

Code Check Plumbing & Mechanical® Fifth Edition

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Code Check Plumbing & Mechanical 5th Edition is a guide to important code requirements and common code violations in the plumbing and Mechanical systems of 1- & 2-family dwellings & townhouses. The main codes referenced in this book are the plumbing and mechanical provisions of the 2015 *International Residential Code® for One- and Two-Family Dwellings* (IRC), the 2015 *Uniform Plumbing Code* (UPC), and the 2015 *Uniform Mechanical Code* (UMC). These codes are the most widely used throughout the United States. Other referenced codes used in the book are listed below in Table 1 (T1). NFPA 54, the *National Fuel Gas Code*, is the basis for the fuel gas provisions of the IRC, UPC, and UMC.

Model codes are published on a three year cycle. Codes are adopted at different times in different places around the country. Some states make extensive modifications to the model codes. Significant code changes are highlighted in the text and summarized on the inside back cover. Minor changes and those that only affected numbering (not substance) are not highlighted. To determine the codes in your area, contact your local building department and the ICC at codes.iccsafe.org. For most topics, these different codes will agree. The codes also references standards, many of which are maintained by the organizations in Table 2 (T2) below.

The 2015 cycle of codes remain in effect in most jurisdictions for 3 to 6 years after the cover date. Energy codes vary greatly between areas, and may modify or overrule the code requirements shown in this book.

Special thanks to Bill Tott, Jeff Hutcher, & John LaTorra

TABLE 1 CODES & STANDARDS USED IN THIS BOOK

Organization	Edition	Code
ASHRAE	2016	ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
ICC	2015	International Residential Code
ICC	2015	ISPDC - International Private Sewage Disposal Code
IAPMO	2015	Uniform Plumbing Code
IAPMO	2015	Uniform Mechanical Code
NFPA	2016	NFPA 31 Standard for Installation of Oil-burning Equipment
NFPA	2016	NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA	2015	NFPA 54 National Fuel Gas Code
NFPA	2017	NFPA 58 Liquefied Petroleum Gas Code
NFPA	2017	NFPA 70 National Electrical Code

TABLE 2 ORGANIZATIONS

Acronym	Name
ASHRAE	American Society of Heating, Air Conditioning, & Refrigeration Engineers
ACCA	Air Conditioning Contractors of America
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (formerly the American Society for Testing & Materials)
CSA	Canadian Standards Association
ICC	International Code Council
IAPMO	International Association of Plumbing & Mechanical Officials
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
SMACNA	Sheet Metal & Air Conditioning Contractors' National Association
UL	Underwriters Laboratories

KEY TO USING CODE CHECK

Code Check Plumbing & Mechanical condenses large amounts of code information by using "shorthand" conventions that are explained here. Each text line begins with a checkbox and ends with the code citations. The first code citation is typically from the IRC, and the second from the UPC or UMC. The following example is taken from p.14 under the topic of plumbing vents:

All fixture traps req venting _____ 3101.2.1 901.2

This line is stating that all fixture traps require venting, and the rule is found in section 3101.2.1 of the IRC and section 901.2 of the UPC.

The actual number in the IRC also includes a letter. Issues pertaining to building start with an R, energy an N, Mechanical an M, fuel gas a G, plumbing a P, and electrical an E. The letters were omitted here to save space. The full IRC section name for the above line would be P3101.2.1.

References to figures and tables are preceded by an **F** or a **T**. The following example is from p.7 on the subject of fittings and changes of direction:

Changes in direction req appropriate fittings **F11-14,T10** _ 3005.1 706.1

This line is stating that changes of directions must use appropriate fittings, as illustrated in Figures 11 through 14 and also in Table 10.

A change from the previous code edition is shown by a code citation in a different color. The superscript endnote after the code citation refers to the table on the inside back cover (p.49), where more information about the change is found. The following example is from p.27 on the subject of general Mechanical requirements:

Plastic pans not OK under gas water heaters _____ 2801.6²⁸ n/a

This line is saying that gas-fired water heater catch pans cannot be plastic, and that this IRC code change is #28 in T49 on p.49. The "n/a" in the right column means that the UPC does not have this rule.

A line ending in EXC means that an exception to the rule is contained in the line that follows. The following example is from p.36 on the subject of electrical requirements for central heating:

No other equipment on central heating circuit EXC _____ 3703.1 422.12
 • Associated pumps, humidifiers, air cleaners, & AC _____ 3703.1 422.12X

These lines are stating that central heating equipment requires its own circuit with no other equipment on that circuit. An exception is made for associated pumps, humidifiers, air cleaners, and AC equipment. The "X" at the end of the citation in the right column refers to an exception in the code, i.e., the full citation is section "422.12 Exception".

Benjamin Franklin was chosen as the main character in our Code Check illustrations for a number of reasons. Franklin's insatiable curiosity, scientific genius, and civic-mindedness drove him to study fire safety, safe exiting, public sanitation, improved heating methods, and of course, electricity.

In 1752, he brought the first bathtub to America. After designing a more comfortable model, he took it with him on his travels to Europe.



CODE CHECK "YOUR KEY TO THE CODES."

For updates & corrections to this book as well as additional tables & information on the Plumbing & Mechanical Codes, a listing all of the Code Check books, seminar training, online resources & help with the Building, Plumbing, Mechanical and Electrical codes, visit:

www.codecheck.com

TABLE OF CONTENTS

GENERAL RULES FOR ALL PIPING _____	4	GAS PIPING (Continued) _____	22-23
General Rules & Materials _____	4	Protection & Installation _____	23
Pipe Support _____	4	Piping Support _____	23
Pipe Protection in Framing _____	4	Valves, Shutoffs & Appliance Connections _____	23
TRENCHES & PIPE PROTECTION _____	5	Electrical _____	23
Piping in Concrete or Masonry _____	5	Drips & Sediment Traps _____	23
Trenching, Backfilling, & Piping in Common Trench _____	5	CORRUGATED STAINLESS STEEL TUBING (CSST) _____	23
DRAINAGE _____	6	CSST – Typical Manufacturer Recommendations _____	23
Building Drain & Building Sewer _____	6	Bonding _____	23
Size _____	7	Medium Pressure (MP) Regulators _____	23
Fittings & Changes of Direction _____	7-8	GAS PIPE & TUBING SIZE _____	24-25
CLEANOUTS _____	9	PROPANE (LP GAS) _____	25
WASTE STACKS & VENTS _____	10	Tank Valves & Regulators _____	25
FIXTURES BELOW MANHOLE COVER OR SEWER _____	10-11	Horizontal ASME Tanks _____	25
Backwater Valves _____	10	Piping & Tubing Systems _____	25
Fixtures below Sewer _____	11	WATER HEATERS _____	26-27
ON-SITE DISPOSAL SYSTEMS _____	11	Water Heaters – General Rules _____	26
TRAPS & TAILPIECES _____	12-13	Special Locations _____	26
Traps _____	12	Access & Working Space _____	26
Fixture Tailpieces _____	12	Tankless (On Demand) Water Heaters _____	27
Trap Arms (Fixture Drains) _____	13	Temperature & Pressure Relief Valves _____	27
VENTS _____	14-15	TPRV Drain Piping _____	27
Vents _____	14	Required Pans & Drain _____	27
Size _____	14	BOILERS & HYDRONICS _____	28
Vertical Wet Venting _____	15	Steam & Hot-Water Boilers _____	28
Common Vent _____	15	Dual Purpose Water Heaters _____	28
Horizontal Wet Venting _____	15	Exposed Piping _____	28
SPECIAL VENTING SYSTEMS _____	16	Hydronic Piping - General _____	28
Island Sinks _____	16	Embedded Piping (Radiant Heating) _____	28
Combination Waste & Vent _____	16	FIXTURES _____	29
VENT TERMINATION _____	16	Fixtures – General _____	29
AIR ADMITTANCE VALVES _____	17	Kitchen Sinks & Dishwashers _____	29
WATER SUPPLY & DISTRIBUTION _____	17	KITCHEN APPLIANCES _____	29
Water Supply – General _____	17	Ranges & Range Hoods _____	29
Materials _____	17	BATHROOMS _____	30
CROSS-CONNECTION CONTROL _____	18	Toilets & Bidets _____	30
JOINTS & VALVES _____	19	Tubs & Whirlpools _____	30
Joints & Connections _____	19	Showers _____	30
Prohibited Joints _____	19	Shower Pan & Liner _____	30
Required Valves _____	19	LAUNDRY _____	31
PRESSURE REGULATORS _____	18	Clothes Washers & Laundry Sinks _____	31
WATER SUPPLY SIZING _____	20-21	IRC Electric or UMC Electric or Gas Dryers _____	31
Water Service Size _____	20	IRC Gas Clothes Dryer Exhaust _____	31
PEX Tubing & Manifolds _____	20-21	Clothes Dryer Electrical _____	31
Trunk & Branch Sizing Methods _____	21	OIL TANKS & PIPING _____	32
GAS PIPING _____	22-23	Tanks – Outside, Inside & Abandoned _____	32
Metallic Pipe Joints & Fittings _____	22	Fill & Vent Piping _____	32
Underground _____	22	Piping & Tubing to Appliances _____	32
Gas Piping in or Below Slab _____	22	OIL-FIRED APPLIANCES _____	32-33



COMBUSTION AIR FOR OIL-FIRED APPLIANCES	33
OIL-FIRED APPLIANCE CHIMNEYS & VENTS	33
Chimneys & Type L Vents	33
Chimney Connectors	33
VENTILATION & EXHAUST SYSTEMS	34
Whole Building Ventilation	34
Local Exhaust	34
Additional Air Quality Requirements	34
Heat Recovery Ventilators (HRV)	34
Ceiling Suspended Paddle Fans	34
Bathroom Exhaust & Ventilation	34
GENERAL MECHANICAL SYSTEM REQUIREMENTS	35
Permits & Interpretations	35
Listing & Labeling	35
Appliance Maintenance	35
Minimum Heating Requirements	35
APPLIANCE LOCATION, ACCESS & ANCHORAGE	35
ELECTRIC HEAT	35
Central Electric Heat	35
Baseboard Heaters	35
Electric Radiant Heat Systems	35
Electric Duct Heaters	35
Embedded Heating Cables in Concrete or Slurry Floors	35
FORCED AIR FURNACES	36
Location & Clearances	36
Electrical Requirements	36
Appliances Under Floors	36
Garage	36
Equipment on Roofs	36
Appliances in Attics	36
AIR-CONDITIONING & HEAT PUMPS	37
Heat Pumps (HPs) & Air-Conditioning (AC)	37
Window & Through-Wall AC Units	37
EVAPORATIVE (SWAMP) COOLERS	37
CONDENSATE DISPOSAL	38
Drain Piping	38
Primary Condensate Lines	38
Secondary Containment	38
Condensate Pumps	38
High-Efficiency Appliances (Category IV)	38
DUCTS	39
Duct Installation	39
SMACNA Standards	39
Return Air	39
Insulation in Unconditioned Space	39
GAS APPLIANCE COMBUSTION AIR (C.A.)	40
Mechanically Supplied Combustion Air	40
Openings	40
Ducts	40
Single-Opening & Two-Opening Methods	40
Attic & Crawl-Space Sources	40
Indoor Air Source	40

GAS APPLIANCE VENTS	41
Gas Vents – General	41
Single Wall Vents	41
Chimneys	41
VENT CONNECTORS	41
Single Wall Connectors for Category I Appliances	41
Type B Double-Wall Connectors	41
VENT SIZES	42
Vent Size (Appliances with Draft Hoods)	42
Vent Size Using GMA Vent Tables	42
Examples of GAMA Vent Tables	42
Multiple Appliances Vented in Common	42
GAS VENT TERMINATIONS	43
Vent Terminations – General	43
Condensing Appliance Forced Vents (Cat. IV)	43
GAS FLOOR FURNACES	44
GAS WALL FURNACES	44
ROOM HEATERS	45
Vented Room Heaters	45
Unvented Heaters	45
DIRECT-VENT HEATING APPLIANCES	45
Direct-Vent Gas Wall Heaters	45
Direct Vent Termination	45
Direct-Vent Gas Fireplaces	45
GAS APPLIANCES IN FIREPLACES	45
Decorative Appliances (log-sets) in Fireplaces	45
Vented Decorative Gas Fireplaces	45
Vented Gas Fireplace Heaters	45
Log Lighters	45
FREESTANDING FIREPLACE STOVES (SOLID FUEL)	46
Fireplace Stoves & Solid-Fuel Room Heaters	46
Connectors	46
Connection to Masonry Fireplaces (Stoves & Fireplace)	46
CLEARANCE REDUCTION SYSTEMS	47
FIREPLACES & CHIMNEYS	47
Fireplace & Chimney Construction	47
SDC D ₀ , D ₁ & D ₂ Reinforcement	47
Flues	47
Masonry Fireplaces	47
Factory-Built Fireplaces & Chimneys	47
Exterior Air Supply (Masonry or Factory-Built)	47
RECOMMENDED INSPECTIONS OF EXISTING CHIMNEYS	47
INSPECTIONS	48
Water Supply	48
DWV Systems	48
Hydronics	48
Fuel Gas	48
STRUCTURAL	48
Pipe Protection in Framing	48
Structural Modifications & Fireblocking	48
Notches in Joists & Rafters	48
Stud Notching & Boring	48
CODE CHANGES TABLE	49

DRAINAGE (CONTINUED)

Drain, waste and vent (DWV) pipe sizes are determined by the number of drainage fixture units that each pipe carries. Begin by drawing an isometric diagram of all the fixtures, and assign each the appropriate number of drainage fixture units from **T6**. Start at the highest point of the system and work down to the building drain, sizing each pipe per **T8** or **T9** for the number of DFUs.

Drain Pipe Size	15 IRC	15 UPC
<input type="checkbox"/> Size piping per DFU loads T6-T9 _____	3005.4	703.1
<input type="checkbox"/> Branches & building drain max load per T7 & T8 _____	3005.4.1&2	703.2
<input type="checkbox"/> Kitchen, bath, & laundry group DFUs can be per T9 _____	T3004.1	n/a

TABLE 6 DFUs & TRAP SIZE ◆ IRC T3004.1 & T3201.7 UPC T702.1

Fixture	IRC		UPC	
	DFUs	Trap Size	DFUs	Trap Size
Bar Sink	1	1¼	1	1½
Bathtub (w/ or w/o shower)	2	1½	2	1½
Bidet	1	1¼	1	1¼
Bidet (1½ in. outlet)	1	1½	2	1½
CW Standpipe	2	2	3	2
Dishwasher (independent drain)	2	1½	2	1½ ^A
Floor drain	0	2	0	2
KS	2 ^B	1½	2	1½ ^A
LT	2	1½	2	1½
Lavatory	1	1¼	1	1¼
Single head shower stall	2	1½	2	2
Additional shower heads	2	Note C	1	2
Water Closet (toilet) ≤ 1.6 GPF	3	n/a	3	n/a
Water Closet (toilet) > 1.6 GPF	4	n/a	4	n/a

A. UPC: Min. 2 in. drain
 B. W/ or w/o DW or food waste grinder.
 C. The IRC bases the trap size on the flow rate. >5.7 gpm & ≤ 12.3 gpm = 2 in., ≤25.8 gpm = 3 in.

