~~Area Outdoor Airflow Rate In Breathing Zone R_a CFM/FT²~~ [2a] People Outdoor Airflow Rate In Breathing Zone R_p CFM/Person	~~Default Occupant Density #/1000 ft²~~ [2a] Area Outdoor Airflow Rate In Breathing Zone R_a CFM/FT²	Exhaust Airflow Rate CFM/FT²
Beauty ~~and nail~~ salons [b, h]	20	0.12	25	0.6
Nail Salons [b,h]	25	20	0.12	0.6

e. Rates are per water closet or urinal. ~~The higher rate shall be provided where periods of heavy use are expected to occur, such as, toilets in theaters, schools, and sports facilities. The lower rate shall be permitted where periods of heavy use are not expected.~~ The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.

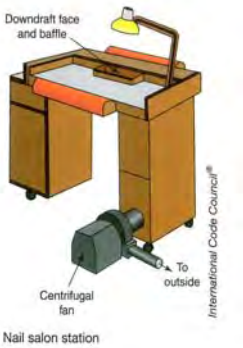
f. Rates are per room unless otherwise indicated. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied ~~normal hours of use~~.

h. For nail salons, ~~the required exhaust shall include ventilation tables or other systems that capture the contaminants and odors at their source and are capable of exhausting a minimum of 50 cfm per station~~ each nail station shall be provided with a source capture system capable of exhausting not less than 50 cfm per station.

[No changes to portions of table and footnotes not shown.]

Table 403.3

Minimum Ventilation Rates for Nail Salons



Nail salon station

Further discussion later in presentation

Enclosed Parking Garages

Carbon monoxide detector *(Courtesy of Brasch Manufacturing Co.)*

2012 CODE: 404.1 Enclosed Parking Garages. Mechanical ventilation systems for enclosed parking garages shall be permitted to operate intermittently in accordance with Item 1, Item 2 or both. ~~where~~

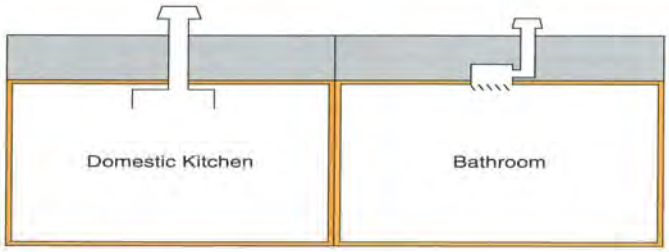
1. The system ~~is~~ shall be arranged to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices.
2. The system shall be arranged to operate automatically by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors. Such detectors shall be installed in accordance with their manufacturers' recommendations.

Exhaust Systems- General Requirements

2012 CODE: 501.2 Independent System Required. Single or combined mechanical exhaust systems for environmental air shall be independent of all other exhaust systems. Dryer exhaust shall be independent of all other systems. Type I exhaust systems shall be independent of all other exhaust systems except as provided in Section 506.3.5. Single or combined Type II exhaust systems for food-processing operations shall be independent of all other exhaust systems. Kitchen exhaust systems shall be constructed in accordance with Section 505 for domestic equipment and Sections 506 through 509 for commercial equipment.

Domestic Kitchen Exhaust Systems

2012 CODE: 505.1 Domestic Systems. Where domestic range hoods and domestic appliances equipped with downdraft exhaust are located within dwelling units, such hoods and appliances shall discharge to the outdoors through sheet metal ducts constructed of galvanized steel, stainless steel, aluminum or copper. Such ducts shall have smooth inner walls, ~~and~~ shall be air tight, and shall be equipped with a back-draft damper, and shall be independent of all other exhaust systems.

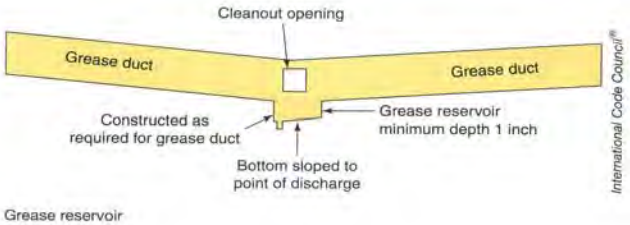


Independent domestic exhaust system

Grease Reservoirs

2012 CODE: 506.3.7.1 Grease Reservoirs. Grease reservoirs shall:

1. Be constructed as required for the grease duct it serves.
2. Be located on the bottom of the horizontal duct or the bottommost section of the duct riser.
3. Have a length and width of not less than 12 inches. Where the grease duct is less than 12 inches in a dimension, the reservoir shall be not more than 2 inches smaller than the duct in that dimension.
4. Have a depth of not less than 1 inch.
5. Have a bottom that is sloped to a point for drainage.
6. Be provided with a cleanout opening constructed in accordance with Section 506.3.8 and installed to provide direct access to the reservoir. The cleanout opening shall be located on a side or on top of the duct so as to permit cleaning of the reservoir.
7. Be installed in accordance with the manufacturer's installation instructions where manufactured devices are utilized.

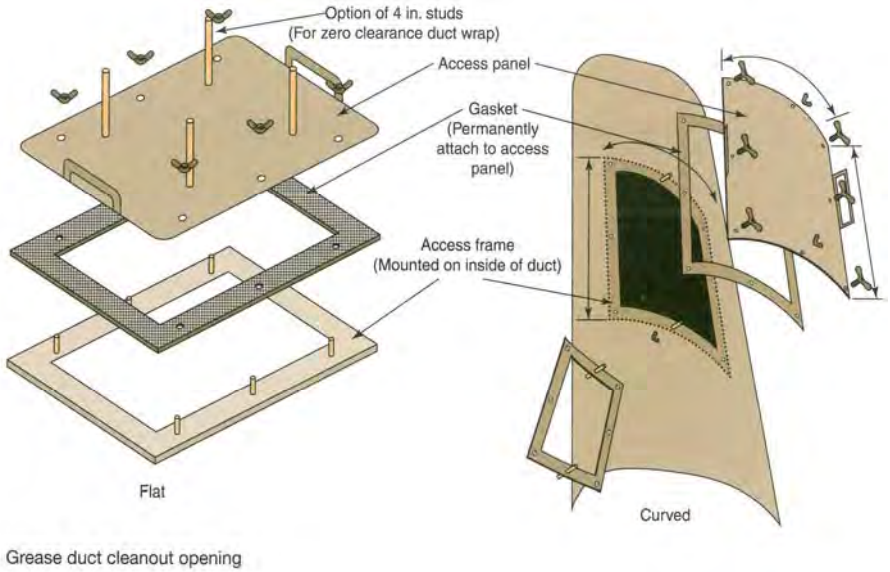


Grease reservoir

506.3.8- Grease Duct Cleanouts and Other openings:

2012 CODE: 506.3.8 Grease Duct Cleanouts and Other Openings.
Grease duct cleanouts and openings shall comply with all of the following:

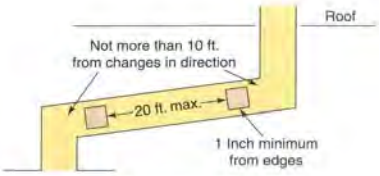
1. Grease ducts shall not have openings except where required for the operation and maintenance of the system.
2. Sections of grease ducts that are inaccessible from the hood or discharge openings shall be provided with cleanout openings.
3. Cleanouts and openings shall be equipped with tight fitting doors constructed of steel having a thickness not less than that required for the duct.
4. Cleanout doors shall be installed liquid tight.
5. Door assemblies including any frames and gaskets shall be approved for the application and shall not have fasteners that penetrate the duct.
6. Gasket and sealing materials shall be rated for not less than 1500 degrees F (815.6 C).
7. Listed door assemblies shall be installed in accordance with the manufacturer's installation instructions.



Grease duct cleanout opening

506.3.9 Grease Duct Horizontal Cleanouts-Cleanouts serving horizontal sections of grease duct shall:

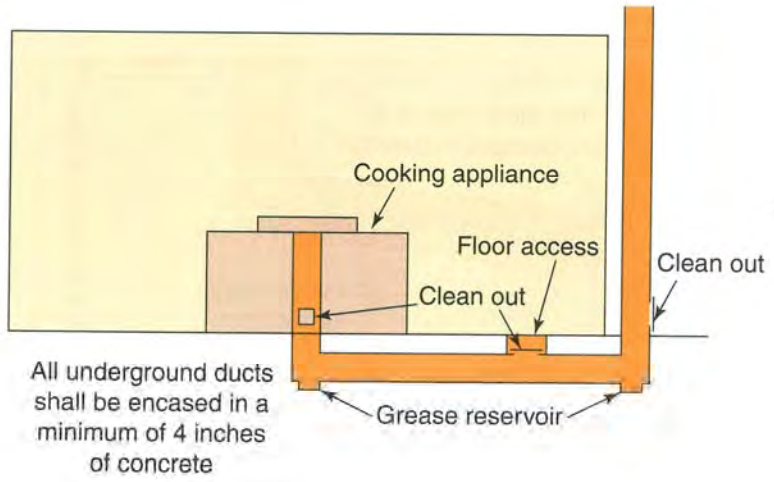
1. Be spaced not more than 20 feet apart.
2. Be located not more than 10 feet from changes in direction that are greater than 45 degrees.
3. Be located on the bottom only where no other locations are available and shall be provided with internal damming of the opening such that grease will flow past the opening without pooling. Bottom cleanouts and openings shall be approved for the application and installed liquid tight.
4. Not be closer than 1 inch from the edges of the duct.
5. Have opening dimensions of not less than 12 inches by 12 inches. Where such dimensions preclude installation, the opening shall be not less than 12 inches on one side and shall be large enough to provide access for cleaning and maintenance.
6. Shall be located at grease reservoirs.



Horizontal grease duct cleanout opening

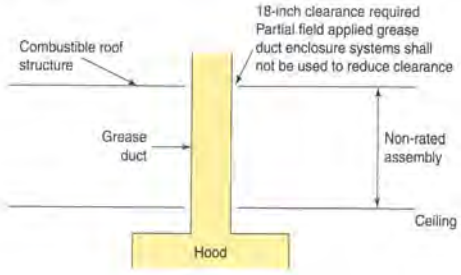
2012 CODE: 506.3.10 Underground Grease Duct Installation. Underground grease duct installations shall comply with all of the following:

1. Underground grease ducts shall be constructed of steel having a minimum thickness of 0.0575 inch (1.463mm) (No. 16 gage) and shall be coated to provide protection from corrosion or shall be constructed of stainless steel having a minimum thickness of 0.0450 inch (1.1400 mm) (No.18 gage).
2. The underground duct system shall be tested and approved in accordance with Section 506.3.2.5 prior to coating or placement in the ground.
3. The underground duct system shall be completely encased in concrete with a minimum thickness of 4 inches.
4. Ducts shall slope toward grease reservoirs.
5. A grease reservoir with a cleanout to allow cleaning of the reservoir shall be provided at the base of each vertical duct riser.
6. Cleanouts shall be provided with access to permit cleaning and inspection of the duct in accordance with Section 506.3.
7. Cleanouts in horizontal ducts shall be installed on the topside of the duct.
8. Cleanout locations shall be legibly identified at the point of access from the interior space



Underground grease duct

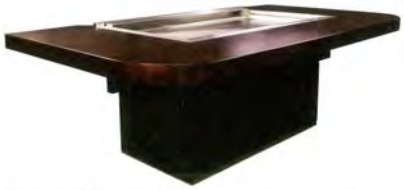
2012 CODE: 506.3.11.2 Field-Applied Grease Duct Enclosure. Commercial kitchen grease ducts constructed in accordance with Section 506.3.1 shall be enclosed by field-applied grease duct enclosure that is a listed and labeled material, system, product, or method of construction specifically evaluated for such purpose in accordance with ASTM E2336. The surface of the duct shall be continuously covered on all sides from the point at which the duct originates to the outlet terminal. Duct penetrations shall be protected with a through-penetration fire-stop system classified in accordance with ASTM E814 or UL 1497 and having a "F" and "T" rating equal to the fire-resistance rating of the assembly being penetrated. Such systems shall be installed in accordance with the listing and the manufacturer's installation instructions. Partial application of a field-applied grease duct enclosure system shall not be installed for the sole purpose of reducing clearance to combustibles at isolated sections of grease duct. Exposed duct-wrap systems shall be protected where subject to physical damage.



