

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:

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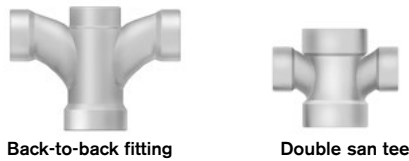
TABLE 10 APPLICATION OF FITTINGS ♦ IRC T3005.1 & UPC 706

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

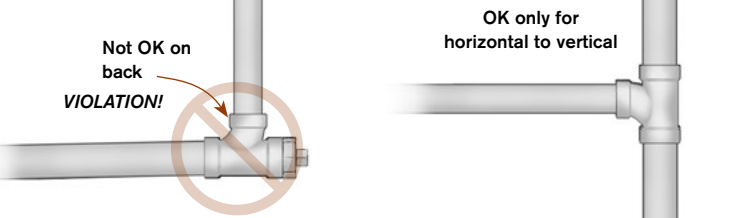


FIG. 13

DWV Fittings

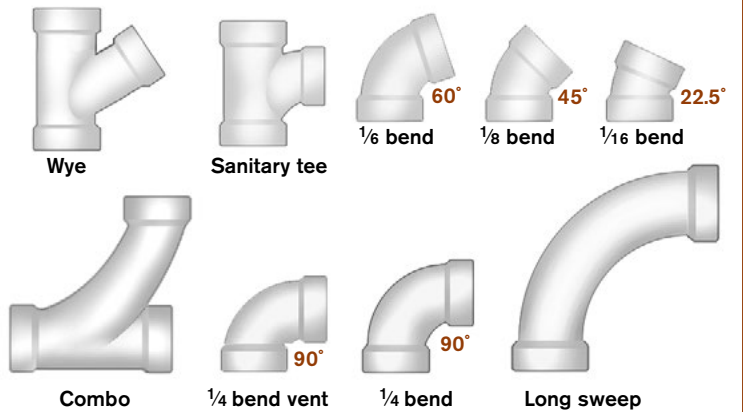
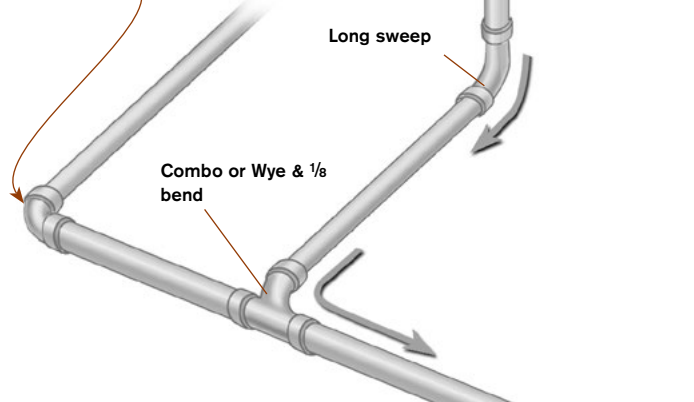


FIG. 14

Application of Fittings

IRC allows horizontal-to-horizontal 1/4 bend up to 2 in. diameter.



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.

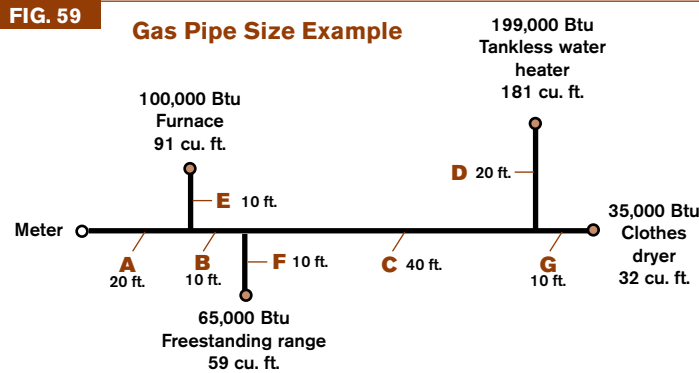


TABLE 33 GAS PIPE SIZE EXAMPLE

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.