TABLE 7

**BRANCH DRAIN MAX DFUS
IRC T3005.4.1 & UPC T703.2**

Pipe size		1¼ in.	1½ in.	2 in.	2½ in.	3 in.	4 in.
IRC DFUs	Vertical	1	4	10	20	48	240
	Horizontal	1 ^A	3 ^A	6 ^A	12 ^A	20	160
UPC DFUs	Vertical	1	2	16	32	48	256
	Horizontal	1	1	8	14	35	216 ^A

A. Based on ¼ in./ft. slope

Building drain branches are the horizontal pipes that connect directly to the building drain. They can be carrying the drainage from multiple branch drains which are less likely to all be used at the same time. Therefore, the IRC allows these drains, and the building drain and building sewer, a larger number of DFUs than for the upstream branch drains of the same pipe size. The UPC does not have a corresponding system other than in an engineered design approved by the AHJ.

TABLE 8 IRC MAX DFUs ON BUILDING DRAIN, BUILDING DRAIN BRANCHES, & BUILDING SEWER ◆ IRC T3005.4.2

Pipe size (in.)	Slope (in. per ft.)		
	1/8	¼	½
1½ ^A	n/a	Note A	Note A
2 ^B	n/a	21	27
2½ ^B	n/a	24	31
3	36	42	50
4	180	216	250

A. 1½ in. horizontal branches to building drains limited to 1 pumped fixture (included food waste grinder) or 2 non-pumped fixtures.
 B. Drains <3 in. may not receive discharge from water closets.

Kitchen, bath, and laundry groups can be sized using **T9**, which allows a smaller number of DFUs than would be calculated if each individual fixture drain were assigned values from **T6**. UPC appendix C (Alternate Plumbing Systems) provides a similar system and requires approval by the AHJ.

TABLE 9 KITCHEN, BATH, & LAUNDRY GROUPS ◆ IRC T3004.1

Group	Description	DFUs
Full Bath	1.6 GPF WC, lavy, tub w/ or w/o shower	5 ^A
Half Bath	1.6 GPF WC + lavy	4 ^A
Laundry	CW standpipe + laundry tray	3
Kitchen	Separate DW & sink	2
Multiple Bath Groups	1 full bath + 1 half bath	7 ^B

A. Add 1 DFU if WC is > 1.6 gal. per flush.
 B. For each additional bath beyond 1½ baths, add 1 DFU per half bath, 2 DFUs per full bath.

Fittings & Changes of Direction

<input type="checkbox"/> Changes in direction req appropriate fittings F11-14,T10 _____	15 IRC	15 UPC
<input type="checkbox"/> Use double sanitary tees or equivalent (back-to-back fixture fitting) for 2 fixture inlets at same level F11 _____	3005.1.1	706.1
<input type="checkbox"/> Double sanitary tee barrel min 2 sizes larger than inlets F11 _____	n/a	706.2
<input type="checkbox"/> No horizontal-horizontal fittings within 10 pipe diameters downstream of stack base or horizontal offset _____	3005.5	n/a
<input type="checkbox"/> Sanitary tee horizontal to vertical only, not on "back" F12 _____	3005.1	706.1

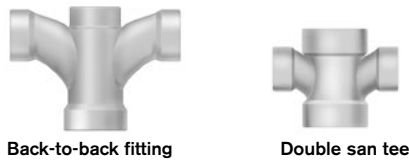
TABLE 10 APPLICATION OF FITTINGS ♦ IRC T3005.1 & UPC 706

Fitting	Horizontal to Vertical	Vertical to Horizontal	Horizontal to Horizontal
1/16 bend	✓	✓	✓
1/8 bend	✓	✓	✓
1/6 bend	✓	✓	IRC ✓ • UPC Ø
1/4 bend	✓	IRC ^A • UPC Ø	IRC ^A • UPC Ø
Short sweep (cast iron)	✓	✓ ^B	✓ ^A
Long sweep	✓	✓	✓
Sanitary tee	✓ ^{C,D}	Ø	Ø
Wye	✓	✓	✓
Combo wye & 1/8 bend	✓	✓	✓

A. IRC max. 2 in. diameter.
 B. IRC fixture drain max 2 in. diameter, fitting min. 3 in. diameter.
 C. Double sanitary tees not to receive discharge from pumped waste or from WCs unless min. 18 in. between WC and fitting.
 D. Double sanitary tees in UPC must have barrel 2 pipe sizes larger than inlets.

FIG. 11

Drains Entering at Same Level



A back-to-back fixture fitting should be used for fixtures or trap arms entering at the same level. The IRC allows a double sanitary tee to be used for this purpose where they are similar fixtures and both drains are the same size. The UPC only allows it for branch drains entering at the same level and into a barrel that is a min of two pipe sizes larger than the inlets.

FIG. 12

Sanitary Tees

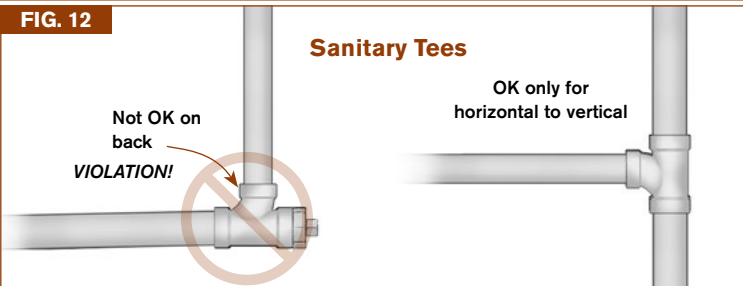


FIG. 13

DWV Fittings

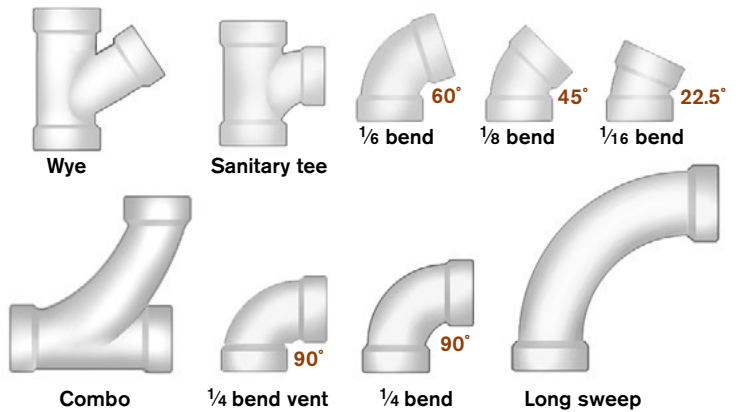
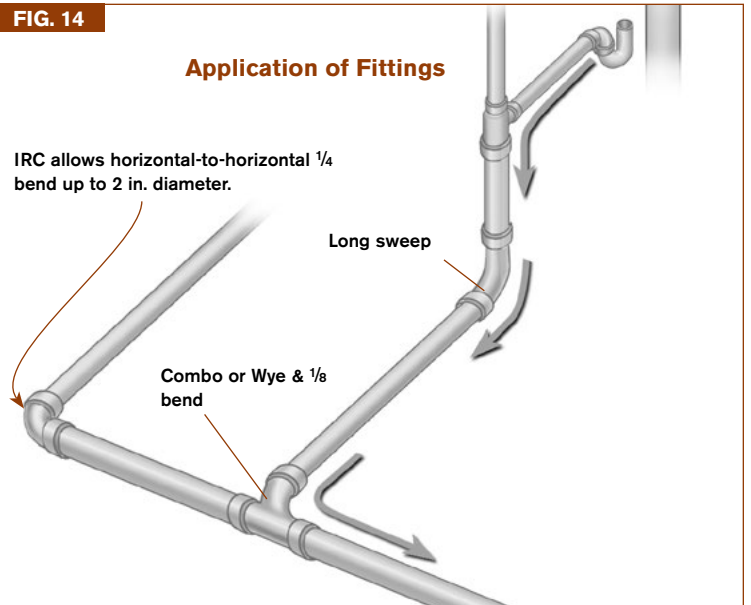


FIG. 14

Application of Fittings



CLEANOUTS

Cleanouts are necessary for clearing drain obstructions and for inspecting the building sewer with a sewer camera. Each code has restrictions on cleanouts in crawlspaces. The UPC requires that underfloor cleanouts be no further than 5 ft. from the crawl access opening. The IRC allows cleanouts in crawlspaces only where the travel path is a minimum of 24 inches high. When those conditions cannot be met, the cleanouts must be extended to the exterior.

IRC Cleanout Requirements

15 IRC

- CO plugs req raised sq. head or countersunk head or slot _____ 3005.2.6⁷
- Size same as drainpipes up to 4 in. diameter EXC _____ 3005.2.5
 - Removable trap OK 1 size smaller than drain(e.g.: kitchen) _____ 3005.2.5X1
 - CO in stacks OK 1 size smaller than stack _____ 3005.2.9X2
- CO to exterior if crawlspace travel path <24 in. in height _____ 3005.2.10⁸
- COs req'd not >100 ft. apart in each horizontal drainline EXC _____ 3005.2.1
 - CO not req'd between nonremovable trap and trap vent _____ 3005.2.1X
- COs below grade must be extended to or above grade **F10** _____ 3005.2.10
- Req'd in horizontal drains, building drains, & building sewer for each change of direction >45° **F16** EXC _____ 3005.2.4
 - First CO may serve up to 40 ft. that contains multiple changes **F16** 3005.2.4
- COs at base of stacks OK one size smaller than stack size _____ 3005.2.5X2.
- CO req'd at (or within 10 ft. developed length upstream of) junction of building drain & building sewer. **F10** Toilet not OK as req'd CO _____ 3005.2.3⁶
- Install COs to allow cleaning in direction of flow _____ 3005.2.8
- Pipes I 6 in. req 18 in. clearance to face of closest obstruction _____ 3005.2.9⁹
- Not OK to obstruct CO w/ permanent finishes, etc. _____ 3005.2.10.1
- CO openings not OK for new fixtures w/o new CO **F17** _____ 3005.2.11

UPC Cleanout Requirements

15 UPC

- COs liquid & gas tight _____ 707.3
- Plugs brass or plastic w/ raised head or countersunk slot _____ 707.1
- Min plug size for ≤2 in. pipe = 1½ in., 2½ in. or 3 in. pipe = 2½ in., ≥4 in. pipe = 3½ in. _____ 707.10
- Req'd at upper terminal of all horizontal runs **F15** EXC _____ 707.4
 - Horizontal runs <5 ft. (unless serving sinks or urinals) _____ 707.4X1
 - Horizontal pipes ≤72° from vertical (1/5 bend) _____ 707.4X2
 - Pipes above lowest floor of building _____ 707.4X3
 - No upper terminal CO req'd if 2-way CO at junction of building drain and building sewer **F10** _____ 707.4X4
- Req'd every 100 ft. length or fraction of developed length _____ 707.4
- Req'd for runs w/ aggregate change of direction >135° **F16** _____ 707.4
- Trap arm bends <90° do not req CO _____ 707.14
- Takeoff above flow line unless wye branch or end of line **F17** _____ 707.5
- Clearance in front of CO min 24 in. exc ≤2 in. pipe 18 in. OK _____ 707.9¹⁰
- Underfloor CO must extend above finished floor or outside building if >5 ft. from access door or if <18 in. vertical clearance or if passageway to CO <30 in. wide _____ 707.9¹¹
- COs must terminate above grade & be readily accessible or under cover plate _____ 707.8

FIG. 15

UPC Cleanouts Horizontal Distances

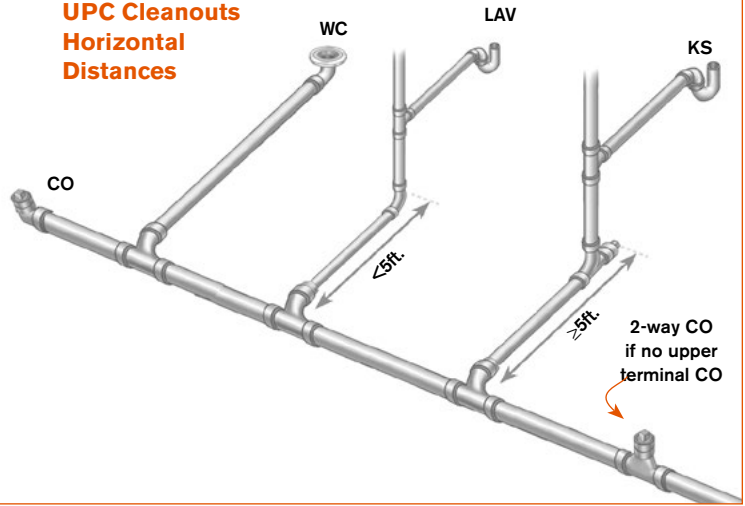


FIG. 16

Cleanout Bends & Clearances (plan view)

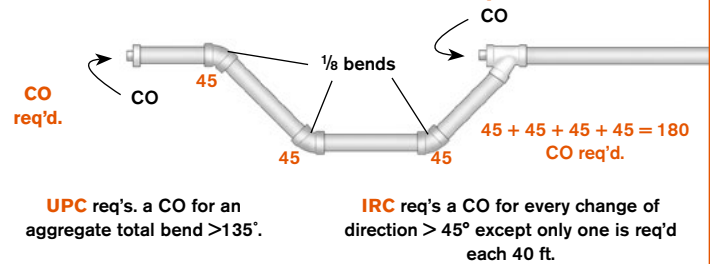
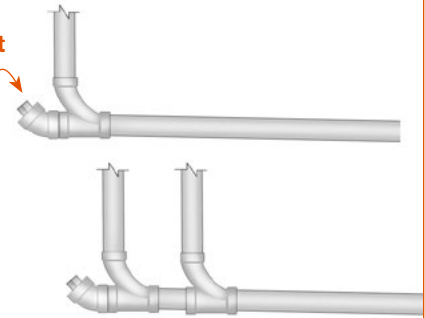


FIG. 17

Adding Drain at Cleanout

If additional drain is added here, new CO is req'd.