Type I or Type II Hood Required

2012 CODE: 507.2 Where Required. A Type I or Type II hood shall be installed at or above all commercial cooking appliances in accordance with Sections 507.2.1 and 507.2.2. Where any cooking appliance under a single hood requires a Type I hood, a Type I hood shall be installed. Where a Type II hood is required, a Type I or Type II hood shall be installed.

Exception: Where cooking appliances are equipped with integral down-draft exhaust systems and such appliances and exhaust systems are listed and labeled for the application, in accordance with NFPA 96, a hood shall not be required at or above them.



Hibachi table with integral downdraft exhaust system *(Courtesy of Roaster Tech)*

Type I Hoods

2012 CODE: 507.2.1 Type I Hoods. Type I hoods shall be installed where cooking appliances produce grease or smoke as a result of the cooking process. Type I hoods shall be installed over medium-duty, heavy-duty and extra-heavy-duty cooking appliances. Type I hoods shall be installed over light-duty cooking appliances that produce grease or smoke.

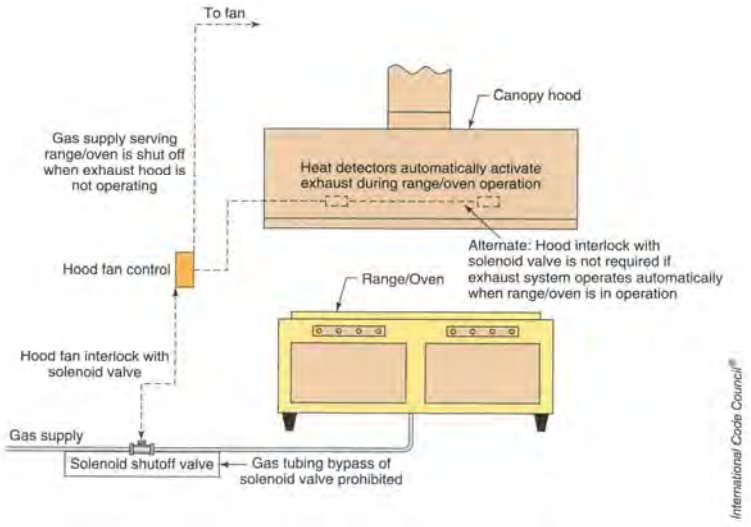
Exception: A Type I hood shall not be required for an electric cooking appliance where an approved testing agency provides documentation that the appliance effluent contains 5 mg/m^3 or less of grease when tested at an exhaust flow rate of 500 cfm (0.236 m^3/s) in accordance with Section 17 of UL 710B.

Electric oven where a hood is not required *(Courtesy of TurboChef Global)*

Operation of Type I Hoods

2012 CODE: 507.2.1.1 Operation. Type I hood systems shall be designed and installed to automatically activate the exhaust fan whenever cooking operations occur. The activation of the exhaust fan shall occur through an interlock with the cooking appliances, by means of heat sensors or by means of other approved methods. A method of interlock between an exhaust hood system and appliances equipped with standing pilot burners shall not cause the pilot burners to be extinguished. A method of interlock between an exhaust hood system and cooking appliances shall not involve or depend upon any component of a fire extinguishing system.

Operation of Type I Hoods

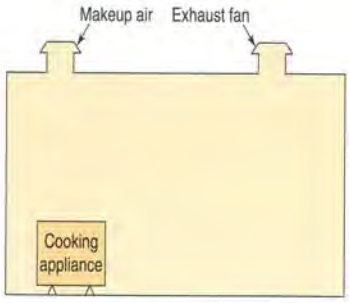


Exhaust Flow Rate for Type I Hoods

2012 CODE: 507 .2.1.2 Exhaust Flow Rate Label. **Type I hoods** shall bear a label indicating the minimum exhaust flow rate in CFM per linear foot of hood that provides for capture and containment of the exhaust effluent for the cooking appliances served by the hood, based on the cooking appliance duty classifications defined in this code.

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

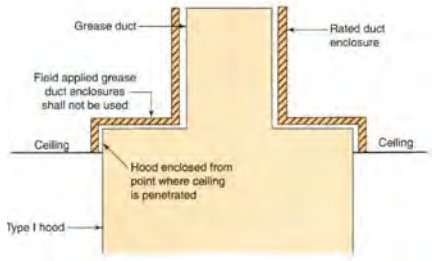
2012 CODE: 507.2.2 Type II Hoods. Type II hoods shall be installed above dishwashers and appliances that produce heat or moisture and do not produce grease or smoke as a result of the cooking process, except where the heat or moisture loads from such appliances are incorporated into the HVAC system design or into the design of a separate removal system. Type II hoods shall be installed above all light duty appliances that produce products of combustion and do not produce grease or smoke as a result of the cooking process. Spaces containing cooking appliances that do not require Type II hoods shall be ~~ventilated~~ provided with exhaust at a rate of 0.70 cfm per square foot (0.00033 m^3/s). ~~in accordance with Section 403.3.~~ For the purpose of determining the floor area required to be ~~ventilated~~ exhausted, each individual appliance that is not required to be installed under a Type II hood shall be considered as occupying not less than 100 square feet. Such additional square footage shall be provided with exhaust at a rate of 0.70 cfm per square foot.



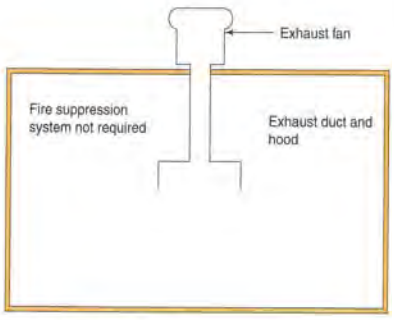
Room = 2000 sq.ft.
Cooking appliance = 100 sq.ft.
2100 x 0.70 = 1470 CFM of exhaust required

Hoods Penetrating a Ceiling

2012 CODE: 507.10 Hoods Penetrating a Ceiling. Type I hoods or portions thereof penetrating a ceiling, wall or furred space shall comply with Section 506.3.11. Field-applied grease duct enclosure systems, as addressed in Section 506.3.11.2, shall not be utilized to satisfy the requirements of this section.



Fire suppression Required for Hazardous Exhaust Ducts



Semiconductor fabrication facility

2012 CODE: 510.7 Suppression Required. Ducts shall be protected with an approved automatic fire suppression system installed in accordance with the *International Building Code*.

Exceptions:

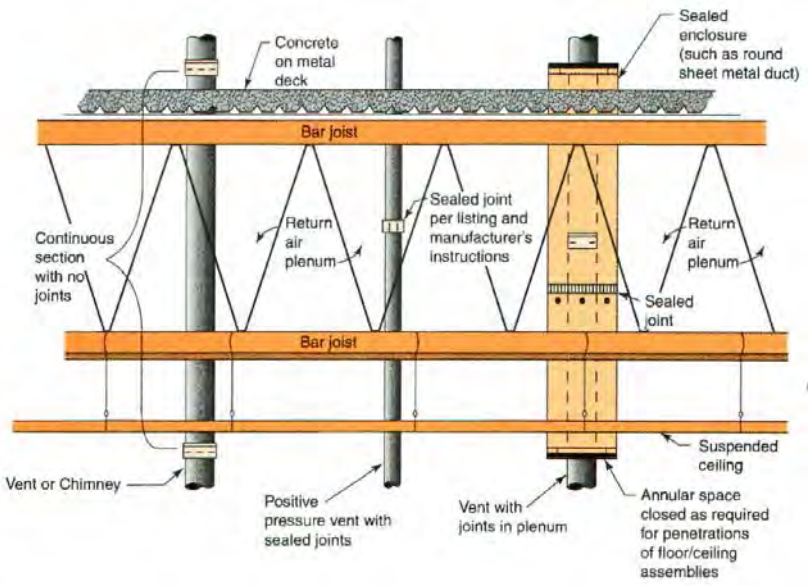
1. An approved automatic fire suppression system shall not be required in ducts conveying materials, fumes, mists and vapors that are nonflammable and noncombustible under all conditions and at any concentrations.
2. Automatic fire suppression systems shall not be required in metallic and noncombustible nonmetallic exhaust ducts in semiconductor fabrication facilities.
2. 3. An approved automatic fire suppression system shall not be required in ducts where the largest cross-sectional diameter of the duct is less than 10 inches (254 mm).
3. 4. For laboratories, as defined in Section 510.1, automatic fire protection systems shall not be required in laboratory hoods or exhaust systems.

Contamination Prevention in Plenums

2012 CODE: 601.4 Contamination Prevention. Exhaust ducts under positive pressure, chimneys and vents shall not extend into or pass through ducts or plenums.

Exceptions:

1. Exhaust systems located in ceiling return air plenums over spaces that are permitted to have 10 percent recirculation in accordance with Section 403.2.1, Item 4. The exhaust duct joints, seams, and connections shall comply with Section 603.9.
2. This section shall not apply to chimneys and vents that pass through plenums where such venting systems comply with one of the following requirements:
   - 2.1. The venting system shall be listed for positive pressure applications and shall be sealed in accordance with the vent manufacturer's instructions.
   - 2.2. The venting system shall be installed such that fittings and joints between sections are not installed in the above ceiling space.
   - 2.3. The venting system shall be installed in a conduit or enclosure with sealed joints separating the interior of the conduit or enclosure from the ceiling space.

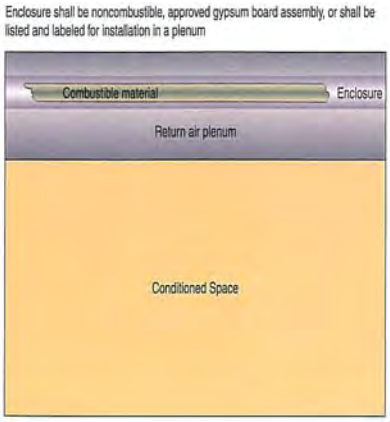


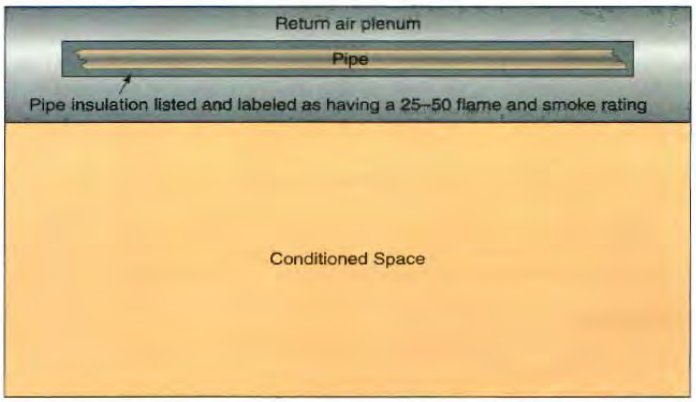
Materials within Plenums

2012 CODE: 602.2.1 Materials within Plenums. Except as required by Sections 602.2.1.1 through ~~602.2.1.6~~ 602.2.1.5 materials within plenums shall be noncombustible or shall be listed and labeled as having a flame spread index 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.

Exceptions:

1. Rigid and flexible ducts and connectors shall conform to Section 603.
2. Duct coverings, linings, tape and connectors shall conform to Sections 603 and 604.
3. This section shall not apply to materials exposed within plenums in one- and two-family dwellings.
4. This section shall not apply to smoke detectors.
5. Combustible materials fully enclosed within one of the following:
   - 5.1. Continuous noncombustible raceways or enclosures
   - 5.2. Approved gypsum board assemblies
   - 5.3. ~~Within~~ Materials listed and labeled for ~~such application~~ installation within a plenum.

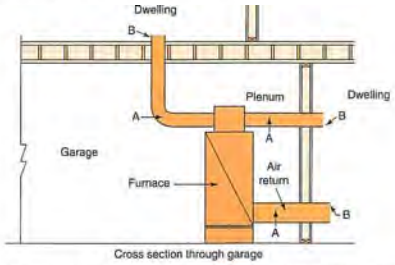




All material within a plenum shall be noncombustible or shall be listed and labeled as having a flame spread rating of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E-84 or UL 728

6. Materials in Group H, Division 5 fabrication areas and the areas above and below the fabrication area that share a common air recirculation path with the fabrication area.

2012 CODE: 603.7 Rigid Duct Penetrations. Duct system penetrations of walls, floors, ceilings and roofs and air transfer openings in such building components shall be protected as required by Section 607. Ducts in a private garage ~~and ducts~~ that penetrate~~ing~~ ~~the~~ a walls or ceilings that ~~separating~~ separates a dwelling from a private garage shall be continuous, ~~and~~ shall be constructed of sheet steel having a minimum thickness of ~~26 gage~~ 0.0187 inch (0.4712 mm) (No. 26 gage) ~~galvanized sheet metal~~ and shall not have openings into the garage. Fire and smoke dampers are not required in such ducts passing through the wall or ceiling separating a dwelling from a private garage except where required by Chapter 7 of the *International Building Code*.



Cross section through garage

Ducts A - 0.019 inch (No. 26 gauge) galvanized steel with no openings into garage
Ducts B - Any duct approved by the Mechanical Code

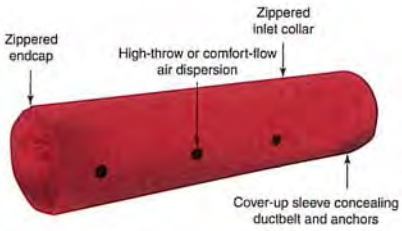
2012 CODE: 603.9 Joints, Seams, and Connections. All longitudal and transverse joints, seams and connections in metallic and nonmetallic ducts shall be constructed as specified in SMACNA HVAC Duct Construction Standards—Metal and Flexible and NAIMA Fibrous Glass Duct Construction Standards. All joints, longitudinal and transverse seams, and connections in ductwork shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded- fabric systems, liquid sealants or tapes. Closure systems used to seal ductwork listed and labeled in accordance with UL 181A shall be marked "181A-P" for pressure-sensitive tape, "181 A-M" for mastic or "181 A-H" for heat-sensitive tape. Closure systems used to seal flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked "181B-FX" for pressure-sensitive tape or "181B-M" for mastic. Duct connections to flanges of air distribution system equipment shall be sealed and mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked "181B-C." Closure systems used to seal metal ductwork shall be installed in accordance with the manufacturer's installation instructions. Unlisted duct tape is not permitted as a sealant on any ~~metal~~ duct.

Does the code restricted listed duct tape from use on sheet metal only duct?

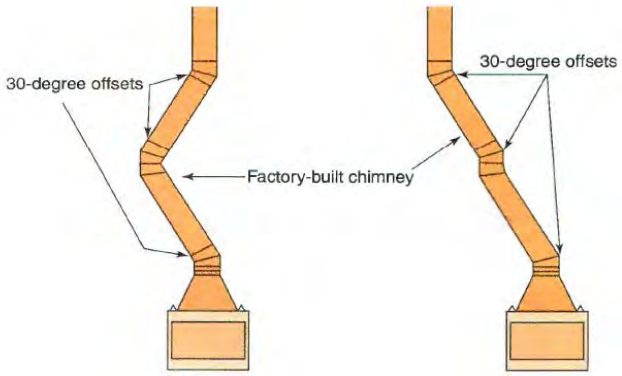
2012 CODE: 202 Air Dispersion System. Any diffuser system designed to both convey air within a room, space or area and diffuse air into that space while operating under positive pressure. Systems are commonly constructed of, but not limited to, fabric or plastic film.

603.17. Air dispersion systems. Air dispersion systems shall:

1. Be installed entirely in exposed locations.
2. Be utilized 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.



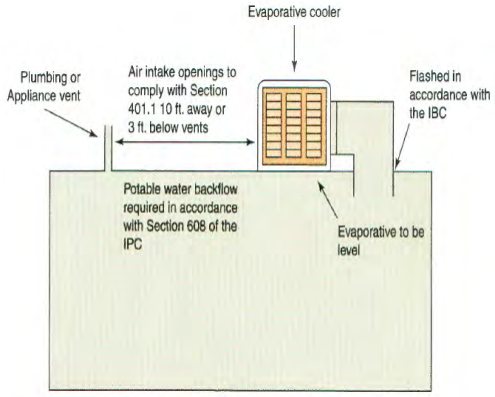
2012 CODE: 805.3 Factory Built Chimney Offsets. Where a factory-built chimney assembly incorporates offsets, no part of the chimney shall be at an angle of more than 30 degrees from vertical at any point in the assembly and the chimney assembly shall not include more than 4 elbows.



SECTION 928
EVAPORATIVE COOLING EQUIPMENT

928.1 General. Evaporative cooling equipment shall:

1. Be installed in accordance with the manufacturer 's installation instructions.
2. Be installed on level platforms in accordance with section 304.10.
3. Have openings in exterior walls or roofs flashed in accordance with the *International Building Code.*
4. Be provided with potable water backflow protection in accordance with Section 608 of the *International Plumbing Code.*
5 . Have air intake opening locations in accordance with Section 401.4.



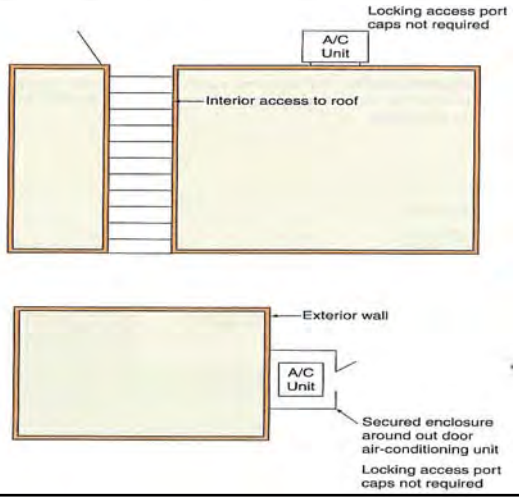
Fireplace Accessories

2012 CODE: 901.4 Fireplace Accessories. Listed and labeled fireplace accessories shall be installed in accordance with the conditions of the listing and the manufacturer's installation instructions. Fireplace accessories shall comply with UL 907.

Listed outside air intake regulator for masonry fireplace

2012 CODE: 1101.10 Locking Access Port Caps. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper-resistant caps or shall be otherwise secured to prevent unauthorized access.

Locking Access Port Cap requirements have been eliminated from the codes by state amendment

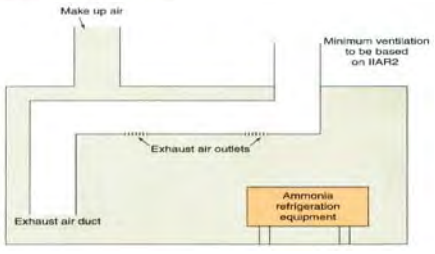


2012 CODE: 1105.6 Ventilation. Machinery rooms shall be mechanically ventilated to the outdoors. ~~Mechanical ventilation shall be capable of exhausting the minimum quality of air both at the normal operating and emergency conditions. Multiple fans or multispeed fans shall be allowed in order to produce the emergency ventilation rate and to obtain a reduced airflow for normal ventilation.~~

Exception: (no changes to text)

1105.6.3 Ventilation Rate. For the other than ammonia systems, the mechanical ventilation systems shall be capable of exhausting the minimum quantity of air both at normal operating and emergency conditions, as required by Sections 1105.6.3.1 and 1105.6.3.2. The minimum required ventilation rate for ammonia shall be 30 air changes per hour, in accordance with IIAR2. Multiple fans or multispeed fans shall be allowed to produce the emergency ventilation rate and to obtain a reduced airflow for normal ventilation.

Machinery Room Ventilation



IFGC- Identification, Testing and Certification

Each length of pipe and fittings shall bear the identification of the manufacturer

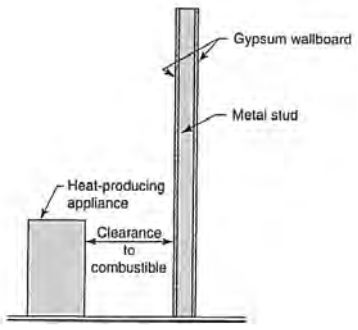
401.9 Identification. Each length of pipe and tubing and each pipe fitting, utilized in a fuel gas system shall bear the identification of the manufacturer.

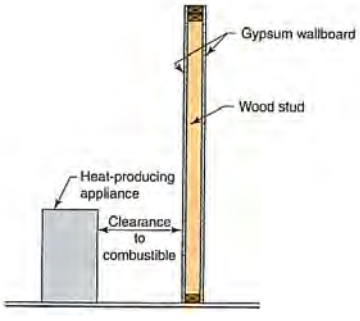
401.10 Third-Party Testing and Certification. All piping, tubing and fittings shall comply with the applicable referenced standards, specifications and performance criteria of this code and shall be identified in accordance with Section 401.9. Piping, tubing and fittings shall either be tested by an approved third-party testing agency or certified by an approved third-party certification agency.

404.1 Installation of Materials. All materials used shall be installed in strict accordance with the standards under which the materials are accepted and approved. In the absence of such installation instructions shall be followed. Where the requirements of referenced standards or manufacturer's installation instructions do not conform to minimum provisions of this code, the provisions of this code shall apply.

Clearance to Combustible Materials

2012 CODE: 308.1 Scope. This section shall govern the reduction in required clearances to combustible materials, including gypsum board, and combustible assemblies for chimneys, vents, appliances, devices and equipment. Clearance requirements for air-conditioning equipment and central heating boilers and furnaces shall comply with Sections 308.3 and 308.4.





404.2 CSST. CSST piping systems shall be installed in accordance with the terms of their approval, the conditions of listing, the manufacturer's installation instructions and this code.

Sample installation instructions for CSST gas piping

IFGC- Prohibited Devices

2012 CODE: ~~**404.16**~~ **404.18 Prohibited Devices.** A device shall not be placed inside the piping or fittings that will reduce the cross-sectional area or otherwise obstruct the free flow of gas.