COs may not be used for new fixtures unless new CO added.



AIR ADMITTANCE VALVES

Air admittance valves (AAVs) operate by gravity, as shown in F43, and have no metal or rubber parts that could corrode or deform. In the IRC they can be used for individual fixtures or for branches. The UPC does not explicitly allow AAV's. Some jurisdictions may accept them under the provisions for Alternate Materials and Methods found in 301.3. If the UPC is the code in your area, be sure to check with your local building department (AHJ) before installing AAVs.

Air Admittance Valves

15 IRC

- Install after DWV leak test _____ 3114.2
- OK at individual, branch, circuit & stack vents F42 _____ 3114.3
- Individual & branch type AAV to vent only fixtures on same floor level & that connect to a horizontal branch drain _____ 3114.3
- Individual fixture & branch AAV ≥ 4 in above branch or fixture drain F42 _____ 3114.4
- Stack-type AAV min 6 in. above FLR of highest fixture _____ 3114.4
- AAV within same max distance as conventional vent T42 _____ 3114.4
- AAVs terminating in attic min 6 in. above insulation _____ 3114.4
- AAVs must be accessible for service & inspection F42 _____ 3114.5
- Space containing air admittance valve must be ventilated _____ 3114.5
- Min 1 vent to outdoors (UPC all vents to exterior) _____ 3114.7
- Not OK for sewer ejector pump or tanks _____ 3114.8

FIG. 42

Air Admittance Valve

An AAV cannot be located inside a stud cavity or other area where not accessible & open to free air.

When AAVs are placed in attics, they must be at least 6 in. above insulation.

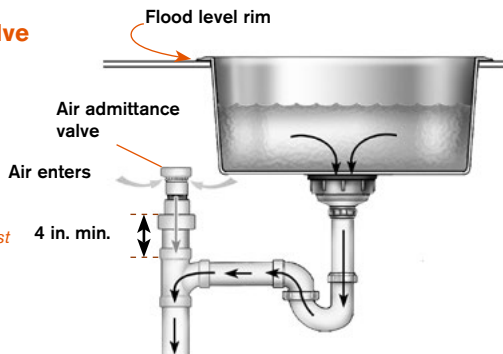
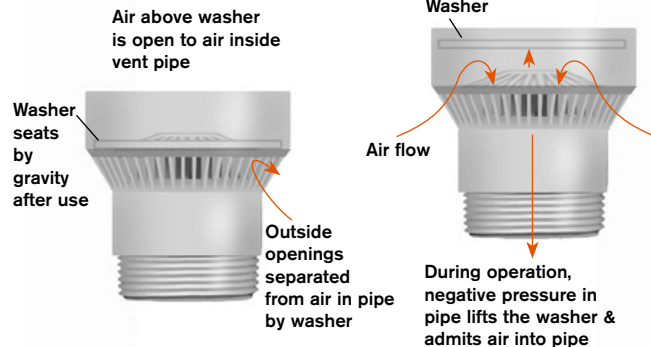


FIG. 43

Air Admittance Valve Operation



WATER SUPPLY & DISTRIBUTION

Plumbing systems must be designed and maintained to prevent contamination of potable water from cross connections to drains or other contaminated sources. Piping must be protected against movement and against damage during construction. Modern plumbing supply systems typically use plastic pipe or tubing with branch piping originating from a central manifold, rather than a trunk and branch system with a main line with branches. Plastics typically can only tolerate exposure to sunlight for limited periods, and some types of plastics require flushing procedures to remove solvents prior to use.

Water Supply - General

15 IRC 15 UPC

- Non-potable water system outlets to be marked
- CAUTION: NONPOTABLE WATER. DO NOT DRINK _2910.3¹⁵ 601.3.2^{CA}
- Plastic underground water service req #18 tracer blue wire _n/a 604.10.1
- Min pressure 40psi (UPC: 15 PSI) _____ 2903.3 608.1
- If pressure insufficient, install booster pump, tanks, etc_ 2903.3 608.1
- Max pressure 80psi (p.19) F51 _____ 2903.3.1 608.2
- Mechanical ASSE 1010 water hammer arrestors (not air chambers) req'd near quick-close valves (DW or CW) _____ 2903.5 609.10^{CA}

TABLE 20 WATER PIPE MATERIALS ◆ IRC T2906.4&5 & UPC T604.1

Material	IRC		UPC	
	Service	Distribution	Service	Distribution
ABS	✓	∅	∅	∅
Brass pipe	✓	✓	✓	✓
CPVC	✓	✓	✓	✓
Cu tubing	✓	✓	✓	✓
Ductile iron	✓	∅	✓	✓
Galvanized steel	✓	✓	✓	✓
PE	✓	∅	✓	∅
PE-AL-PE	✓	✓	✓	✓
PEX	✓	✓	✓	✓
PEX-AL-PEX ^{CA}	✓	✓	✓	✓
PEX-AL-HDPE	✓	✓	∅	∅
Polypropylene plastic tubing (PP)	✓	✓	✓	✓
PVC	✓	∅	✓	∅
Stainless steel	✓	✓	✓	✓

Materials

15 IRC 15 UPC

- All materials must meet NSF 61 & be approved T20 _2906.4&5 604.1^{CA}
- Lead content of pipe & fittings max 8% _____ 2906.2 604.2
- Cu alloy fittings & valves >15% Zi by weight & used w/ plastic piping systems req resistance to dezincification per NSF 14 _n/a 604.1¹⁶
- Flex connectors per ASME A112.18.6/CSA B125.6 _____ 2906.7 604.5¹⁷
- Flex connectors accessible (UPC: readily accessible) _____ 2906.7 604.5¹⁷
- Cu pipe markings: K=green, L=blue, M=red _____ 2906.5 604.4
- CPVC joints AMI, primer must be orange EXC _____ 2906.9.1.2 605.3.1
- One-step cements AMI yellow (IRC: or red) _____ 2906.9.1.2¹⁸ 605.3.1

CROSS-CONNECTION CONTROL

Backflow prevention devices protect water systems from backup and contamination. Protection of the drinking water system is critical. Vacuum breakers prevent contaminants from entering through systems such as lawn sprinklers. An air gap is a physical separation and is used to protect waste receptors, such as sinks.

Protection of Potable Water

15 IRC

15 UPC

- Prevent contamination of potable water supply _____ 2902.1 602.1
- Connections for private to public water supply prohibited 2902.1 602.2
- Reduced pressure principle backflow preventers **F45** OK for:
 - Boilers w/ conditioning chemicals _____ 2902.5.1 603.5.10
 - Fire-sprinkler systems w/ additives _____ 2902.5.4.1 603.5.14.2
 - Lawn irrigation systems w/ chemical injectors _____ 2902.5.3 603.5.6.3
 - Solar heating piping w/ additives _____ 2902.5.5.3 603.5.6.3
 - Pool/spa makeup water _____ n/a 603.5.20
- Atmospheric vacuum breakers OK for:
 - Hose bibbs (not needed for tank drain valves) **F47** _____ 2902.4.3 603.5.7
 - Pool/spa inlets 6 in. critical level & after last valve _____ 2902.3.2 603.5.5
 - Irrigation system, 6 in. above highest head **F46** _____ 2902.3.2 603.5.6
- Integral air gaps in fixtures to recognized standards OK:
 - Reverse osmosis drinking water treatment units _____ 2909.2 603.4.6
 - DWs (AMI may req air gap if discharge connection low) 2717.1 n/a
 - Pullout spouts and sprayers w/ integral backflow AMI 2902.4.2 603.4.6
 - Pull-out or separate shower spray wands _____ 2902.4.2 603.4.6
 - Flush tank fill w/ critical level 1 in. above overflow _____ 2902.4.1 603.5.2
- Fixture outlet receptor air gaps:
 - Min 2x diameter of outlet and per table **F44,T21** _____ 2902.3.1 603.3.1

TABLE 21 MINIMUM AIR GAPS ♦ IRC T2902.3.1 & UPC T603.3.1

Opening diameter & typical fixtures (in.)	Not Affected by Side Walls (in.)		Affected by Side Walls ^A (in.)	
	IRC	UPC	IRC	UPC
1 1/2 (lav)	1	1	1 1/2	1 1/2
1 3/4 (LT)	1 1/2	1 1/2	2 1/2	2 1/4
1 1 (BT)	2	2	3	3
>1 (pool)	2x diameter	2x diameter	3x diameter	3x diameter

A. Affected by side walls = any time the distance from the spout to the wall is <3x the diameter of the effective opening, or <4x the dia for 2 intersecting walls.

FIG. 44

Air Gap

The air gap is the distance between the lowest edge of the faucet opening **D** & the top of the flood level.

2x D or 1in.min.

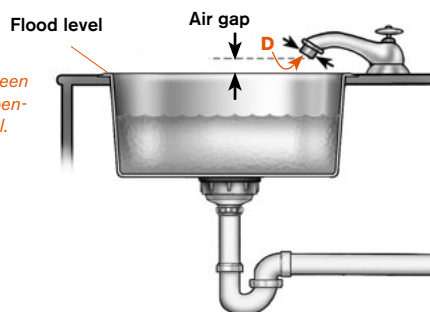
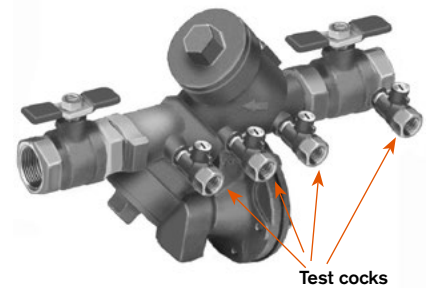


FIG. 45

Reduced Pressure Backflow Device

Reduced pressure backflow device used for:

- Boilers
- Fire-sprinkler systems
- Lawn irrigation systems
- Solar heating piping



Outdoors & Irrigation Systems

15 IRC 15 UPC

- Irrigation vacuum breakers 6 in. above highest head **F46** _____ 2902.5.3 T603.2
- Hose bibb integral backflow or vacuum breaker EXC **F47** _ 2902.4.3 603.5.7
 - Water heater & boiler drains, clothes washers _____ 2902.4.3X 603.5.7

FIG. 46

Vacuum Breakers

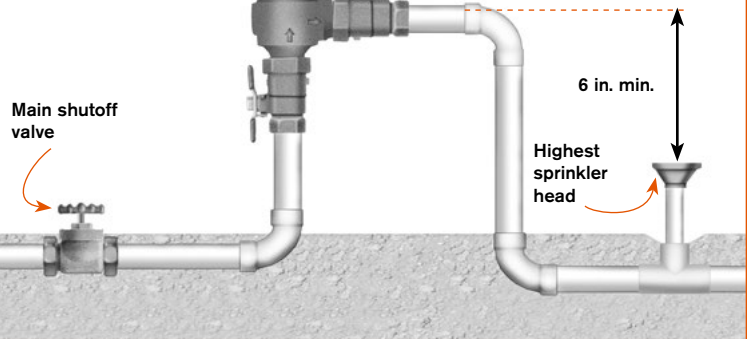


FIG. 47

Backflow Protection Devices



Hose bibbs req. backflow protection devices, except for clothes washers, tank drains, & water heaters.

JOINTS & VALVES

Joints & Connections

15 IRC

15 UPC

- Joints between dissimilar materials AMI _____ 2906.17 605.16
- Cu to Fe req's brass (UPC: min 6 in.) or dielectric fitting_ 2906.17.1 605.16.1^{ca}
- Cu joints in or under concrete slab on grade within building req brazed wrought-Cu fittings _____ local 609.3#2
- Slip joints only at exposed fixture supply _____ local 605.14
- Unions req'd within 12 in. of WH _____ local 609.5
- Unions req'd ≤12 in. of softeners, filters, regulators, etc. _____ local 609.5

Prohibited Joints

- Connection between different types of plastic piping or different piping materials reqs approved adapter fitting _____ 2906.17.2 605.16.2
- Except for necessary valves, intermixing of dissimilar metals only at exposed or accessible locations _____ local 310.6
- Female threaded CPVC fittings w/ male plastic only _____ local 605.2.3
- Female threaded PVC fittings w/ male plastic only _____ local 605.12.3

Required Valves

- Accessible main valves req'd near water entrance _____ 2903.9.1 606.2
- Main & WH valve must be full-open type **F48,49** _____ 2903.9.1&2 606.2
- Throttling valves not OK for main & WH **F50** _____ 2903.9.1&2 606.2
- Main valve must be on discharge side of water meter _____ local 606.2
- Main valve must have bleed orifice or separate drain _____ 2903.9.1 n/a
- Valve req'd on each appliance supply _____ 2903.9.3 606.5
- Valves req'd on each fixture supply EXC _____ 2903.9.3 606.5
 - Tubs & showers (UPC: fixtures w/o slip joints) _____ 2903.9.3 606.5
- Valves OK at accessible manifold **F53** if labeled EXC _____ 2903.8.4 606.5
 - If manifold in attic, crawlspace, or otherwise not readily accessible, separate shutoff req'd at each individual fixture _____ n/a 606.5¹⁹
- Hose bibs subject to freezing req valve w/drain (stop-and-waste-type) EXC _____ 2903.10 603.5.7
 - Frostproof hose bibs w/ stem through insulation _____ 2903.10X local
- Valves req'd on cold-water supply at each WH _____ 2903.9.2 606.2
- Req'd shutoffs must be accessible _____ 2903.9.3 606.6

PRESSURE REGULATORS

A "closed system" is created when a one-way valve is installed on the main water supply. As water in a storage tank water heater is replaced by cold water, pressure in the tank is reduced. As the temperature rises in the tank, pressure increases but is equalized with the municipal water system pressure. Backflow preventers or pressure-reducing regulators prevent this pressure equalization, and an expansion tank is necessary to prevent excess pressure in the piping. The expansion tank is installed on the cold water line at the water heater and is set to the static pressure of the system. Some pressure regulators have an "integral backflow" feature and do not create a closed system; check the specifications of the regulator to determine if such is the case.