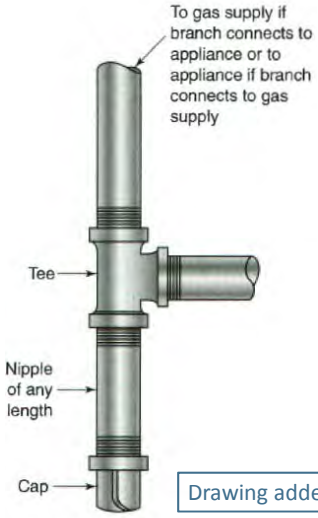
Listed excess flow valve

Exceptions:

1. Approved gas filters.
2. An approved fitting or device where the gas piping system has been sized to accommodate the pressure drop of the fitting or device.

Sediment Traps

408.4 Sediment Trap. Where a sediment trap is not incorporated as part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical. The sediment trap shall be either a tee fitting having a capped nipple of any length installed vertically in the bottommost opening of the tee as illustrated in Figure 408.4 or other device approved as an effective sediment trap. Illuminating appliances, ranges, clothes dryers, decorative vented appliances for installation in vented fireplaces, gas fireplaces and outdoor grills need not be so equipped.

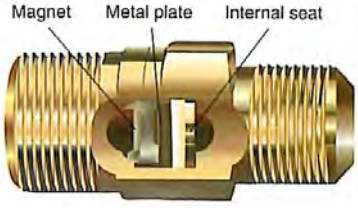


Sediment trap

Drawing added to code for clarity

Excess Flow Valves

2012 CODE: **410.4 Excess Flow Valves.** Where automatic excess flow valves are installed, they shall be listed for the application and shall be sized and installed in accordance with the manufacturers' instructions.



Listed excessive flow valve

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space

SECTION R303 LIGHT, VENTILATION AND HEATING

R303.1 Habitable rooms. All habitable rooms shall have an aggregate glazing area of not less than 8 percent of the floor area of such rooms. *Natural ventilation shall be through windows, doors, louvers or other approved openings to the outdoor air. Such openings shall be provided with ready access or shall otherwise be readily controllable by the building occupants. The minimum openable area to the outdoors shall be 4 percent of the floor area being ventilated.*

Exception

- *The glazed areas need not be openable where the opening is not required by Section R310 and an approved mechanical ventilation system capable of producing 0.35 air change per hour in the room is installed or a whole-house mechanical ventilation system is installed capable of supplying outdoor ventilation air of 15 cubic feet per minute (CFM) per occupant computed on the basis of two occupants for the first bedroom and one occupant for each additional bedroom.*

Key to Understanding Ventilation

- Outside air introduced into home in order to maintain indoor air quality
- Becomes critical as the envelope is tightened
- Often confused with circulation
- Current code allows opening windows and doors

Ventilation requirements may be met by:

- Opening windows, doors and louvers to allow fresh outside air to enter the home
- Exhausting contaminated air from the home with ventilation air being provided from outside by 'leakage' into the home to replace exhausted air
- Drawing fresh air into a home, by use of a duct introducing outside air in to the return air system or a fan/ventilator blowing outside ventilation air into the house. Inside air will then 'leaks' to outside at a rate equal to the rate outside air is introduced into the home.

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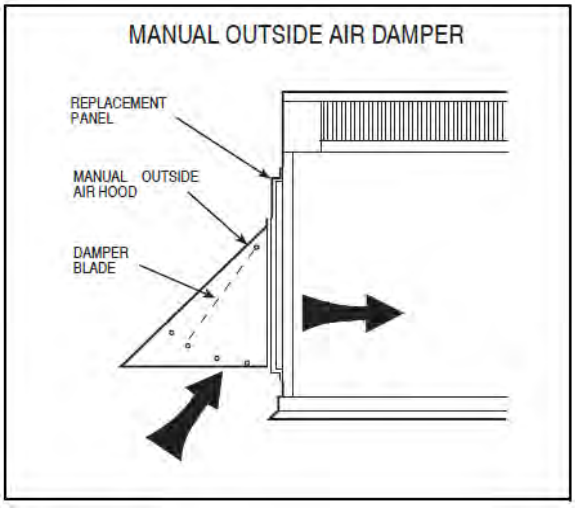
Ventilation Air on RTU

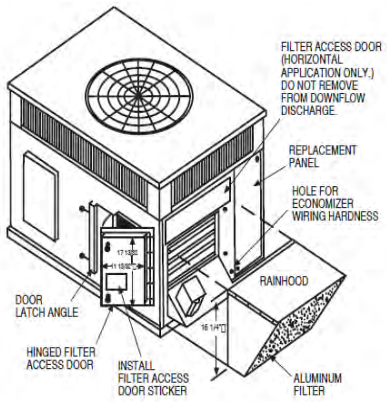


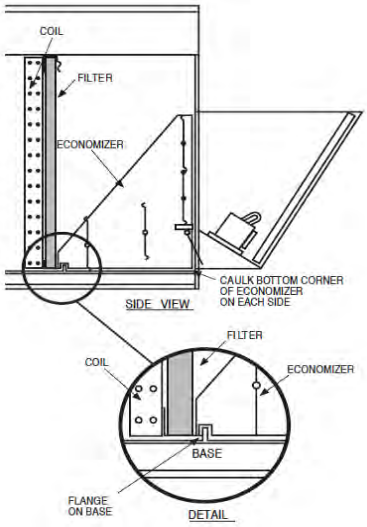
90

Economizers

- Required by IECC when cooling > 54,000 BTU/h
- Automatically uses outside air for 'free cooling' when outside conditions are correct
- Locks out compressors in typical operation, limiting power consumption to indoor fan operation

Economizer installed on RTU





THEATER ROOMS UNDER GARAGE –

and other rooms where natural ventilation is not possible

- These rooms typically do not have windows or doors to outside, allowing use of the natural ventilation option. Leads to the necessity to provide mechanical ventilation
- Adding a supply air and return air from the *typical* HVAC system provides circulation, not ventilation.

Theater Room Ventilation- Option 1

- Approved Mechanical ventilation capable of producing 0.35 air changes per hour
- A ventilation fan installed with a switch in the theater to be turned on when needed
- If the home is forced air- then the supply and return airs to the room will provide a path for replacement ventilation air back into the theater
- If radiant heated, a transfer duct/grill will be required to let air into the theater from the other areas of the home

Option 1- Example- 20' X 30" X 10' Theater Room

20 X 30 X 10 = 6000 cu. ft.

For 0.35 air changes in an hour:
6000 cu. ft. X .35 = 2100 cu. ft. per hour

2100 cu. ft. per hour divided by 60 min. per hour
= 35 cu. ft. per minute (CFM)

There are a number of quiet 70 to 80 CFM quiet fans on the market that will meet this requirement

Theater Room Ventilation- Option 2

- Whole house mechanical ventilation system capable of supplying outdoor ventilation air of 15 CFM per occupant computed on the basis of two occupants for the first bedroom and one occupant for each additional bedroom

Option 2- Example 4 Bedroom House

Master bedroom: 30 CFM
Other bedrooms: 45 CFM

Total 75 CFM

Under this option, 75 CFM may be introduced into the return air duct from outside, with the ability on the thermostat to run the fan continuously

Other Options:

- Heat Recovery Ventilators/ Energy Recovery Ventilators
- High efficient fans with automatic controls
- Control systems that detect carbon dioxide, moisture and other contaminants

Heat Recovery/Energy Recovery Ventilators

HRV or ERV?

- If you live in a colder climate with a longer heating season such as Canada or the northern US, the HRV will provide the most comfort and efficiency.
- In the Midwest and southern states, where humidity removal is needed for the incoming air, an ERV provides year-round efficiency.

HRV/ERV is now in the IECC for some commercial applications requiring large quantities of ventilation air

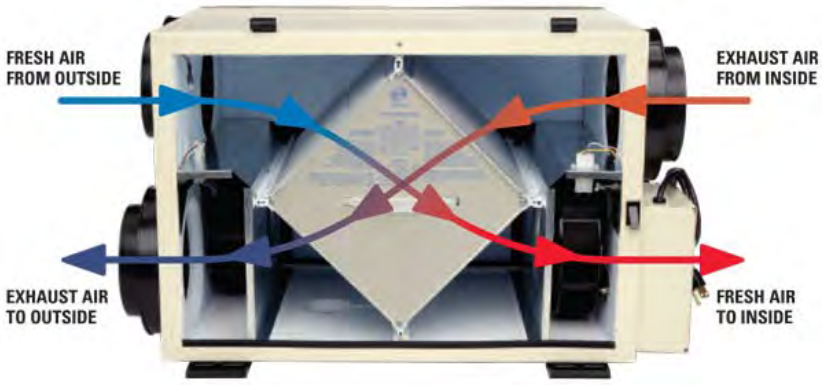
HRV FEATURES
(Heat Recovery Ventilator)

- **Provides clean, fresh indoor air**
- **Designed to provide comfort in colder climates**
- **Transfers heat from indoor air before it is discharged**
- **Ideal for new homes which are tightly sealed or remodeled homes with energy efficiency upgrades**

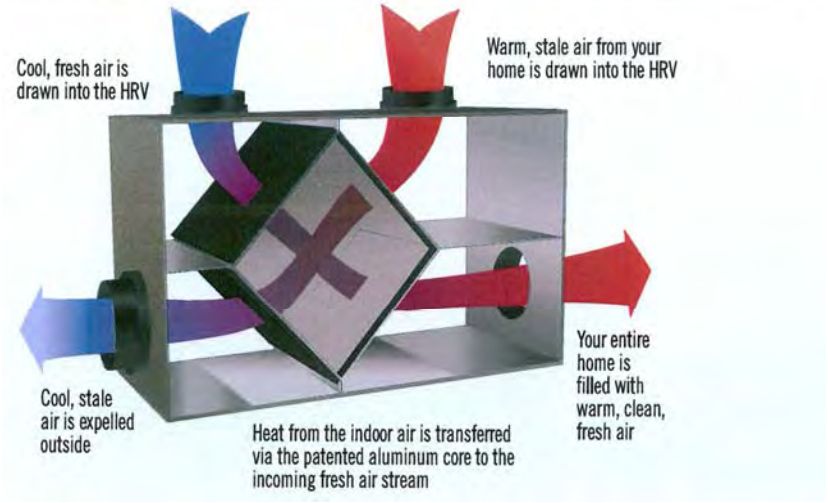
ERV FEATURES
(Energy Recovery Ventilator)

- **Provides clean, fresh indoor air**
- **Designed to provide comfort in warmer, humid climates**
- ***Transfers incoming humidity back outdoors***
- **Ideal for new homes which are tightly sealed or remodeled homes with energy efficiency upgrades**