Pressure Regulators - General

15 IRC

15 UPC

- Req'd when building water pressure exceeds 80 psi _____ 2903.3.1 608.2
- Strainer req'd ahead of regulator **F51** _____ n/a 608.2
- Regulator & strainer accessible w/o removing piping _____ MFR 608.2
- Pipe sizing based on 80% of regulated pressure _____ n/a 608.2
- Expansion tank req'd on systems w/ regulators w/o integral bypass or devices that prevent pressure dissipation **F52** _____ 2903.4.1 608.3
- Expansion tank req'd for systems w/ supply check valves _____ 2903.4.2 608.3
- Booster req'd if min flow rates not achieved (UPC: ≥15 psi) 2903.3 608.0

FIG. 51

Pressure Regulator

Strainer must remain accessible

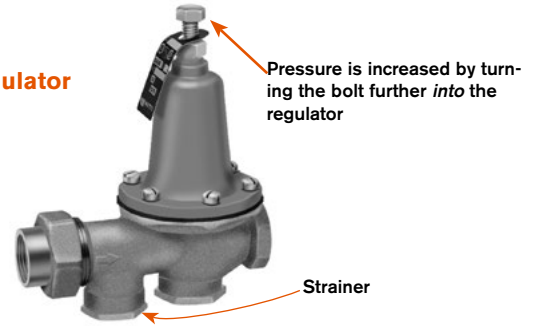


FIG. 52

Expansion Tank

TPRV not to be used for thermal expansion control

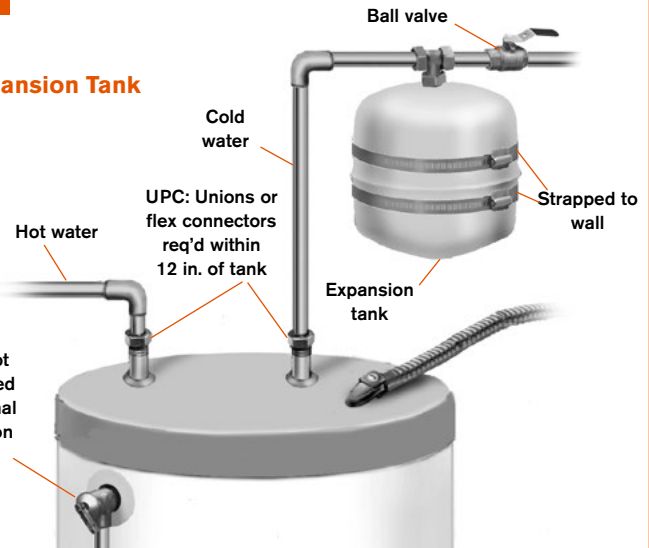


FIG. 48

Gate Valve



FIG. 49

Ball Valve



Full-open valves

FIG. 50

Globe Valve



Flow control valve

PIPE SIZE

Gas piping systems in series (F59) can be sized using either the longest length or the branch length method. Systems with MP regulators are sized using the hybrid pressure method.

- Pipe Size** **15 IRC** **15 UPC**
- Size per max demand based on appliance input ratings _ 2413.2 1208.4.1
 - Assume all appliances operating simultaneously EXC ___ 2413.2 1208.4.1
 - Where diversity of load can be established _____ 2413.2 1208.4.1X
 - Size AMI or per tables **T30 & T32-35** _____ 2413.3 1208.4.2
 - Adjust volumetric flow rate for altitudes > 2,000 ft. _____ 2413.2 1208.4.1

TABLE 32 GAS PIPE SIZING PROCEDURES ♦ IRC 2413.3 & UPC 1216.1

1. Determine Btu/cu.ft. from local gas provider
 2. Determine cu.ft./hr. demand for each appliance
 3. Sketch layout w/ piping lengths to each appliance (F52)
 4. Determine total cu.ft./hr. demand on each pipe section
 5. Determine length to most remote appliance
 - 6A. (longest length method) use row of **T32** for that length for all appliances
 - 6B. (branch length method) use same row for all sections in series w/ most remote appliance. For other branches, use actual length of each branch.
- The "longest length" method is more conservative, and compensates for pressure losses throughout the system. The "branch length method" has less leeway, and consideration should be given to the lengths of pipe fittings. The codes accept both methods. Systems w/ MP regulators use the "hybrid pressure" method, where the pipe sizes before the regulator are determined separately, each by the longest length method.

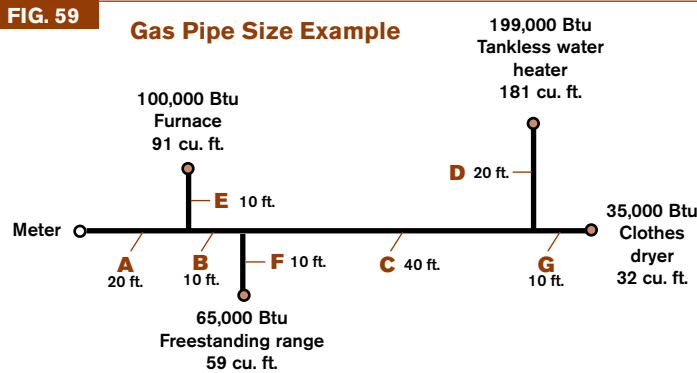


TABLE 33 GAS PIPE SIZE EXAMPLE

Pipe Section	Total cu. ft./hr. ^A	Longest Length	Longest-Length Method	Actual Lengths	Branch-Length Method
A	363	90 ft.	1¼ in.	90 ft.	1¼ in.
B	272	90 ft.	1¼ in.	90 ft.	1¼ in.
C	213	90 ft.	1¼ in.	90 ft.	1¼ in.
D	181	90 ft.	1 in.	90 ft.	1 in.
E	91	90 ft.	¾ in.	30 ft.	½ in.
F	59	90 ft.	¾ in.	40 ft.	½ in.
G	32	90 ft.	½ in.	80 ft.	½ in.

A. Ex based on 1100 Btu/cu. ft.—contact local provider for actual values.

TABLE 34 CUBIC FEET CAPACITY OF SCHEDULE 40 METALLIC GAS PIPE^A ♦ IRC T2413.4(1) & UPC T1216.2(1)

Pipe Length (in ft.)	Nominal Pipe Size (in.)								
	½	¾	1	1¼	1½	2	2½	3	4
	Demand Capacity (in cu.ft./hr.)								
10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900
30	95	199	374	768	1,150	2,220	3,530	6,250	12,700
40	81	170	320	657	985	1,900	3,020	5,350	10,900
50	72	151	284	583	873	1,680	2,680	4,740	9,660
60	65	137	257	528	791	1,520	2,430	4,290	8,760
70	60	126	237	486	728	1,400	2,230	3,950	8,050
80	56	117	220	452	677	1,300	2,080	3,670	7,490
90	52	110	207	424	635	1,220	1,950	3,450	7,030
100	50	104	195	400	600	1,160	1,840	3,260	6,640
125	44	92	173	355	532	1,020	1,630	2,890	5,890
150	40	83	157	322	482	928	1,480	2,610	5,330
175	37	77	144	296	443	854	1,360	2,410	4,910
200	34	71	134	275	412	794	1,270	2,240	4,560
250	30	63	119	244	366	704	1,120	1,980	4,050
300	27	57	108	221	331	638	1,020	1,800	3,670
350	25	53	99	203	305	587	935	1,650	3,370
400	23	49	92	189	283	546	870	1,540	3,140
450	22	46	86	177	266	512	816	1,440	2,940
500	21	43	82	168	251	484	771	1,360	2,780

A. Based on inlet pressure <2 psi, pressure drop 0.5 in. water column, specific gravity 0.60

GAS PIPE SIZE EXAMPLE FILL-IN

Pipe Section	Total cu. ft./hr. ^A	Longest Length	Longest-Length Method	Actual Lengths	Branch-Length Method
A					
B					
C					
D					
E					
F					
G					

A. Btu/cu.ft. (from gas supplier)

WATER HEATERS

Water heaters should be maintained at as low a temperature as comfortably practical to reduce the risk of scalding. An undersized water heater is more likely to be turned to a dangerously high setting. Other means of protection against scalding include tempering valves at the water heater or at individual fixtures. Tankless water heaters are becoming more popular, including hybrid systems that contain a small storage tank and circulating line. **T36** sizing represent the minimum the code allows but may not provide adequate hot water supply under all conditions. Improperly sized tankless water heaters is a common issue. Local energy codes may influence sizing as well. Water heaters that are part of a boiler system are discussed on **p.28**.

- Water Heaters – General** **15 IRC** **15 UPC**
- Replacement water heaters req permits _____ 105.1 502.1
 - Installation & maintenance instructions to be left w/ WH_ 1307.1 507.24
 - Size to meet demand **T36** _____ 2448.1 501.1
 - Installation AMI & all instructions in L&L _____ 2005.1 501.1
 - Full-open type valve req'd on supply at WH **F48,49** _ 2903.9.2 606.2
 - WH also used for space heating must be L&L for both _ 2448.2 501.1
 - Systems also used for space heating req master mixing valve to temper domestic water to 140°F or less **F68** _ 2803.2 n/a
 - Unions req'd (UPC: Within 12 in.) to allow removal **F61,67** local 609.5
 - Electric WH req's in-sight or lockable disconnect **F67** _ T4101.5 505.1
 - Fuel-fired WH combustion air (**p.40**) _____ 2407.1 506.1
 - Fuel-fired WH venting (**pp. 33,41-43**) _____ 1801.1 & 2427.1 509.0

TABLE 36 WATER HEATER MIN CAPACITY^A ♦ T501.1(1)

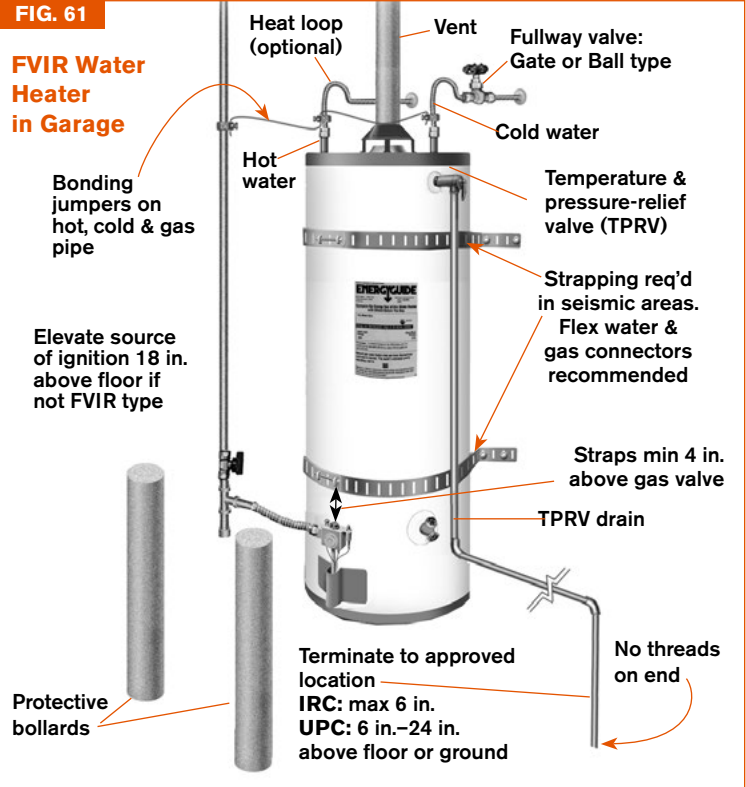
Number of Bathrooms	Number of Bedrooms	1st hr. Rating ^B
1 to 1½	1	42
	2 to 3	54
2 to 2½	2	54
	3 to 4	67
	5	80
3 to 3½	3	67
	4 to 6	80

A. Based upon the first-hr. rating found on the "Energy Guide" label. This number is approximately equal to the storage size plus hourly recovery rate.
 B. This table can also be used to size tankless water heaters.

- Special Locations** **15 IRC** **15 UPC**
- Fuel-fired WH prohibited in storage closets _ 2005.2 & 2406.2 local
 - Not in bedrooms or bathrooms EXC _____ 2005.2 & 2406.2 504.1
 - In dedicated enclosure w/ solid, weatherstripped, self-close door & all combustion air from exterior _____ 2005.2 & 2406.2 504.1(1)
 - Direct-vent WH OK w/o enclosure _____ 2005.2 & 2406.2 504.1(2)
 - Ignition source ≥18 in. above garage floor EXC **F61** _____ 2801.7 507.13
 - Flame Vapor Ignition-Resistant (FVIR) WH **F62** _____ 2801.7X 507.13
 - WH in separate enclosure accessible only from outside the garage & no combustion air from garage _____ 1307.3 507.13.2
 - Min 18 in. above floor in area where flammables stored (basements) unless FVIR **F61** _____ local 507.12
 - Seismic bracing req'd upper & lower 1/3 of tank in SDC D & townhomes SDC C (UPC: all occupancies SDC C,D,F) **F61** _ 1307.2 & 2801.8 507.2^{CA}
 - Barrier or elevation req'd in vehicle path (garages, etc) **F61** _ 1307.3.1 507.13.1
 - Min 3 in concrete pad req'd if supported on ground _ 1305.1.4.1 507.4

FIG. 61

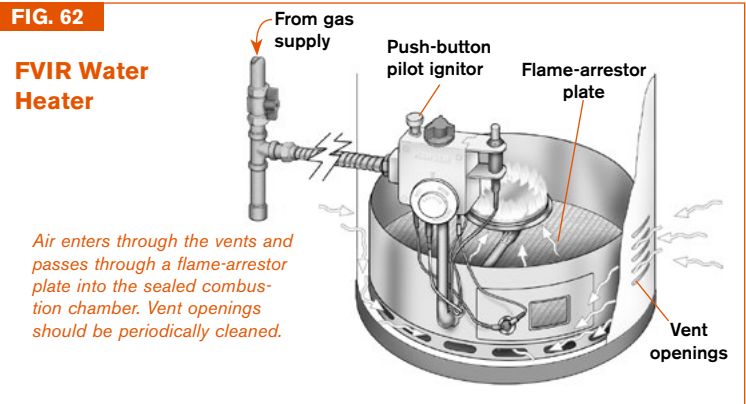
FVIR Water Heater in Garage



- Access & Working Space** **15 IRC** **15 UPC**
- Clearances to combustibles per L&L and AMI _____ 1307.1 504.3.1
 - Remain accessible for service, inspection, & removal _ 1305.1 504.3.1
 - Attic hatch or door min 22 in. wide x 30 in. high _ 1305.1.3&1.4 508.4
 - Largest appliance fits through access (crawl, attic) _ 1305.1.3&1.4 508.4
 - Attic min 24 in. passageway, solid floor to WH _ 1305.1.3&1.4 508.4.2
 - Max 20 ft. from attic access if ceiling <6 ft. _____ 1305.1.3&1.4 508.4.1
 - Min 30 x 30 in. level working platform req'd EXC 1305.1.3&1.4 508.4.3
 - Platform not req'd if can be serviced from opening 1305.1.3X1 local
 - Attic & crawl req's light & receptacle near WH 1305.1.3.1&1.4.3 508.4.4
 - Light switch req'd at normal access _ 1305.1.3.1&1.4.3 & 3903.4 508.4.4

FIG. 62

FVIR Water Heater



BOILERS & HYDRONICS

Modern high-efficiency boilers can be used for hydronic heating systems and for indirect-fired water heating systems. Distribution can be through radiators, baseboard convectors, radiant in-floor tubing, or duct heaters. Valves, backflow preventers, drain piping, and other items are governed also by plumbing codes.

- Steam & Hot-Water Boilers** **15 IRC** **15 UMC**
- Install AMI & per ASME standards _____ 2001.1 1002.1
 - Installer to supply control diagram & operating manual __ 2001.1 1012.1
 - Must be securely anchored to structure _____ 1307.2 1001.5
 - Hot water boilers req pressure & temperature gauges **F69** 2002.2 1003.3
 - Steam boilers req sight-glass & pressure gauge _____ 2002.3 1003.3
 - Pressure regulator req'd on water feed **F69** _____ MFR MFR
 - Shutoff valves req'd in supply & return piping **F69** _____ 2001.3 1212.3
 - Low-water cutoff control req'd EXC _____ 2002.5 1008.1
 - Coil-type or forced-circulation boiler w/ flow sensor **2002.5X³¹** 1008.1
 - Hydronic boilers req expansion tanks **F69** _____ 2003.1 1004.1
 - Tank test pressure 2½ × allowable system pressure __ 2003.1.1 1004.3
 - Tank support designed for twice waterlogged weight __ 2003.1 1004.1
 - Tank capacity based on system volume **T37** _____ 2003.2 1004.4
 - PRV req'd **F69** _____ 2002.4 1005.1&1206.2
 - PRV drain piped to within 18 in. of floor or receptor ____ 2002.4 ∅
 - Discharge piping same rules as for WH (**p.26**) _____ n/a 1005.2³²

- Dual Purpose Water Heaters**
- Water heaters used for space heating & domestic HW
L&L for the purpose & installed AMI **F68** _____ 2004.1 & 2448.2 1203.2
 - Tempering valve must limit potable water to 140°F max **F68** _n/a 12073.1

- Exposed Piping**
- Support piping to avoid strain **T3,4** _____ 2101.9 1210.3
 - Allow for expansion & contraction _____ 2101.8 1210.2
 - Wrap/sleeve pipes through concrete walls or floors ____ 2101.4 12176.1

- Hydronic Piping - General** **15 IRC** **15 UMC**
- Materials rated for temperature & heat transfer medium _ 2101.1 1210.1
 - Provide means of system drain down **F69** _____ 2101.2 1202.1
 - Maintain backflow protection to potable water **F69** _____ 2101.3 1202.1
 - RPPBP req'd to protect potable water if additives used _ 2101.3 1202.2
 - Provide for expansion and contraction of piping _____ 2101.8 1210.2
 - Expansion tank req'd every hydronic system **F69** _____ 2003.1 1209.1
 - Pressure-reducing valve req'd on makeup water feed **F69** _n/a 1214.4
 - PEX & PB in closed systems req oxygen barrier _____ T2101.1 1205.4
 - Indicate flow directions on system **F69** _____ n/a 1204.6

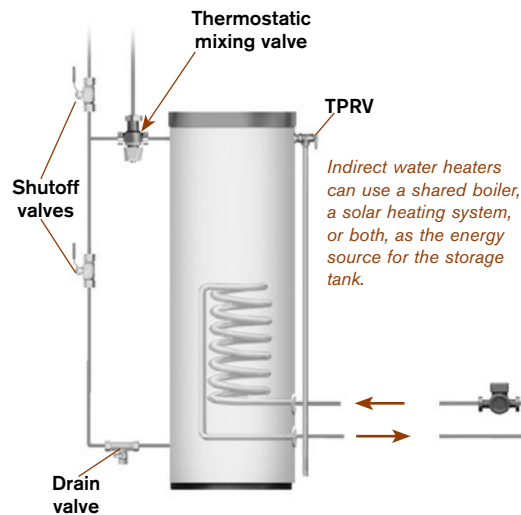
- Embedded Piping (Radiant heating)**
- Plastic pipe rated min 100psi at 180°F _____ 2103.1 1221.2
 - Cu tubing joints brazed not soldered _____ T2101.1 1221.2.2
 - Tubing embedded in concrete min 2 in. below surface ____ n/a 1217.6
 - Min R-5 insulation under poured concrete radiant system in soil contact & R-5 on vertical slab edges on grade _____ 2103.2.1 12176.2

TABLE 37 MIN. EXPANSION TANK CAPACITY ♦ IRC 2003.2		
System Volume (gal.)	Pressurized Tank	Open Tanks
10	1.0	1.5
20	1.5	3.0
30	2.5	4.5
40	3.0	6.0
50	4.0	7.5
60	5.0	9.0
70	6.0	10.5
80	6.5	12.0
90	7.5	13.5
100	8.0	15.0

Based on average water temperature of 195°F, fill pressure of 12 PSIG, max operating pressure 30 PSIG

FIG. 68

Indirect Water Heater



The hydronic system components shown here can be designed in many different arrangements; the purpose of this illustration is simply to depict the major components required by code. Other components, such as balancing valves, check valves, purge valves, thermostats, zone valves, and control wiring, are not shown.

FIG. 69

Hydronic Heating Boiler

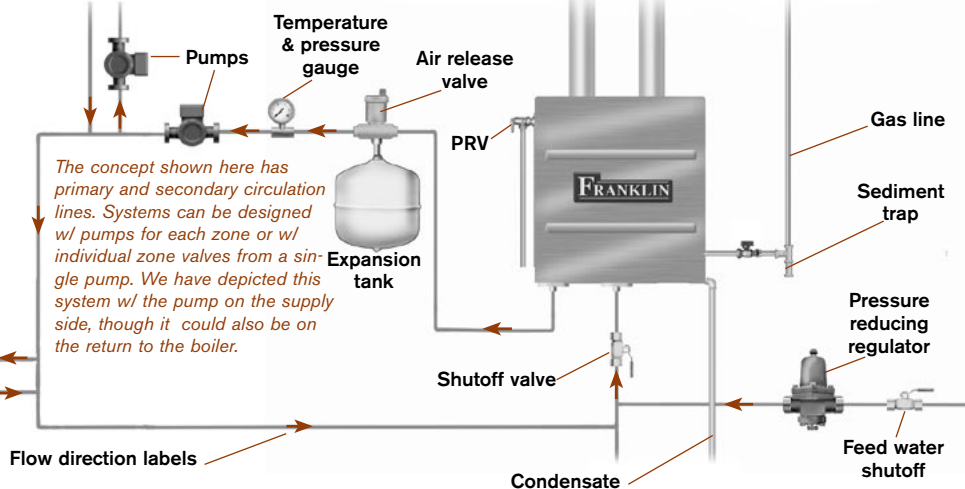


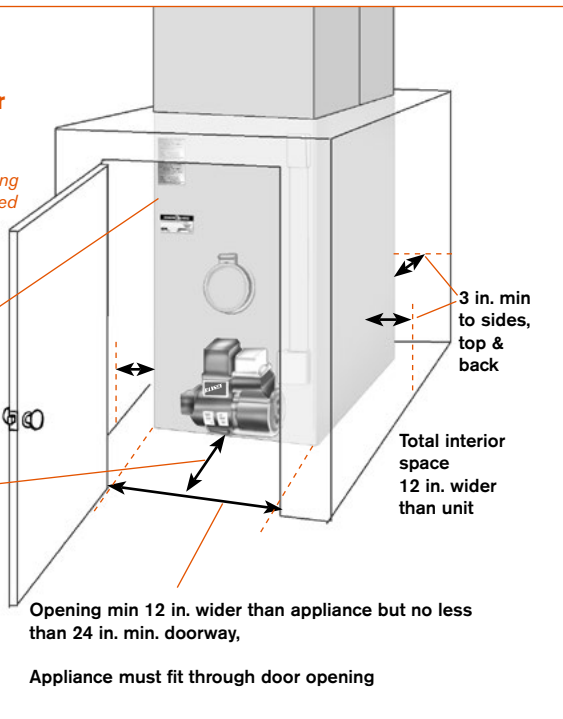
FIG. 84

Oil Furnace in Alcoves or Closets

New FAU's in existing closets OK if installed w/ clearances AMI

Oil-burning furnace

6 in. front clearance of open firebox



OIL-FIRED APPLIANCES (CONTINUED)

Oil-Fired Recessed Wall Furnace	15 IRC	NFPA 31
<input type="checkbox"/> Must be L&L for combustible construction _____	1409.1	10.13.1
<input type="checkbox"/> Install AMI _____	1409.1	10.13.3
<input type="checkbox"/> Locate so no fire hazard to walls, floors, or furnishings _____	1409.1	10.13.4
<input type="checkbox"/> Doors swing arc not within 12 in. of face of furnace _____	1409.2	MFR
<input type="checkbox"/> Doorstop cannot be used to maintain req'd clearance _____	1409.2	MFR
<input type="checkbox"/> Min 3 ft. from wall opposite register _____	MFR	10.13.5
<input type="checkbox"/> Panels, grills & access doors not attached to walls _____	MFR	10.13.6
<input type="checkbox"/> Provide adequate combustion air _____	1701.1	10.13.7

COMBUSTION AIR FOR OIL-FIRED APPLIANCES

The IRC no longer includes a separate set of rules for combustion air for oil-burning appliances. Instead refers to NFPA 31 oil appliance combustion air.

Oil-fired Appliance Combustion Air - General	NFPA 31
<input type="checkbox"/> Source from outside if building is unusually tight construction _____	5.2.3
<input type="checkbox"/> Consider effect from exhaust fans (kitchen, bath, laundry) _____	5.2.3
<input type="checkbox"/> Screen req'd on outside openings, mesh openings $\geq 1/4$ in. _____	5.6.2
<input type="checkbox"/> Consider restrictive effect of louvers on openings: _____	5.6.3
• Net free area 60–75% for metal louvers	
• Net free area 20–25% for wood louvers	

Indoor Air Source

<input type="checkbox"/> Only OK for buildings of ordinary tightness _____	5.3.1
<input type="checkbox"/> Infiltration sufficient for unconfined space _____	5.3.1
<input type="checkbox"/> Unconfined space = ≥ 50 cu. ft./kBtu/hr. of all appliances in space F110	3.3.60
<input type="checkbox"/> Confined area req's openings to unconfined space of adequate volume	5.4.1.3
<input type="checkbox"/> Openings to unconfined space min 1sq. in./kBtu/hr. T40	5.4.1.2
<input type="checkbox"/> Openings located near top & bottom of confined space F111	5.4.1.1

Outside Air Source

<input type="checkbox"/> Openings located near top & bottom of confined space F111	5.4.2.1
<input type="checkbox"/> Openings to vented attic or crawlspace equivalent to outdoors F107	5.4.2.2
<input type="checkbox"/> Direct exterior openings each sized at 1sq. in./4kBtu/hr. F106	5.4.2.3
<input type="checkbox"/> Vertical ducts each sized at 1sq. in./4kBtu/hr. F103,109	5.4.2.3
<input type="checkbox"/> Horizontal ducts each sized at 1sq. in./2kBtu/hr. F104	5.4.2.4

OIL-FIRED APPLIANCE CHIMNEYS & VENTS

Oil-fired appliances can be vented to listed L vents, into masonry or listed chimneys. IRC chapter 18 deals with this subject. The UMC defers to NFPA 211 for oil-fired appliances, though NFPA 31 also contains similar rules. NFPA 211 does not address as many topics on oil-fired vents as NFPA 31, and for consistency with the rest of the codes in this section we are providing the NFPA 31 rules below.

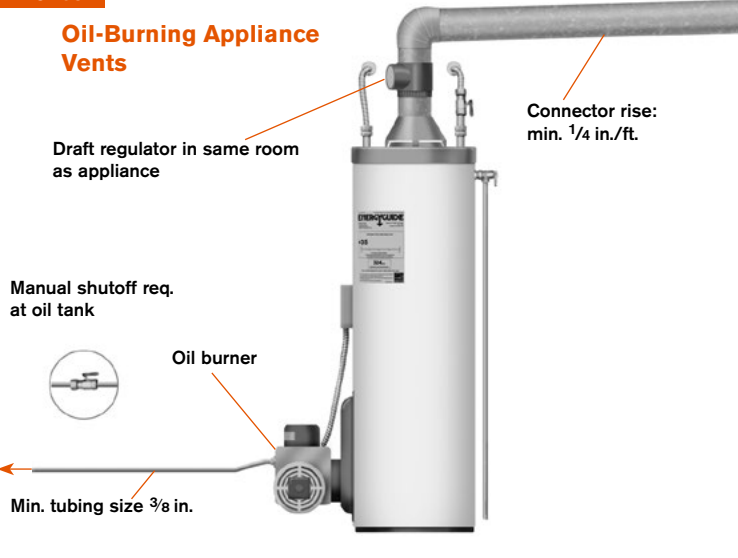
Oil Appliance Chimneys & Vents - General	15 IRC	NFPA 31
<input type="checkbox"/> Appliances must be listed _____	1302.1	13.2
<input type="checkbox"/> Fuel-burning appliances req venting to outdoors _____	1801.1	6.2.1
<input type="checkbox"/> Vent system AMI of connected appliance _____	1801.2	6.3.1
<input type="checkbox"/> Draft regulator req'd if connected to chimney EXC _____	1802.3	6.4.1
• Arrangements that prevent excessive chimney draft _____	n/a	6.4.1
• Appliances L&L for use w/o draft regulator _____	n/a	6.4.1
<input type="checkbox"/> No manually operated dampers _____	1802.2.1	6.4.2
<input type="checkbox"/> Automatic dampers req burner interlock _____	1802.2.2	6.4.3
<input type="checkbox"/> Unused openings not OK in vent system _____	1801.10	n/a