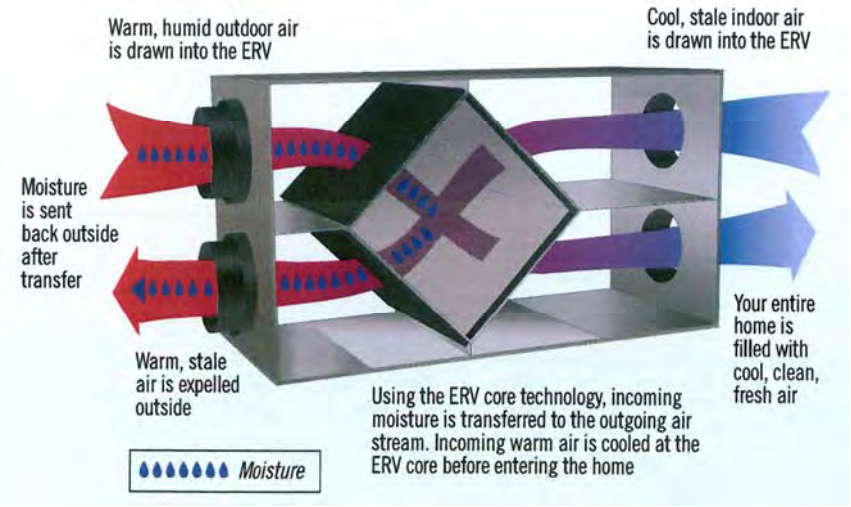
HRV/ERV Operation



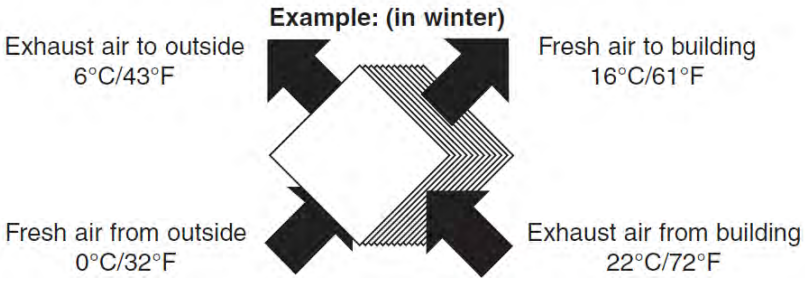
How it works: HRV



How it works: ERV

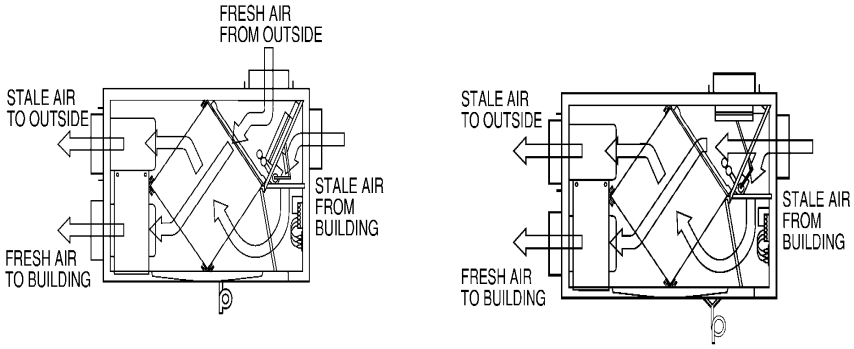


HRV/ERV Heat Exchange



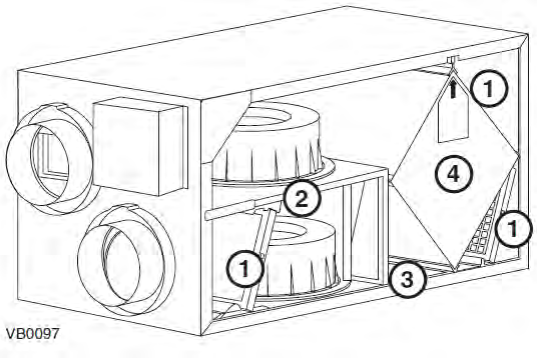
HRV Operation

Normal | **Defrost**

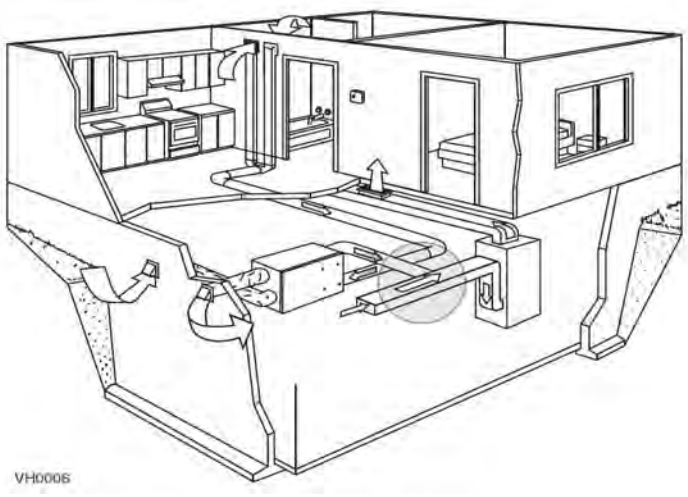


HRV/ERV
Internal View

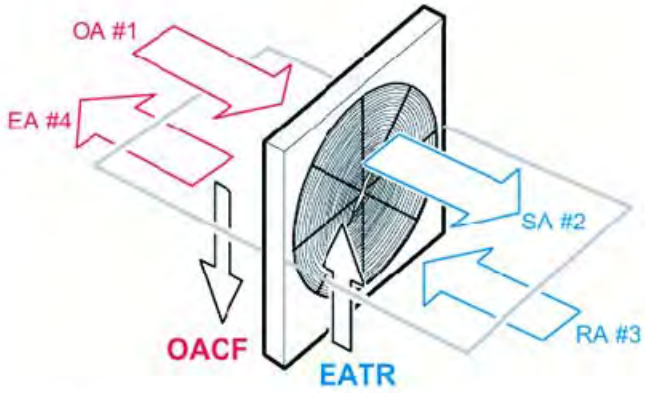
1. Filters
2. Blowers
3. Condensation tray
4. Heat recovery core



Typical HRV Installation



Wheel Type ERV

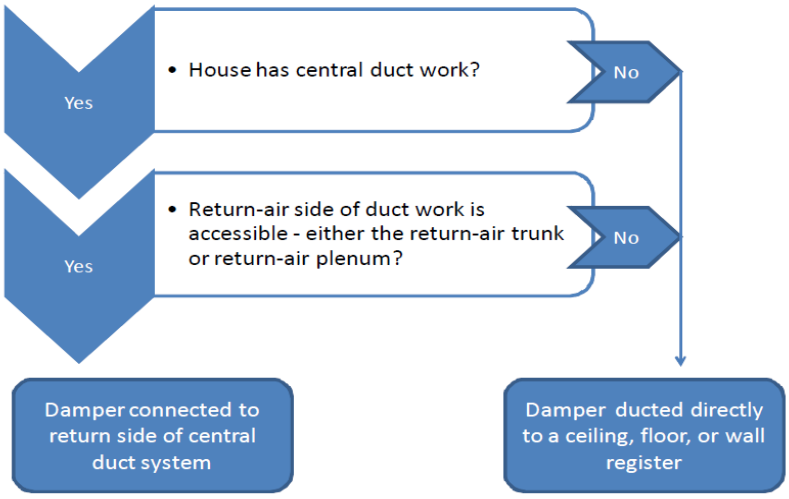


Airflow Configuration Convention

In 2009 a significant Mechanical Code Change

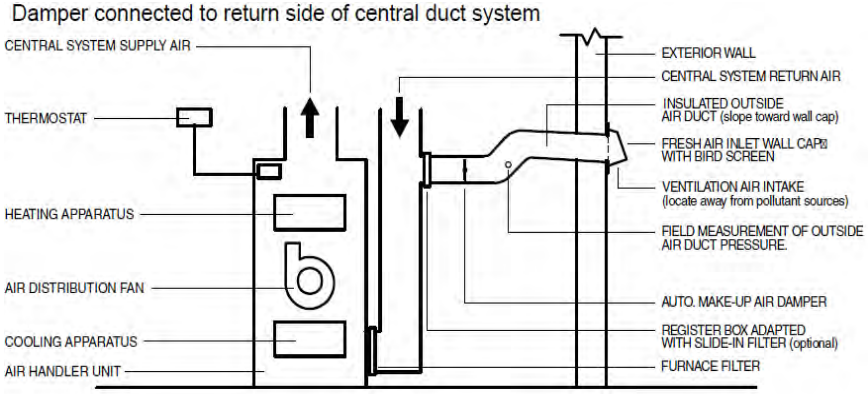
- ***IRC M1503.4, IMC 505.2: Makeup air required.*** *Exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and stop simultaneously with the exhaust system.*

Make up Air Options



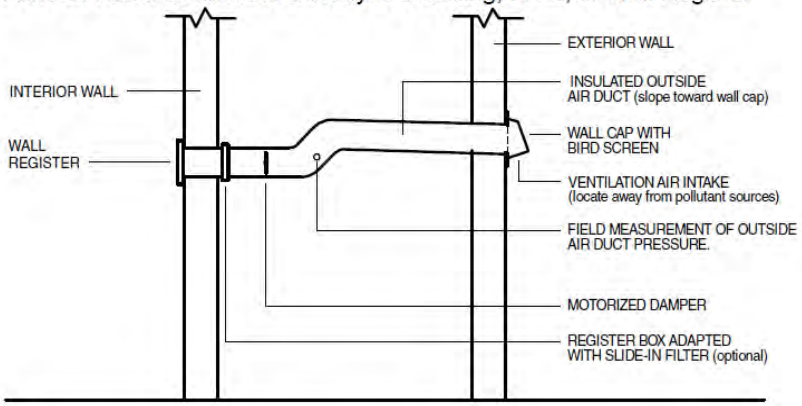
Make up Air for Kitchen Range Hood-with Forced Air Heating/Cooling

Damper connected to return side of central duct system

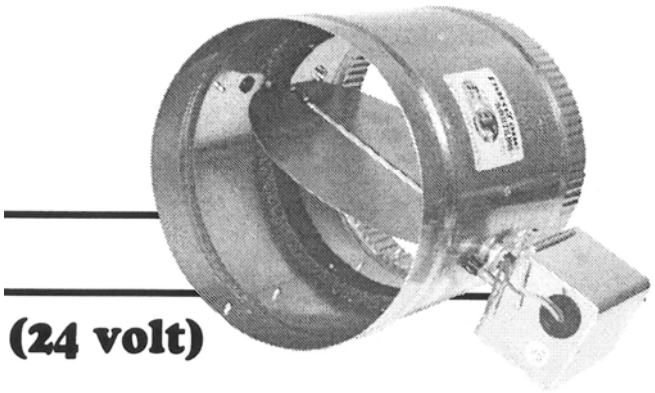


Make-Air for Kitchen Range Hood-w/o Forced Air Return Duct

Damper and OA Duct Connected Directly to a Ceiling, Floor, or Wall Register



Spring Loaded Damper



Switching Option- Pressure switch

Grainger Item #	3ZM96
Price (ea.)	**$25.80**
Brand	CLEVELAND CONTROLS
Mfr. Model #	RSS-495-11
Ship Qty.	1
Sell Qty. (Will-Call)	1
Ship Weight (lbs.)	0.25
Usually Ships**	Today
Catalog Page No.	4336
Country of Origin (Country of Origin is subject to change.)	USA

Summary

- Control must be automatic- damper opens with hood operation
- Smooth metal duct must be used- not flex- unless specifically allowed by the manufacturer
- Damper must close when the hood is not in operation- or power failure
- Damper should be at the exterior wall

Summary- cont.

- Outside air duct through conditioned space must be insulated
- Some manufacturers are producing an dedicated fan and damper system that communicates through house wiring
- Actual airflow may be less than advertized- measure it?

COMMERCIAL KITCHENS

507.2.1- Type I hoods

- Type I hoods shall be installed where cooking appliances produce grease or smoke
- Type I hoods shall be installed over medium-duty, heavy-duty and extra-heavy-duty cooking appliances
- Type I hoods shall be installed over light-duty cooking appliances that produce grease or smoke.
- Shall operate automatically by heat or other approved methods

Type I Hood

506.3 DUCTS SERVING TYPE 1 HOODS

- Steel- minimum 16 gage (0.0575 inches) -or-
- Stainless Steel- minimum 18 gage (0.0450) -or-
- Factory- built commercial kitchen grease ducts listed and labeled (UL1978), installed per manufacturer.
- *Make-up air ducts connected to or within 18" of hood must be non-combustible or listed for the application*

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506.3.1.1 Grease duct materials. Grease ducts serving Type I hoods shall be constructed of steel having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) or stainless steel not less than 0.0450 inch (1.14 mm) (No. 18 gage) in thickness.

Exception: Factory-built commercial kitchen grease ducts *listed* and *labeled* in accordance with UL 1978 and installed in accordance with Section 304.1.

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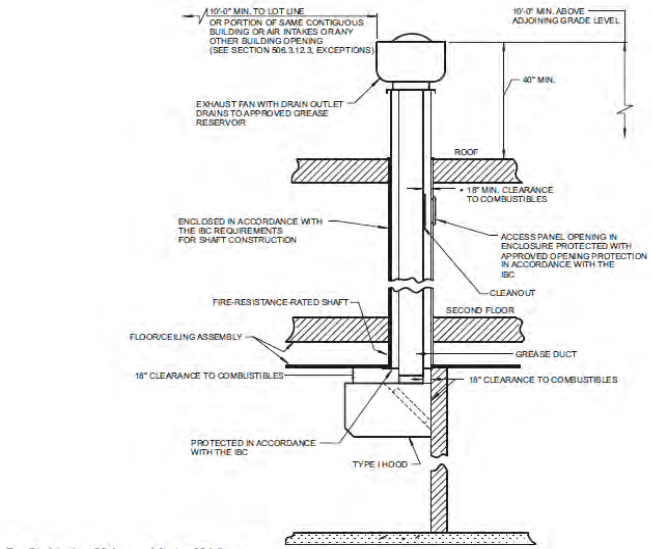

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Figure 506.3.10(1)
EXHAUST DUCT ENCLOSED BY A VERTICAL SHAFT

Figure 506.5.1(1)
ROOF-MOUNTED EXHAUST FAN FOR A TYPE I HOOD

507.2.2 - Type II hoods

- Installed above dishwashers and *light-duty appliances that produce* heat or moisture and do not produce grease or smoke

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506.4- Ducts serving Type II hoods

- Rigid metallic materials
- Meet requirements of Chapter 6
- Positive pressure, moisture-laden or waste-heat-laden constructed and sealed in an approved manner
- Installed, terminated per manufacturers instructions
- Terminate 3’ from openings, 10’ from buildings, property, 30” from roof and vertical walls
- Terminations to be weather protected, not directed on walkways

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508.1 Makeup air

- *Makeup air shall be supplied during the* operation of commercial kitchen exhaust systems that are provided for *commercial cooking appliances.*
- *The amount of makeup air supplied to the building from all sources shall be* approximately equal to the amount of *exhaust air for all* exhaust systems for the building.
- The *makeup air shall not* reduce the effectiveness of the exhaust system

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Make Up Air Unit- Indirect Fired

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Make-up air- continued

- *Makeup air* shall be provided by gravity or mechanical means or both
- Mechanical *makeup air systems shall be automatically controlled* to start and operate simultaneously with the exhaust system
- *Makeup air intake opening locations shall comply with* Section 401.4. (Ventilation intake opening requirements)

Makeup Air Strategies

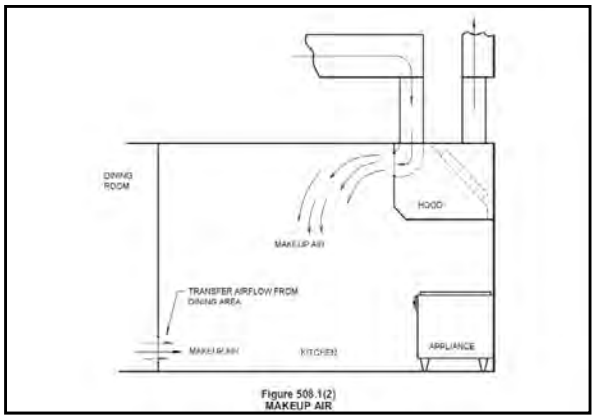


Figure 508.1(2)
MAKEUP AIR

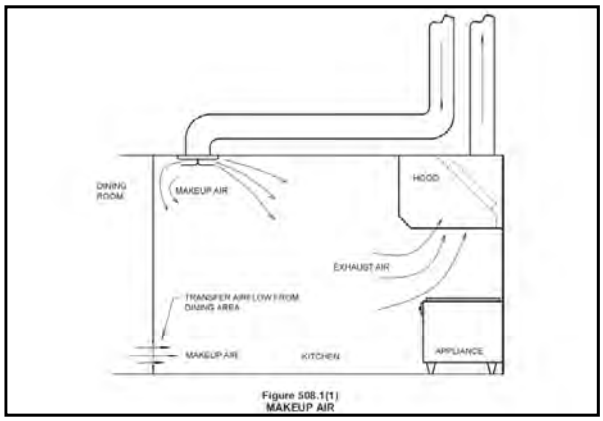


Figure 508.1(1)
MAKEUP AIR

Make-up Air – most effective

508.1.1
Makeup air temperature

- The temperature differential between *makeup air and the air in the conditioned* space shall not exceed 10ºF (6ºC) except where the added heating and cooling loads of the *makeup air do not exceed* the capacity of the HVAC system

Returning to IMC Ventilation Definitions:

Ventilation

- The natural or mechanical process of supplying air conditioned or unconditioned air to, or removing such air from, any space.

Ventilation Air

- That portion of supply air that comes from outside (outdoors), plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

IMC Definitions- cont.

Breathing Zone

- The region within an occupied space between planes 3 to 72 inches above the floor and more than 2 feet from the walls of the space or from fixed air conditioning equipment

Air, Exhaust

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

IMC Definitions- cont.

Recirculated Air

- Air removed from a conditioned space and intended for reuse as supply air

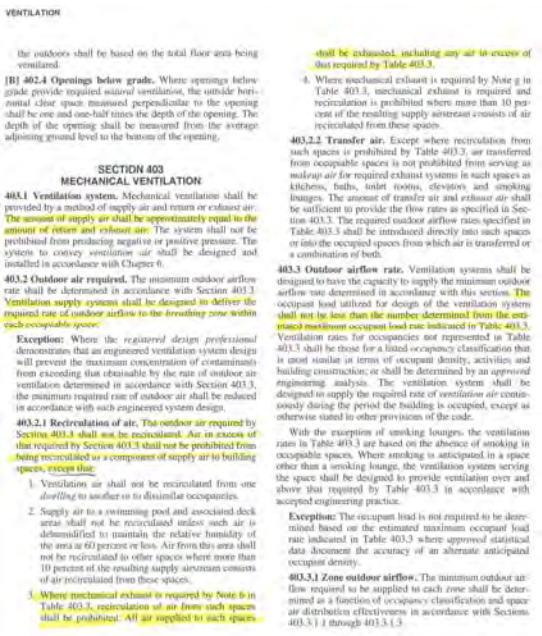
Source Capture System

- A mechanical exhaust system design and constructed to capture air contaminants at the source and to exhaust such contaminants to outside

IMC Definitions- cont.

Net Occupiable Floor Area

- The floor area of an occupiable space defined by the inside surfaces of walls but excluding shafts, column enclosures and other permanently enclosed, inaccessible and unoccupiable areas. Obstructions in the space such as furnishings, display or storage racks and other obstructions, whether temporary or permanent, *shall not* be deducted from the space area.



VENTILATION

the outdoors shall be based on the total floor area being ventilated.

[B] 402.4 Openings below grade. Where openings below grade provide required *natural ventilation*, the outside horizontal clear space measured perpendicular to the opening shall be one and one-half times the depth of the opening. The depth of the opening shall be measured from the average adjoining ground level to the bottom of the opening.

SECTION 403
MECHANICAL VENTILATION

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return or *exhaust air*. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey *ventilation air* shall be designed and installed in accordance with Chapter 6.

403.2 Outdoor air required. The minimum outdoor airflow rate shall be determined in accordance with Section 403.3. Ventilation supply systems shall be designed to deliver the required rate of outdoor airflow to the *breathing zone* within each *occupiable space*.

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

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

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

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

403.3 Outdoor airflow rate. Ventilation systems shall be designed to have the capacity to supply the minimum outdoor airflow rate determined in accordance with this section. The occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3. Ventilation rates for occupancies not represented in Table 403.3 shall be those for a listed *occupancy* classification that is most similar in terms of occupant density, activities and building construction; or shall be determined by an *approved* engineering analysis. The ventilation system shall be designed to supply the required rate of *ventilation air* continuously during the period the building is occupied, except as otherwise stated in other provisions of the code.

With the exception of smoking lounges, the ventilation rates in Table 403.3 are based on the absence of smoking in occupiable spaces. Where smoking is anticipated in a space other than a smoking lounge, the ventilation system serving the space shall be designed to provide ventilation over and above that required by Table 403.3 in accordance with accepted engineering practice.

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

403.3.1 Zone outdoor airflow. The minimum outdoor airflow required to be supplied to each *zone* shall be determined as a function of *occupancy* classification and space air distribution effectiveness in accordance with Sections 403.3.1.1 through 403.3.1.3.

TABLE 403.3—continued
MINIMUM VENTILATION RATES

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT²[a]	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_a CFM/FT²[b]	EXHAUST AIRFLOW RATE CFM/FT²[c]
Specialty shops				
Automotive motor-fuel-dispensing stations[d]	—	—	—	1.5
Barber	25	7.5	0.06	0.5
Beauty salons[e]	25	20	0.12	0.6
Nail salons[e,f]	25	20	0.12	0.6
Embalming room[g]	—	—	—	2.0
Pet shops (animal area)[e]	10	7.5	0.18	0.9
Supermarkets	8	7.5	0.06	—
Sports and amusement				
Disco/dance floors	100	20	0.06	—
Bowling alleys (seating areas)	40	10	0.12	—
Game arcades	20	7.5	0.18	—
Ice arenas without combustion engines	—	—	0.30	0.5
Gym, stadium, arena (play area)	—	—	0.30	—
Spectator areas	150	7.5	0.06	—
Swimming pools (pool and deck area)	—	—	0.48	—
Health club/aerobics room	40	20	0.06	—
Health club/weight room	10	20	0.06	—
Storage				
Repair garages, enclosed parking garages[d,i]	—	—	—	0.75
Warehouses	—	—	0.06	—
Theaters				
Auditoriums (see relocatable)	—	—	—	—
Lobbies	150	5	0.06	—
Stages, studios	70	10	0.06	—
Ticket booths	60	5	0.06	—
Transportation				
Platforms	100	7.5	0.06	—
Transportation waiting	100	7.5	0.06	—
Workrooms				
Bank vaults/safe deposit	5	5	0.06	—
Darkrooms	—	—	—	1.0
Copy, printing rooms	4	5	0.06	0.5
Meat processing[e]	10	15	—	—
Pharmacy (prep. area)	10	5	0.18	—
Photo studios	10	5	0.12	—
Computer (without printing)	4	5	0.06	—

For SI: 1 cubic foot per minute = 0.0004719 m³/s, 1 ton = 908 kg, 1 cubic foot per minute per square foot = 0.00508 m³/(s · m²),
°C = [(°F) - 32]/1.8, 1 square foot = 0.0929 m².

a. Based upon net occupiable floor area.

b. Mechanical exhaust required and recirculation of air from such spaces is prohibited (see Section 403.2.1, Items 3).

c. Spaces unheated or maintained below 50°F are not covered by these requirements unless the occupancy is continuous.

d. Ventilation systems in enclosed parking garages shall comply with Section 404.

e. Rates are per water (hose) in actual. The higher rate shall be provided where the exhaust system is designed to operate continuously. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.

f. Rates are per room unless otherwise indicated. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.

g. Mechanical exhaust is required and recirculation is prohibited except that recirculation shall be permitted where the resulting supply air system consists of not more than 10 percent air recirculated from these spaces (see Section 403.2.1, Items 2 and 4).

h. For pool cabins, each hair cleaning shall be provided with a source capture system capable of exhausting not less than 50 cfm per station.