Chimneys & Type L Vents

<input type="checkbox"/> Chimney flues serving oil systems sized per NFPA 31 _____	1805.3X	6.6
<input type="checkbox"/> Verify existing chimney OK if installing new appliance _____	1801.3	6.6.7
<input type="checkbox"/> Installer verify chimney size OK or resize per NFPA 31 _____	1801.3.1	6.6.7
<input type="checkbox"/> If deterioration visible, inspect per NFPA 211 (Chapter 14) _____	n/a	6.6.7.2
<input type="checkbox"/> Type L vents must be L&L & installed AMI _____	1804.1&3	6.7.1.2
<input type="checkbox"/> Type L vent termination min 2 ft. above roof _____	1804.2.4	6.7.1.4
<input type="checkbox"/> Chimney termination min 3 ft. above roof F133 _____	1805.1	6.6.6
<input type="checkbox"/> Vent or chimney termination min 2 ft. above any portion of building within 10 ft. F133 _____	1804.2.4 & 1805.1	6.7.1.4
<input type="checkbox"/> Masonry chimneys req CO _____	1801.3.3	6.6.1
<input type="checkbox"/> Masonry chimneys req liner _____	1805.1	6.6.8

FIG. 85

Oil-Burning Appliance Vents



Chimney Connectors	15 IRC	NFPA 31
<input type="checkbox"/> Connectors as short & straight as practical _____	1803.3	6.5.1
<input type="checkbox"/> Min rise $1/4$ in./ft. _____	1803.3	6.5.10
<input type="checkbox"/> Secure support, screw or rivet joints (NFPA 31: min 3) _____	1803.3	6.5.13&14
<input type="checkbox"/> Single-wall clearance 18 in., 9 in. if appliance listed type L _____	1803.3.4	6.5.17
<input type="checkbox"/> Type L connector 9 in., 3 in. if appliance listed type L _____	1803.3.4	6.5.17
<input type="checkbox"/> Reduced clearances per F130 _____	1803.3.4	6.5.17
<input type="checkbox"/> Diameter min size of flue collar of appliance or AMI _____	1803.3.3	6.5.7
<input type="checkbox"/> Entire length accessible for cleaning & replacement _____	1803.3.5	6.5.16
<input type="checkbox"/> Unlisted connector horizontal run max 75% of vertical _____	1803.3.2	6.5.1.2
<input type="checkbox"/> Horizontal distance max 10 ft. w/out draft fan _____	n/a	6.5.1.1
<input type="checkbox"/> Draft fans req's burner interlock _____	n/a	6.3.2

VENTILATION & EXHAUST SYSTEMS

In general, building codes tell us when we must provide ventilation for interior spaces, and mechanical codes tell us how to provide it. The energy codes and green building standards also impact required ventilation. ASHRAE 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings is the standard referenced by many energy codes. Check with your local jurisdiction to determine the standards in your area. Greater energy efficiency results in the need to provide systematic whole-house ventilation to dilute contaminants from materials such as volatile organics compounds (VOCs) found in furnishings, and building products. Localized exhaust removes contaminants from specific sources, such as kitchens and baths.

Whole Building Ventilation

ASHRAE 62.2

- Mechanical exhaust, supply, or combination system req'd _____ 4.1
- Min ventilation rate must comply w/ **T39** _____ 4.1
- Local exhaust fans can count to req'd whole-house continuous ventilation _____ 4.2
- Min ventilation rates from **T39** averaged over min 3 hr. period _____ 4.5.1
- Measured infiltration rate can be used as credit to req'd ventilation _____ 4.1.2
- Whole building or continuous ventilation fans max 1.0 sone EXC _____ 7.2.1
 - Mechanical air handlers _____ 7.2X
 - Remote-mounted fans w/min 4 ft. ductwork between grill & fan _____ 7.2X

TABLE 39 MIN. VENTILATION RATES IN CFM ◆ ASHRAE 62.2 T4.1A					
Floor Area (sq. ft.)	Number of Bedrooms				
	1	2	3	4	5
<500	30	38	45	53	60
501-1000	45	53	60	68	75
1001-1500	60	68	75	83	90
1501-2000	75	83	90	98	105
2001-2500	90	98	105	113	120
2501-3000	105	113	120	128	135
3001-3500	120	128	135	143	150
3501-4000	135	143	150	158	165
4001-4500	150	158	165	173	180
4501-5000	165	173	180	188	195

Multiple continuously operating exhaust fans adding up to a min of the required amount is acceptable. Assumes 2 occupants up to 1 BR, plus 1 additional occupant per BR. Add 7.5 cfm per additional occupant.

Local Exhaust

ASHRAE 62.2

- Demand exhaust (kitchen, bath) < 400 CFM max 3.0 sone _____ 7.2.2
- Mechanical exhaust req'd each kitchen & bath w/ tub or shower _____ 5.1
- Kitchen exhaust min 100 cfm intermittent or 5 ACH continuous _____ T5.1 & T5.2
- Vented range hood req'd if 100 cfm is <5 kitchen ACH of kitchen volume _____ T5.1
- Bathroom 50 cfm intermittent or 20 cfm continuous _____ T5.1 & T5.2
- Controls may be humidistat, timer, or occupancy sensor provided that occupant has manual override control (ON/OFF) _____ 5.2.1
- Duct sizes & length per **T40** _____ T5.3

Additional Air Quality Requirements

- Clothes dryers req exterior exhaust except condensing dryers _____ 6.3
- Air inlets min 10 ft. from contaminants such as plumbing vents _____ 6.8
- Exhaust ventilation may not deplete combustion air to appliances within pressure boundary (sum of 2 largest exhaust max 15 cfm/100 sq. ft.) _____ 6.4
- Door from attached garage to house weather-stripped _____ 6.5.1
- Duct leakage outside pressure boundary max 6% _____ 6.5.2
- Central furnace or AC system filter min efficiency MERV 6 _____ 6.7
- Habitable spaces req ventilation ≥4% (min 5 sq. ft.) of floor area _____ 6.6.1
- Utility/WC rooms req ventilation ≥4% (min 1 1/2 sq. ft.) of floor area EXC _____ 6.6.2
 - Utility rooms w/ dryer exhaust duct _____ 6.6X
- All controls labeled as to purpose, manuals present for occupants _____ 6.2

Heat Recovery Ventilators (HRV)

15 IRC 15 15 UMC

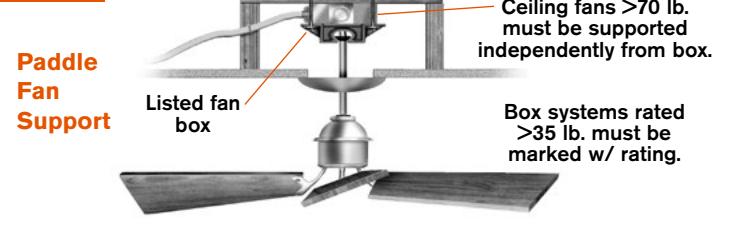
- Install per L&L to UL 815 & AMI _____ 1302.1 504.5
- Exhaust outside, not to attics or crawlspaces _____ 1507.2 502.1
- Combine all sources for red'd ventilation rate per **T39** _____ 1507.3.3 402.1.2
- Do not recirculate Class II air (baths, kitchens) to Class I _____ MFR 403.9.2

Ceiling-Suspended Paddle Fans F86

15 IRC 17 NEC

- Listed box for fan support (no standard boxes) _____ 3905.8 314.27C
- Listed fan boxes w/o weight marking OK up to 35 lb. _____ 3905.8 314.27C
- Fan >35 & <70 lb., fan box L&L for suitable weight _____ 3905.8 314.27C
- Independent support for fans >70 lb. _____ 3905.8 314.27C
- If spare separately switched ungrounded conductors run to ceiling box, box or box system must be listed for paddle fan support _____ 3905.8 314.27C

FIG. 86



Bathroom Exhaust & Ventilation

15 IRC ASHRAE

- Mechanical ventilation 50 cfm intermittent or 20 cfm continuous direct to exterior OK EXC **F87** _____ 303.3X T5.10&T5.2
 - Natural ventilation openings min 1.5 sq. ft. OK _____ 303.3 ∅
- Air may not be exhausted into attic **F87** _____ 1501.1 definition
- WC room vent openings min 1.5 sq. ft. & ≥4% of floor area EXC _____ n/a 6.6.2^{CA}
 - Toilet compartments within bathrooms _____ n/a 6.6.2X
- Air exhaust & intake openings req screens (62.2: intake only) _____ 303.6 6.8

FIG. 87



Bathroom Exhaust Venting

Exhaust air is vented to the outside to prevent the build-up of mold or mildew from condensation.

TABLE 40 EXHAUST DUCT SIZE ◆ ASHRAE 62.2 T5.3

Fan CFM	50	80	100	125	150	200	250	300
Size (in.) ^A	Max Length of Flexible Duct ^B (ft.)							
4	56	4	∅	∅	∅	∅	∅	∅
5	NL	81	42	16	2	∅	∅	∅
6	NL	NL	158	91	55	18	1	∅
7	NL	NL	NL	NL	161	78	40	19
≥ 8	NL	NL	NL	NL	NL	189	111	69
Size (in.)	Max Length of Smooth Duct ^B (ft.)							
3	2	∅	∅	∅	∅	∅	∅	∅
4	114	31	10	∅	∅	∅	∅	∅
5	NL	152	91	51	28	4	∅	∅
6	NL	NL	NL	168	112	53	25	9
7	NL	NL	NL	NL	NL	148	88	54
≥ 8	NL	NL	NL	NL	NL	NL	198	133

A. Flex duct smaller than 4 in. not allowed.
C. NL = No Limit, ∅ = not allowed

FORCED AIR FURNACES

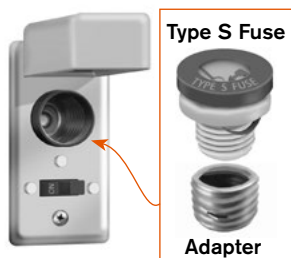
Furnace design must be in accordance with approved methods, such as ACCA Manuals S & J. High-efficiency furnaces may have options for combustion air and venting; follow the manufacturer's instructions and have the installation instructions and users manuals on site.

Location & Clearances	15 IRC	15 UMC
<input type="checkbox"/> Prohibited in bedroom, bathroom or their closets EXC	2406.2	904.1
• Direct-vent type installed AMI	2406.2#1	904.1(2)
• Separated by weather-stripped self-closing door & all combustion air from exterior	2406.2#5	904.1(1)
<input type="checkbox"/> Equipment room door & passageway min 24 in. wide & large enough to service or replace appliance	1305.1.2	304.1 ⁴²
<input type="checkbox"/> Work space min 30 in. deep & wide in front of appliance	1305.1	304.1
<input type="checkbox"/> Clearances to combustibles per nameplate	1306.1 & 2409.3.1	904.2(1)
<input type="checkbox"/> Install above design floor elevation	1401.5	305.2

Electrical Requirements		
<input type="checkbox"/> Receptacle within 25 ft. of appliance	1305.1.3.1 & 1305.1.4.3	210.63
<input type="checkbox"/> Crawlspace furnace req's light w/switch at access	1305.1.4.3	210.70A3
<input type="checkbox"/> Attic furnace req's light w/switch at access	1305.1.3.1	210.70A3
<input type="checkbox"/> Individual circuit req'd for central heating	3703.1	422.12
<input type="checkbox"/> No other equipment on central heating circuit EXC	3703.1	422.12
• Associated pumps, humidifiers, air cleaners, & AC	3703.1	422.12X

FIG. 89
"SSU" Switch

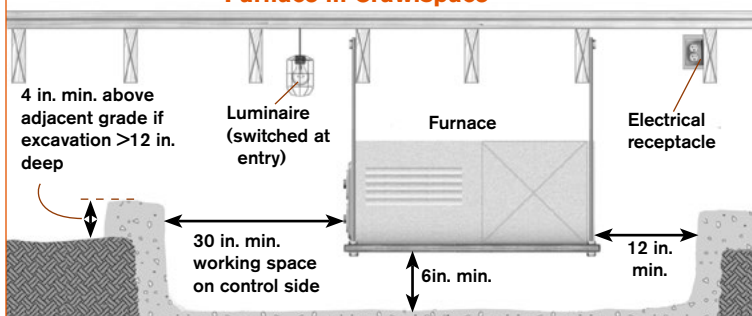
Manufacturer's instructions may req supplementary over-current protection, which can be provided by a fused switch. An ex: might be a furnace requiring 15A overcurrent protection installed on a 20A circuit.



Fuseholders must be supplied w/ Type S adapters, which prevent replacement w/ the wrong size fuse.

Appliances Under Floors (also see p. 44)	15 IRC	15 UMC
<input type="checkbox"/> Access opening & passageway min size 22 x 30 in.	1305.1.4	304.4
<input type="checkbox"/> Appliance must fit through opening	1305.1.4	304.4
<input type="checkbox"/> Passageway max 20 ft. long EXC	1305.1.4	304.4.1
• Passageway ≥ 6 ft. high OK for unlimited length	1305.1.4X2	304.4.1
<input type="checkbox"/> Min 30 x 30 in. level space on service side F90	1305.1.4	304.4.3
<input type="checkbox"/> Support on concrete slab min 3 in. above adjoining ground or suspend from floor AMI & min 6 in. above ground F90	1305.1.4.1	904.3.1
<input type="checkbox"/> Excavations min 6 in. below appliance, 12 in. on sides, 30 in. on control side F90	1305.1.4.2	904.3.1.3
<input type="checkbox"/> If excavation >12 in. below adjacent grade, line w/ concrete extending 4 in. above adjacent grade F90	1305.1.4	904.3.1.3
<input type="checkbox"/> Luminaire & receptacle outlet near appliance F90	1305.1.4.3	304.4.4
<input type="checkbox"/> Switch for luminaire at passageway entrance F90	1305.1.4.3	304.4.4
<input type="checkbox"/> Exposed lamp protected by location or lamp guards F90,F91	1305.1.4.3 ⁴³	n/a

FIG. 90
Furnace in Crawlspace

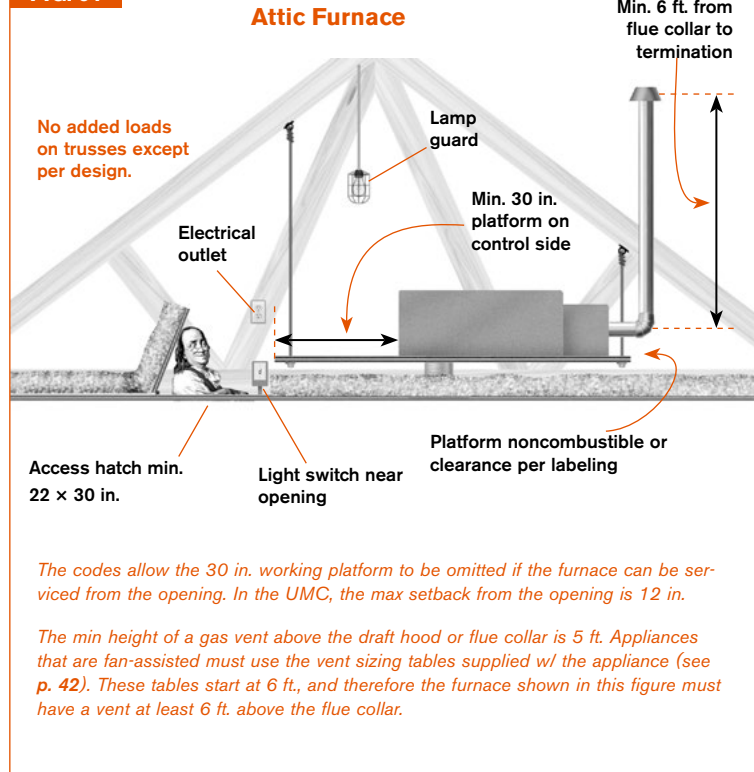


Garage	15 IRC	15 UMC
<input type="checkbox"/> Protect appliance from impact	1307.3.1 & 2408.3X	305.1.1
<input type="checkbox"/> Ignition source min 18 in. above floor EXC	1307.3 & 2408.2	305.1
• FVIR appliances	1307.3X & 2408.2X	305.1
<input type="checkbox"/> Gas-fired appliance OK on garage floor if in separate space w/ access only from outside & exterior combustion air	2408.2.1	305.1.2
<input type="checkbox"/> Ducts & penetrations min 26 gage steel	302.5.2	local
<input type="checkbox"/> Ducts through common wall to house min 26 gage steel	302.5.2	local
<input type="checkbox"/> No duct openings into garage	302.5.2	local
<input type="checkbox"/> Openings around duct penetrations through common wall sealed w/ approved materials	302.5.3	local

Equipment on Roofs		
<input type="checkbox"/> Appliances on roofs shall be accessible	1305.1	304.3
<input type="checkbox"/> Level work space min 30 x 30 in. req'd on service side of appliance (UMC: when roof slope ≥ 4:12)	1305.1	304.2 ⁴⁴
<input type="checkbox"/> Buildings > 15 ft. high must have inside means of access to roof or other means acceptable to AHJ	n/a	304.3.1

Appliances in Attics F91		
<input type="checkbox"/> Appliance must fit through opening	1305.1.3	304.4
<input type="checkbox"/> Opening & passageway min 22 in. wide x 30 in. high	1305.1.3	304.4
<input type="checkbox"/> Max 20 ft. from access opening to appliance EXC	1305.1.3	304.4.1
• 50ft OK (UMC: unlimited) if passageway ≥ 6 ft. high	1305.1.3X2	304.4.1
<input type="checkbox"/> Solid floor min. 24 in. wide to equipment	1305.1.3	304.4.2
<input type="checkbox"/> Min 30 x 30 in. platform at service area EXC	1305.1.3	304.4.3
• Not req'd if equipment can be serviced from opening	1305.1.3X1	304.4.3X
• (UMC only) max 1 ft. setback if serviced from opening	n/a	304.4.3X
<input type="checkbox"/> Floor under furnace noncombustible construction EXC	2449.4	904.3
• Not req'd if appliance L&L for combustible floor	2449.4	904.3X1
• Not req'd if floor protected in approved manner	2449.4	904.3X2
<input type="checkbox"/> Luminaire & receptacle req'd near appliance	1305.1.3.1	304.4.4
<input type="checkbox"/> Switch for luminaire req'd at entrance	1305.1.3.1	304.4.4
<input type="checkbox"/> Exposed lamp protected by location or lamp guards	1305.1.3.1 ⁴³	n/a

FIG. 91



The codes allow the 30 in. working platform to be omitted if the furnace can be serviced from the opening. In the UMC, the max setback from the opening is 12 in.

The min height of a gas vent above the draft hood or flue collar is 5 ft. Appliances that are fan-assisted must use the vent sizing tables supplied w/ the appliance (see p. 42). These tables start at 6 ft., and therefore the furnace shown in this figure must have a vent at least 6 ft. above the flue collar.

DUCTS

Manual D by ACCE is the design standard for sizing residential duct systems. SMACNA provides fabrication and support standards for sheet metal ducting and installation standards for factory-made duct systems. Factory-made ducts must also comply with UL standards. Local or state energy codes may require duct leakage testing and other performance tests.

Ducts - General

15 IRC 15 UMC

- Factory-made ducts L&L, per UL 181 & installed AMI_ 1601.1.1 603.4
- Max 2 stories for vertical riser on factory-made duct _____ n/a 603.4
- Fireblock openings around ducts between floors _____ 302.11(4) n/a
- Stud cavities prohibited as supply air plenum _____ 1601.1.1 n/a

FIG. 99

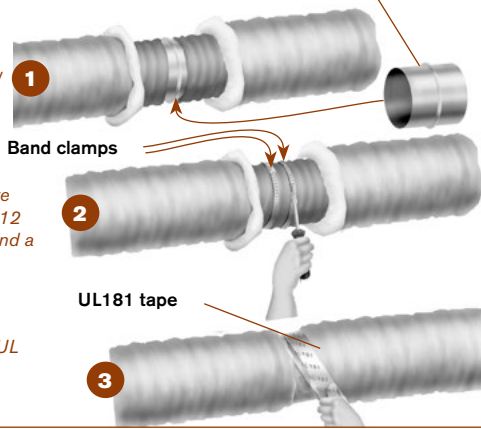
Duct Splices

Metal collar min 4 in. wide

Step 1.
Peel jacket & insulation from core & butt cores together, w/ min. 1 in. lap over collar on each side.

Step 2.
Apply approved tape & secure w/ band clamps. If collar > 12 in. draw band must be behind a bead on the metal collar.

Step 3.
Pull jacket & insulation back together & apply 2 wraps of UL 181 pressure-sensitive tape.



Duct Installation

15 IRC 15 UMC

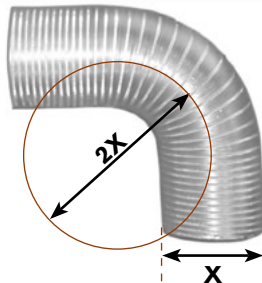
- Ground clearance min 4 in. _____ 1601.4.8 603.3&4
- 18 in. vertical clearance where needed under duct to prevent cutting off access to crawl space _____ n/a 603.2
- Joints, seams & connections per SMACNA standards 1601.4.1 603.10
- Mechanically fasten ducts to plenums & flanges _____ 1601.4.1 603.10
- Crimp joints fasten w/ min 3 sheet metal screws _____ 1601.4.1 603.10
- Seal w/ UL-181 pressure-sensitive tape **F99** _____ 1601.4.1 603.10
- Factory-made (flex) ducts that are L&L to UL 181 AMI 1601.4.4⁵⁶ 603.8⁵⁶
- Install all other ducts per SMACNA standards **F100** 1601.4.4⁵⁶ 603.8⁵⁶
- Exposed gypsum in duct OK if no condensation _____ 1601.1.1 602.5
- Stud cavity return not to convey from > 1 floor _____ 1601.1.1 n/a
- Duct in garage min 26 gauge. sheet steel - no flex _____ 302.5.2 n/a
- UG metal ducts in min 2 in. concrete encasement _____ 1601.1.2 603.12
- UG ducts must slope 1% to a drain _____ 1601.1.2 603.12

FIG. 100

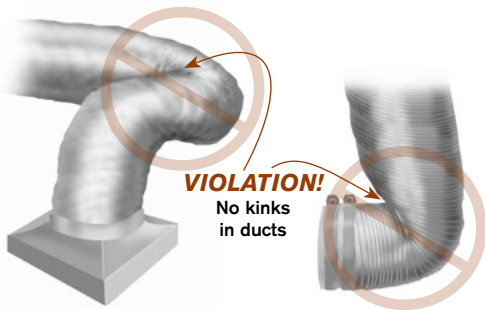
Flexible Duct Bends

Ducts should not be compressed. Use the min length of duct to avoid extra turns and kinks

The radius of the turn at the center line must be no less than the diameter of the duct



Ducts should extend a few in. beyond a sheet metal connection before bending

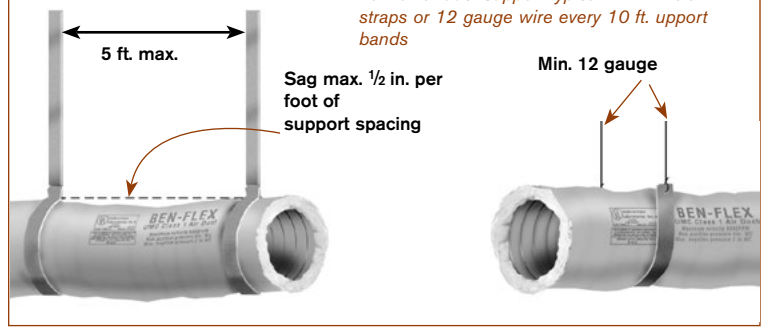


VIOLATION!
No kinks in ducts

FIG. 101

Flex Duct Support

Flex typical 1 1/2 in. straps @ 5 ft., round metal horizontal duct support typical 1/2 in. metal straps or 12 gauge wire every 10 ft. upport bands



SMACNA Standards

ANSI/SMACNA 006-2006

- Rigid horizontal ducts req support within 2 ft. each elbow _____ 5.1.1
- Rigid horizontal ducts req support within 4 ft. each branch intersection _____ 5.1.1
- Rigid round duct max support spacing 12 ft. _____ T5-2
- Round duct up to 24 in. diameter: support straps 1 in. x 22 gage _____ T5-2
- Round 10 in. diameter duct support wires 1 @ 12 gage _____ T5-2
- Round 11- 18 in. diameter duct support wires 2 @ 12 gage or 1 @ 8 gage **F101** _____ T5-2
- Round 19- 24 in. diameter duct support wires 2 @ 10 gage _____ T5-2
- Sleeves **F99** for joining sections min 4 in. length _____ 3.5: S3.30
- Draw bands **F99** req'd _____ 3.5: S3.33

Return Air

15 IRC 15 UMC

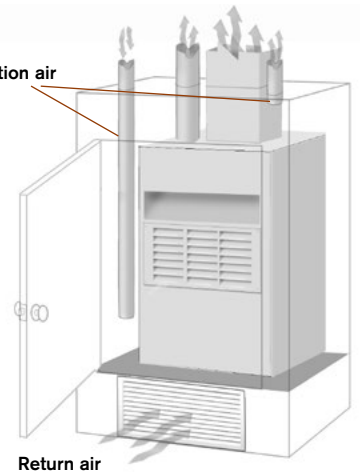
- Air filters req'd _____ MFR 311.2
- Not to be taken from bathroom, kitchen, Mechanical room, closet, garage, or separate dwelling unit _____ 1602.2(4) & 2442.4(6) 311.3(3&5)
- Amount of return air from any space ≤ supply air _____ 1602.2(2) n/a
- System must be balanced by an approved method _____ n/a 314.1
- No return air from one dwelling to another dwelling _____ 1602.2X4 311.4
- Must be open to min 25% area served _____ 1602.2 & 2442.5 311.3(4)
- Return openings min. 10 ft. from appliance vent outlets 2442.4(1) 311.3(1)
- Duct min size 2 sq. in./kBtu output rating _____ 2442.2 MFR
- Return OK from room w/ fuel-burning equipment if supply air provided to replace return air, return min 10 ft. from draft hood, & room volume min 100 cu. ft. per 1,000Btu of equipment **F102** _____ 2442.4(5)X 311.3(6)X3

FIG. 102

Closet Furnace Above Return Air

Combustion air

Separation of combustion and circulating air is essential for safe and complete combustion of flue gases. In this common setup, if the closet door is open the return air competes w/ the combustion air ducts, resulting in incomplete combustion and production of carbon monoxide. The basic rule is that return air must be at least 10 ft. from the appliance draft hood and burners.



Insulation in Unconditioned Space

15 IRC 15 UMC

- Factory-made duct insulation value marked on duct _____ 1601.3(3) 604.1
 - In Attics: R-8 ducts > 3 in. diameter, R-6 if ≤ 3 in. _____ 1103.3.1⁵⁷ n/a
 - Other areas: R-6 > 3 in. diameter, R-4.2 if ≤ 3 in. EXC _____ 1103.3.1⁵⁷ n/a
 - Ducts completely inside building thermal envelope _____ 1103.3.1X n/a
- Note: Energy codes may take precedence over mechanical code insulation reqs.

VENT SIZES

Category I appliances ship with tables for sizing the vent system. These supplied tables were developed by GAMA (the Gas Appliance Manufacturers Association). They are repeated in the model codes and downloadable from many web sites. IRC Appendix B and UMC Appendix F contain instructions and examples on how to use the tables. The tables distinguish between fan-assisted and "natural" draft appliances. Fan-assisted appliances must be sized using the tables.