403.3.1.1 Breathing zone outdoor airflow. The outdoor airflow rate required in the *breathing zone* (V_{bz}) of the *occupiable space* or spaces in a zone shall be determined in accordance with Equation 4-1.

$$V_{bz} = R_p P_z + R_a A_z \qquad \text{(Equation 4-1)}$$

where:

A_z = Zone floor area: the *net occupiable floor area* of the space or spaces in the zone.

P_z = Zone population: the number of people in the space or spaces in the zone.

R_p = People outdoor air rate: the outdoor airflow rate required per person from Table 403.3.

R_a = Area outdoor air rate: the outdoor airflow rate required per unit area from Table 403.3.

403.3.1.2 Zone air distribution effectiveness. The zone air distribution effectiveness (E_z) shall be determined using Table 403.3.1.2.

TABLE 403.3.1.2
ZONE AIR DISTRIBUTION EFFECTIVENESS[a,b,c,d,e]

Air Distribution Configuration	E_z
Ceiling or floor supply of cool air	1.0[f]
Ceiling or floor supply of warm air and floor return	1.0
Ceiling supply of warm air and ceiling return	0.8[g]
Floor supply of warm air and ceiling return	0.7
Makeup air drawn in on the opposite side of the room from the exhaust and/or return	0.8
Makeup air drawn in near to the exhaust and/or return location	0.5

For SI: 1 foot = 304.8 mm, 1 foot per minute = 0.00506 m/s,
°C = [(°F) - 32]/1.8.

a. "Cool air" is air cooler than space temperature.
b. "Warm air" is air warmer than space temperature.
c. "Ceiling" includes any point above the breathing zone.
d. "Floor" includes any point below the breathing zone.
e. "Makeup air" is air supplied or transferred to a zone to replace air removed from the zone by exhaust or return systems.
f. Zone air distribution effectiveness of 1.2 shall be permitted for systems with a floor supply of cool air and ceiling return, provided that low-velocity displacement ventilation achieves unidirectional flow and thermal stratification.
g. Zone air distribution effectiveness of 1.0 shall be permitted for systems with a ceiling supply of warm air, provided that supply air temperature is less than 15°F above space temperature and provided that the 150 foot-per-minute supply air jet reaches to within 4½ feet of floor level.

403.3.1.3 Zone outdoor airflow. The zone outdoor airflow rate (V_{oz}), shall be determined in accordance with Equation 4-2.

$$V_{oz} = \frac{V_{bz}}{E_z} \qquad \text{(Equation 4-2)}$$

403.3.2 System outdoor airflow. The outdoor air required to be supplied by each ventilation system shall be determined in accordance with Sections 403.3.2.1 through 403.3.2.3 as a function of system type and zone outdoor airflow rates.

403.3.2.1 Single zone systems. Where one air handler supplies a mixture of outdoor air and recirculated return air to only one zone, the system outdoor air intake flow rate (V_{ot}) shall be determined in accordance with Equation 4-3.

$$V_{ot} = V_{oz} \qquad \text{(Equation 4-3)}$$

403.3.2.2 100-percent outdoor air systems. Where one air handler supplies only outdoor air to one or more zones, the system outdoor air intake flow rate (V_{ot}) shall be determined using Equation 4-4.

$$V_{ot} = \Sigma_{all\ zones} V_{oz} \qquad \text{(Equation 4-4)}$$

403.3.2.3 Multiple zone recirculating systems. Where one air handler supplies a mixture of outdoor air and recirculated return air to more than one zone, the system outdoor air intake flow rate (V_{ot}) shall be determined in accordance with Sections 403.3.2.3.1 through 403.3.2.3.4.

403.3.2.3.1 Primary outdoor air fraction. The primary outdoor air fraction (Z_p) shall be determined for each zone in accordance with Equation 4-5.

$$Z_p = \frac{V_{oz}}{V_{pz}} \qquad \text{(Equation 4-5)}$$

where:

V_{pz} = Primary airflow: The airflow rate supplied to the zone from the air-handling unit at which the outdoor air intake is located. It includes outdoor intake air and recirculated air from that air-handling unit but does not include air transferred or air recirculated to the zone by other means. For design purposes, V_{pz} shall be the zone design primary airflow rate, except for zones with variable air volume supply and V_{pz} shall be the lowest expected primary airflow rate to the zone when it is fully occupied.

403.3.2.3.2 System ventilation efficiency. The system ventilation efficiency (E_v) shall be determined using Table 403.3.2.3.2 or Appendix A of ASHRAE 62.1.

Example- 1200 sq. ft Beauty and Nail Salon with 5 nail stations

Step 1: Determine occupant load

Table 403.3- occupant density: 25 occ./1000 ft²

1200 ft² X 25 occ. ÷ 1000 ft² = 30 occupants

(This is a minimum value, as the particular design may be larger - use greater value.)

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

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

R_p = People outdoor air rate (Table 403.3) = 20 CFM/occupant

P_z = Zone population = 30 occupants

R_a = Area outdoor air rate (Table 403.3) = 0.12 CFM/ft²

A_z = net occupiable floor area = 1200 ft²

$$V_{bz} = 20x30 + 0.12x1200 = 744\ CFM$$

Step 3: Determine zone airflow rate- (adjust for air distribution effectiveness- 403.3.1.2)

Typical system- ceiling supply and return-

From Table 403.3.1.2

E_z *(cooling) = 1.0*

E_z *(cooling) = 0.8* (*use the most restrictive value, 0.8)*

Using Equation 4-2

$$V_{oz} = \frac{V_{bz}}{E_z} = \frac{744}{.8} = 930\ CFM$$

Single zone system-

Zone airflow (V_{oz}) = Outdoor air intake flow (V_{ot})

Step 4: Determine exhaust airflow rate

From Table 403.3- 0.6 CFM/ft²

1200 CFM x 0.6 CFM/ft² = 720 CFM

Additionally Table 403.3 footnote h: For nail salons, each nail station shall be provided with a source capture system capable of exhausting not less than 50 CFM per station.

50 CFM x 5 stations = 250 CFM

720 CFM + 250 CFM = 970 CFM exhaust flow rate

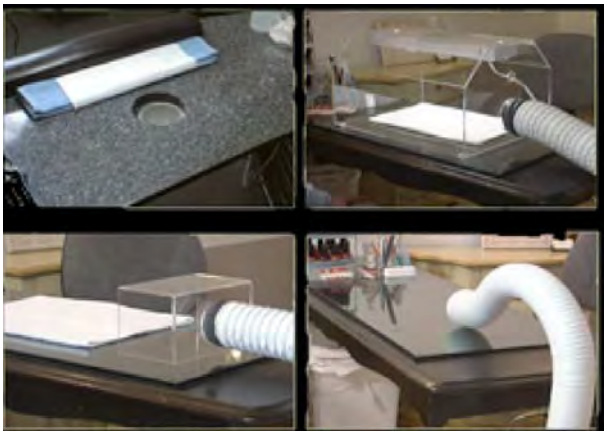
Per 403.2.1 The outdoor air required by Section 403.3 shall not be recirculated.

3. All air (outside) supplied to such spaces shall be exhausted, including any air in excess of that required by Table 403.3

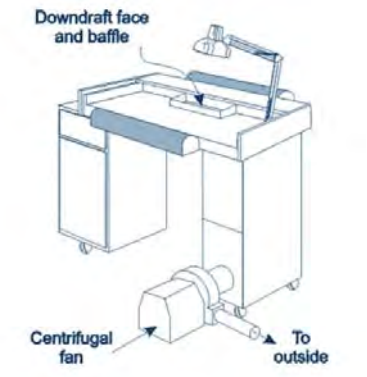
Source capture

Source capture system

Source capture systems



Details- Source capture system



Recirculating system

- Search on the internet will show many of these types of systems and tables with a system built in it.
- 403.2.1 (3) Specifically states *'where mechanical exhaust is required by Note b in Table 403.3, recirculation of air from such spaces shall be prohibited.'*
- *Poorly written state amendment allows recirculating system as defined in 'rule'. Confusion exists on the requirements of a recirculating system*
- *Must have a substantial activated carbon filter*

Fuel Gas Piping

ANODELESS RISER

- A transition assembly in which plastic piping is installed and terminated above ground outside of a building.

- *As the name implies, these riser assemblies protect the steel riser from corrosion by means other than cathodic protection involving a sacrificial anode. Some anodeless risers allow the termination of plastic piping aboveground by encasing the piping in a steel conduit equipped with a plastic-to-steel transition fitting*

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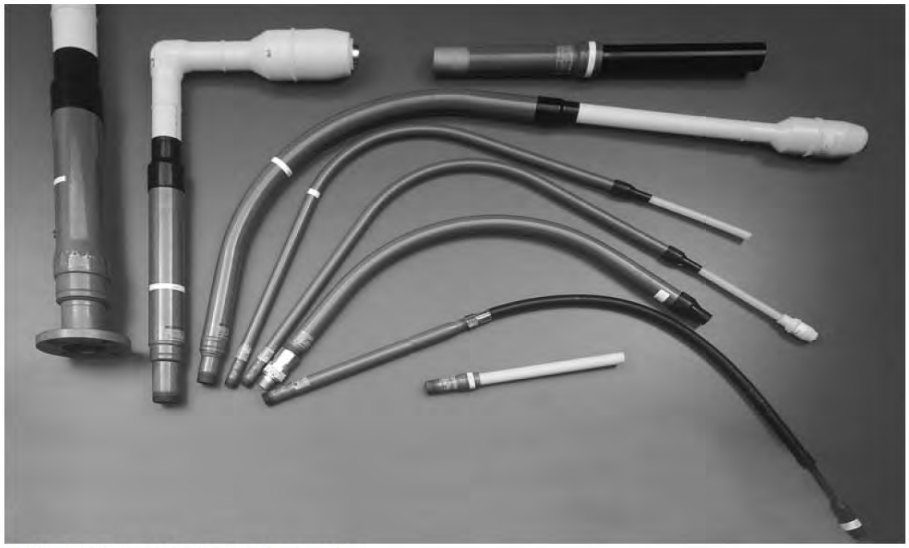

Photo courtesy of Perfection Corporation

Figure 202(1)
ANODELESS RISERS

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POINT OF DELIVERY

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

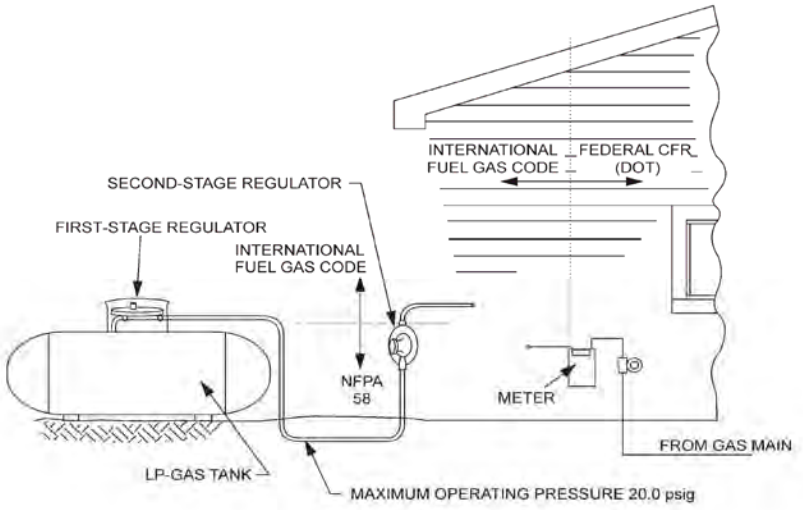

Figure 401.1(1)
SCOPE OF CODES

401.4 Additional appliances

- Where an additional appliance is to be served, the existing piping shall be checked to determine if it has adequate capacity for all appliances served. If inadequate, the existing system shall be enlarged as required or separate piping of adequate capacity shall be provided.

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401.7 Piping meter identification

- Piping from multiple meter installations shall be marked with an approved permanent identification by the installer so that the piping system supplied by each meter is readily identifiable.

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402.3 Sizing

- Gas piping shall be sized in accordance with one of the following:

1. Pipe sizing tables or sizing equations in accordance with Section 402.4.
2. The sizing tables included in a listed piping system's manufacturer's installation instructions.
3. Other approved engineering methods.

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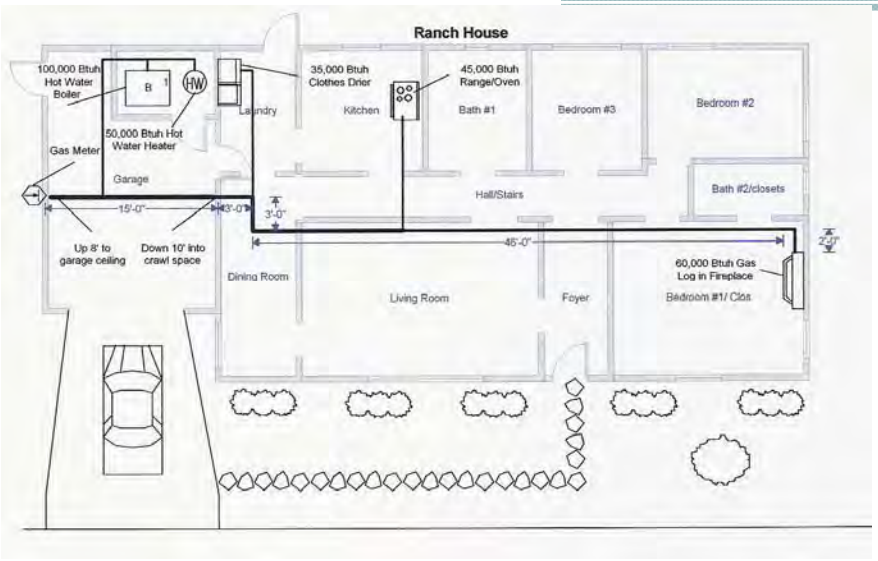

Longest run = 8 + 15 + 10 + 3 + 3 + 46 + 2 = ***87 Linear Feet***

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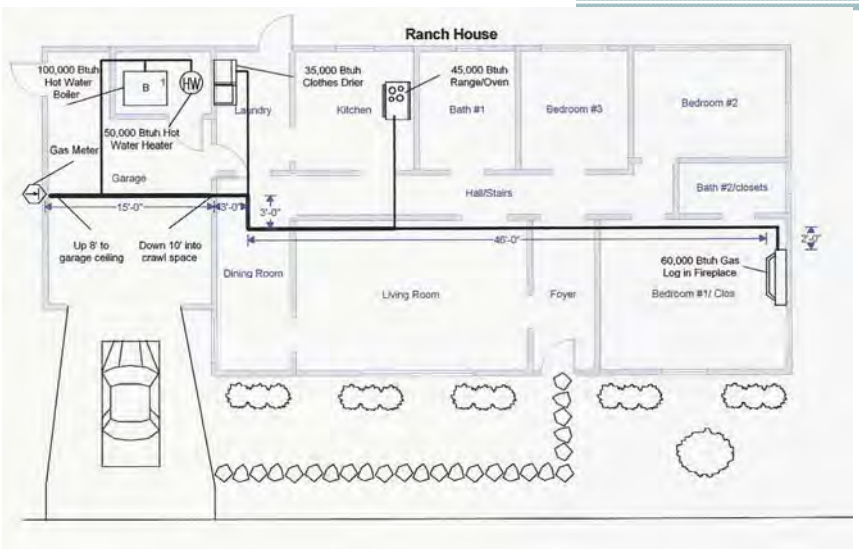

Total Btuh input of all appliances = 100 + 50 + 35 + 45 + 60 = ***290,000 Btuh***

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Longest run = 87’

Table 10-1 Maximum Capacity of Pipe in Cubic Feet of Gas per Hour for Gas Pressures of 0.5 psi or Less and a Pressure Drop of 0.3 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size (Inches)	Internal Diameter (Inches)	Length of Pipe (Feet)													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
¼	.364	32	22	18	15	14	12	11	11	10	9	8	8	7	6
⅜	.493	72	49	40	34	30	27	25	23	22	21	18	17	15	14
½	.622	132	92	73	63	56	50	46	43	40	38	34	31	28	26
¾	.824	278	190	152	130	115	105	96	90	84	79	72	64	59	55
1	1.049	520	350	285	245	215	195	180	170	160	150	130	120	110	100
1¼	1.380	1,050	730	590	500	440	400	370	350	320	305	275	250	225	210
1½	1.610	1,600	1,100	890	760	670	610	560	530	490	460	410	380	350	320
2	2.067	3,050	2,100	1,650	1,450	1,270	1,150	1,050	990	930	870	780	710	650	610
2½	2.469	4,800	3,300	2,700	2,300	2,000	1,850	1,700	1,600	1,500	1,400	1,250	1,130	1,050	980
3	3.068	8,500	5,900	4,700	4,100	3,600	3,250	3,000	2,800	2,650	2,500	2,200	2,000	1,850	1,700
4	4.026	17,500	12,000	9,700	8,300	7,400	6,800	6,200	5,800	5,400	5,100	4,500	4,100	3,800	3,500

Pipe size = 1 ¼”

Total input = 290 MBH

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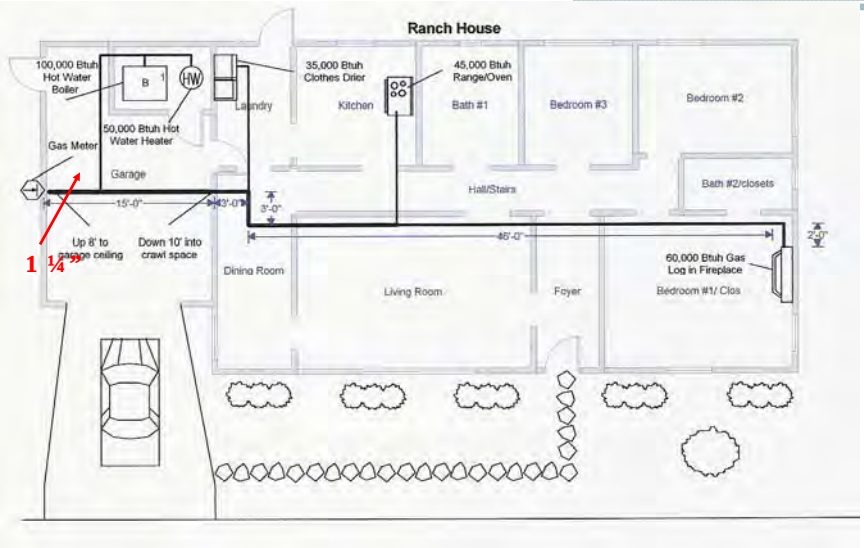

290 – 150 = ***140,000 Btuh***

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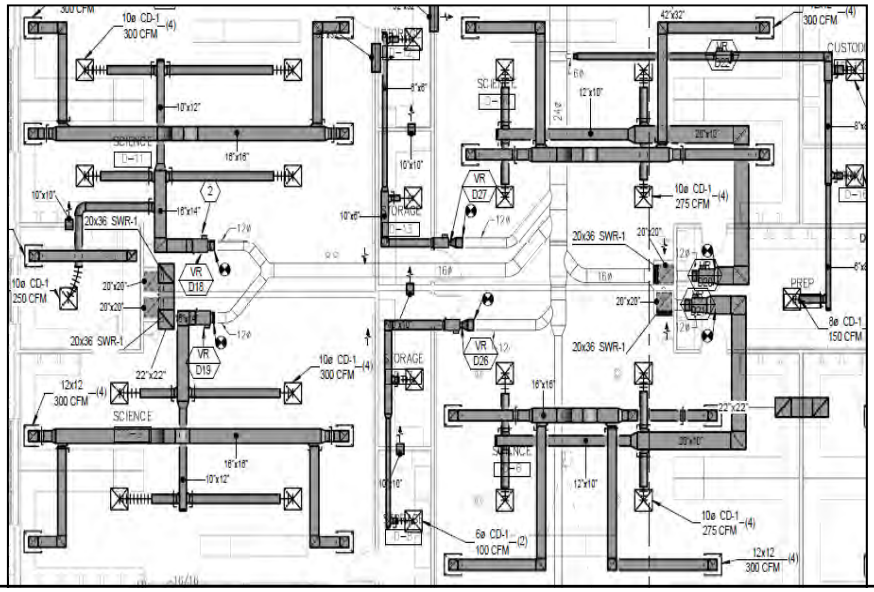
VAV- Variable Air Volume



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VAV- Variable Air Volume- Typical System

- Complex mechanical system per IECC
- *High pressure* cooled air supplied to VAV box/terminal from large air handler or RTU
- Heating for perimeter zones accomplished by re-heating- hot water re-heat coils that re-heat the cooled air to provide heating as required to zone
- Interior zones cooling only
- VAV box/terminal modulates from 15% to 100% rated flow
- High pressure small duct in, larger low pressure low velocity out
- Relatively affordable single room zones- corners of buildings

Single Duct Terminals

Cooling only

With hot water re-heat

Typical VAV airflow chart-

Table 2. Primary airflow control factory settings - I-P

Control Type	Air Valve Size (in.)	Maximum Valve Cfm	Maximum Controller Cfm	Minimum Controller Cfm	Constant Volume Cfm
Direct Digital Control/ UCM	4	225	25-225	0,25-225	25-225
	5	350	40-350	0,40-350	40-350
	6	500	60-500	0,60-500	60-500
	8	900	105-900	0,105-900	105-900
	10	1400	165-1400	0,165-1400	165-1400
	12	2000	240-2000	0,240-2000	240-2000
	14	3000	320-3000	0,320-3000	320-3000
	16	4000	420-4000	0,420-4000	420-4000
	24 x 16	8000	800-8000	0,800-8000	800-8000

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Other VAV Types

Dual Duct VAV-
- One duct for heat
- One for cooling

Single Duct Fan Powered
- One duct for cooling- min. OA
- Fan draws air from plenum

Thank you for your participation!

- Questions/comments may be addressed to me at:
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