Vent Size (Appliances w/ Draft Hoods)	15 IRC	15 UMC
<input type="checkbox"/> Min size same as flue collar	2427.6.8.1(2)	802.6.3.1(3)
<input type="checkbox"/> Max size 7x area of smallest flue collar	2427.6.8.1(2)	802.6.3.1(3)
<input type="checkbox"/> If 2 appliances, 100% of larger + 50% of smaller	2427.6.8.1(3)	802.6.3.1(4)
<input type="checkbox"/> Offsets 45° max except one of 60° OK	2427.6.8.2	802.6.3.2
<input type="checkbox"/> Total horizontal distance of vent + connector ≤ 75% of vertical height of vent if offsets in vent	F113 2427.6.8.2	802.6.3.2

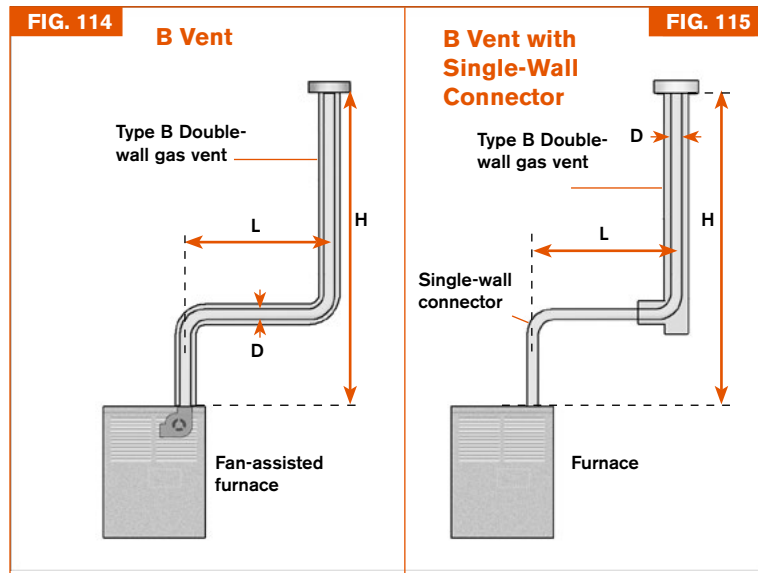
Vent Size Using GAMA Vent Tables

- Tables can be used for all Category I appliances __ 2427.6.8.1(1) 802.6.3.1(1)
- Tables mandatory for fan-assisted Category I __ 2427.6.8.1(1) 802.6.3.1(2)
- Appliances w/ draft hoods: connector & vent min size same as draft hood outlet area, max size 7x area __ 2427.6.8.1(2) 802.6.3.1(3)
- When vertical vent > than connector, use vertical diameter to determine table min & connector diameter for table max 2428.2.8 803.1.8
- Flow area of vertical vent max 7x appliance flue collar 2428.2.8 803.1.8
- Use double-wall vent tables only for vents not exposed to outdoors below the roof line (B vent in unvented chase insulated to R-8 or in unused masonry chimney flue not considered outdoors) **F118** 2428.2.9 803.1.10
- Zero lateral values in tables only OK if straight vertical vent connects directly to a top outlet draft hood or flue collar 2428.2.4 803.1.3
- No elbows if using "zero lateral length" table column __ 2428.2.3 803.1.2
- Tables w/ lateral length allow for 2-90° elbows **F114** 2428.2.3 803.1.2
- Reduce table capacity 5% for each additional elbow up to 45° & 10% for each additional elbow >45° up to 90° _ 2428.2.3 803.1.2
- Reductions for elbows in common vents same as above 2428.3.6 803.2.5

Examples of GAMA Vent Tables

The first step is to select the correct table based on the type of vent or chimney, the connector type, and the number of appliances. In **F114**, the situation is a double-wall B vent connected directly to the appliance. Two 90° elbows are allowed w/o requiring a further reduction in table values. The table has different columns for natural and fan-assisted appliances.

Question: Is 4 in. vent adequate for an 80,000 Btu fan-assisted furnace if H = 10 ft. and L = 5 ft?
Solution: Use IRC table G2428.2(1) or UMC table 803.1.2(1). In the 4 in. "fan" column, on the row for 10 ft. height and 5 ft. lateral, the minimum kBtu for this size vent is 32, and the maximum is 113, and the furnace is within that range. If this had been a natural draft appliance, the maximum kBtu rating would have been 77. It would require either a larger vent, a lesser "L" or taller "H".



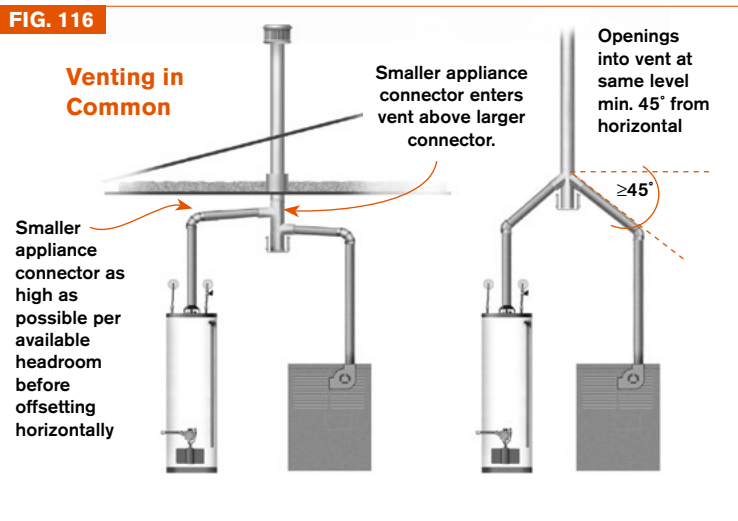
F115 shows a draft-hood equipped appliance w/ a 5 in. draft hood outlet and a single-wall metal 4 in. connector. If the appliance kBtu = 120, H = 10 & L = 5, what size "D" is required for the vent? Use IRC table G2428.2(2) or UMC table 803.1.2(2). Find the row associated w/ a 10 ft. height and 5 ft. lateral. Read across until reaching a capacity >120k. A 5-in. vent is sufficient. Note that if more than two elbows had been used, the next higher size (6 in.) would be required.

Appliances can share a common vent by separate connectors to the vent, or by a common manifold that then connects to the vent. When the common-vented appliances all have draft hoods, the vent and connector sizes are determined by the size of the draft hood outlets. If one or more appliances are fan-assisted, the tables are used to determine the proper sizes.

Multiple Appliances Vented in Common 15 IRC 15 UMC

- If both appliances have draft hoods, size vent for 100% of larger draft hood outlet + 50% of smaller & ≤ 7x area of smaller draft hood outlet 2427.6.8.1(3) 802.6.3.1(4)
- Tables mandatory for fan-assisted Category I 2427.6.8.1(1) 802.6.3.1(2)
- Max horizontal length of vent connector 18 in. per in. of connector diameter **T43** EXC 2428.3.2 803.2.1
 - Longer lengths allowed by subtracting 10% of max table capacity for each added multiplier of allowed length in **T43** 2427.6.11 803.2.2
 - Ex: If a 4-in. connector, normally allowed to be 6 ft., is between 6 ft. & 12 ft. in length (one multiplier of 6), reduce the allowed BTU capacity in the tables by 10%.
- Size connectors using supplied tables 2427.10.3.3 802.10.2.2
- Join common vent connectors as high as possible per available headroom & clearance 2427.10.3.4 802.10.2.3
- Two or more connectors to common vent must enter at different levels EXC **F116** 2427.10.4.1 802.10.3
 - OK at same level if max 45° from vertical **F116** 2427.10.4.1 802.10.3
- Smaller connector to enter above larger 2427.10.4 802.10.3.1
- Reduce connector table capacity 5% each elbow up to 45° & 10% each elbow >45° up to 90° 2428.3.7 803.2.5

TABLE 43 MAXIMUM HORIZONTAL LENGTH VENT CONNECTOR FOR COMMON VENTING ◆ IRC T2428.3.2 & UMC T803.2.1			
Diameter (in.)	Max. Horizontal Length (ft.)	Diameter (in.)	Max. Horizontal Length (ft.)
3	4½	7	10½
4	6	8	12
5	7½	9	13½
6	9	10	15



Examples of GAMA Vent Tables for Common Venting

Given that the appliances in **F116** are a 35,000 Btu water heater and a 100,000 BTU fan-assisted furnace, each w/ 4-inch flue collars, connecting to a type B common vent. The overall height of the common vent (measured from the taller appliance outlet to the top of the common vent) is 20 ft. The horizontal length of each vent connector is 4 ft., the rise of the water heater connector is 2 ft., and the rise of the furnace connector is 4 ft.

Question: What diameter single-wall connectors and type B common vent should be used?
Solution: Use IRC table G2428.3(1) or UMC table 803.2(2). The connector horizontal lengths comply w/ **T43** without adjustment. First the water heater: Go to the table row for 20 ft. vent height and read across the 2 ft. row to the first number in the "NAT" column that exceeds 35k. Though that is in the 3-in. diameter column, a 4-in. connector must be used to be at least the same size as the flue collar. Do the same procedure for the furnace, this time using the 0.3 ft. connector rise row, and going across to the first number in the "FAN" column that has a "Min" rating < 100k and a "Max" > 100k rating of the furnace. Again it is a 4-in. connector. In the "common vent capacity" portion of the table, use the "FAN + NAT" column. A 4-in. vent is limited to 123k, and a 5-in. vent is good for 183k. Therefore, use a 5-in. B vent for the common vent portion.

GAS VENT TERMINATIONS

Gas Vent Terminations – General

15 IRC

15 UMC

- Gas vents must extend above roof EXC _____ 2427.6.3(1&2) 802.6.2(1)
- Direct vent appliances **F120, 127** _____ 2427.6.3(3) 802.6.2(3)
- Appliances w/ integral vents _____ 2427.6.3(4) 802.6.2(4)
- Mechanical draft appliances AMI _____ 2427.6.3(5) 802.6.2(5)
- Roof penetration req's flashing _____ 2427.6.5 802.6.5
- Must have listed cap or listed roof assembly _____ 2427.6.5 802.6.2.5
- Decorative shrouds only if L&L & AMI _____ 2427.6.3.1 802.6.2.4
- Vent termination min 5 ft. vertical above flue collar _____ 2427.6.4 802.6.2.1
- Vent termination min 6 ft. vertical using tables _____ 2428.2 803.0
- B vents ≤ 12 in. per **F117 & T44** if > 8 ft. from wall _____ 2427.6.3(1) 802.6.2(1)
- B vents > 12 in. diameter min 2 ft. above roof _____ 2427.6.3(2) 802.6.2(1)
- Wall furnace min 12 ft. from bottom of furnace **F124** _____ 2427.6.4 802.6.2.2
- Direct vent per **T45** _____ 2427.8(3) 802.8.2

FIG. 117

B Vent Termination

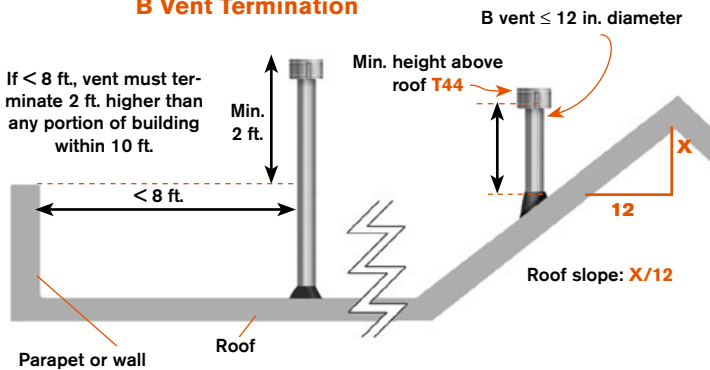


TABLE 44 B VENT TERMINATION (F117) ♦ IRC 2427.6.3 & UMC 802.6.2

Roof Slope	Min. Height (ft.)	Roof Slope	Min. Height (ft.)
Flat to 6/12	1	>11/12 to 12/12	4
>6/12 to 7/12	1¼	>12/12 to 14/12	5
>7/12 to 8/12	1½	>14/12 to 16/12	6
>8/12 to 9/12	2	>16/12 to 18/12	7
>9/12 to 10/12	2½	>18/12 to 20/12	7½
>10/12 to 11/12	3¼	>20/12 to 21/12	8

FIG. 118

Location of Vent Termination

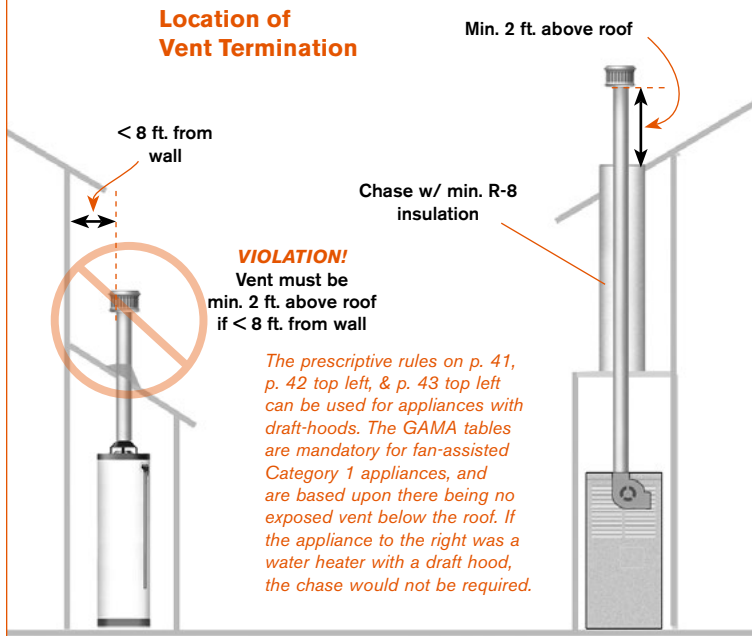


FIG. 119

Forced-Vent Terminations

Vent Termination:
Min. 4 ft. below
Min. 4 ft. horizontal
or
1 ft. above building
openings

Most Cat. IV furnaces can be installed either as a forced-vent w/ clearances as shown above, or as direct-vent, w/ clearance to openings per **T45**

Condensing Appliance Forced Vents (Cat. IV)

15 IRC

15 UMC

- Burner interlock req'd to forced-vent fan _____ 2427.3.3(5) 802.3.3.4
- Installation & support of vent AMI _____ 2426.5 802.6.5
- Size Category II, III & IV appliance vents AMI _____ 2427.6.8.3 802.6.3.3
- All Mechanical draft systems L&L & installed AMI _____ 2427.3.3(1) 802.3.3
- Positive-pressure systems req'd to be gas tight _____ 2427.3.3(3) 802.3.3.2
- No mixing natural & forced-draft connectors or vents 2427.3.3(4) 802.3.3.3
- Furnaces w/ combustion air piping terminating AMI in same location as vent typically considered direct-vent (MFR) **F97** 2427.8(1)X1 802.8.X1
- Terminate 3 ft. above forced air inlets within 10 ft. EXC _____ 2427.8 802.8
- Systems installed as direct-vent AMI **F120** _____ 2427.8X1&2 802.8X1&2
- Terminate min 4 ft. to side or below or 1 ft. above building openings, min 1 ft. above ground level **F119** EXC _____ 2427.8(2) 802.8.1
- Termination can be same as direct vent if AMI **F120** 2427.8(2) 802.8.1
- Through-wall vents of condensate-producing appliances not to terminate over public way or where creating nuisance _____ 2427.8(4) 802.8.3
- Min 7 ft. above ground if adjacent to public walkway 2427.3.3(6) 802.3.3.5
- Through-wall vent min 10 ft. horizontally from openings in (facing) buildings if ≤ 2 ft. above or ≤ 25 ft. below openings _____ 2427.8(5)⁵⁹ 802.8.5X⁵⁹
- Collect & dispose of condensate from vent (**p.38**) _____ 2427.9 802.9
- Condensate drains AMI for appliance & vent MFR _____ 2427.8(4) 802.8.3
- Plastic vents for Category IV AMI per appliance MFR _____ 2426.1 802.4.2
- Pressure-rated plastic only – no cellular core _____ 2427.4.1 802.4.1
- Plastic vent joint primer must be contrasting color _____ 2427.4.1.1 802.4.2

FIG. 120

Direct Vent Terminations