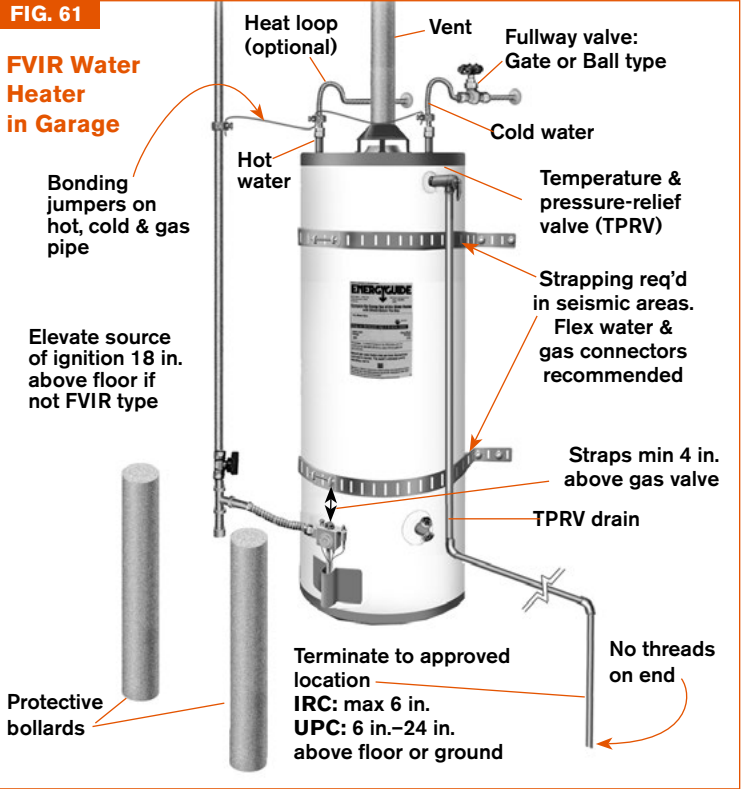
- Water Heaters - General
Replacement water heaters req permits 105.1 502.1
Installation & maintenance instructions to be left w/ WH 1307.1 507.24
Size to meet demand T36 2448.1 501.1
Installation AMI & all instructions in L&L 2005.1 501.1
Full-open type valve req'd on supply at WH F48,49 2903.9.2 606.2
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 CAPACITYA ♦ T501.1(1)
Number of Bathrooms, Number of Bedrooms, 1st hr. RatingB
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
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 & 2801.8 507.2CA
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

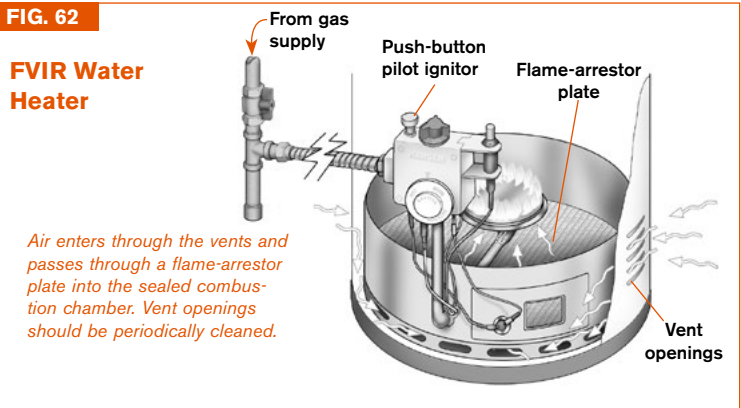


Access & Working Space

- 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



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

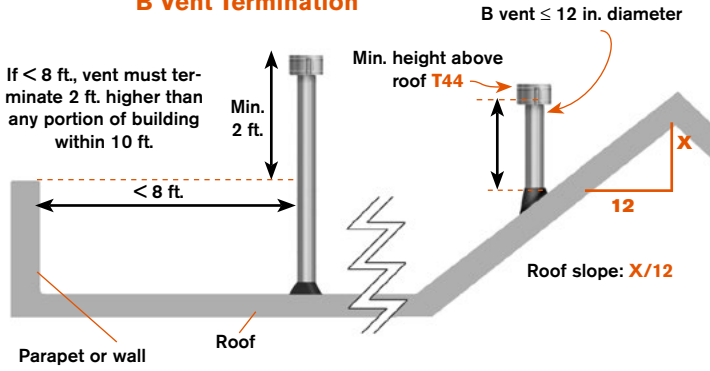


TABLE 44 B VENT TERMINATION (F117) ◆ IRC 2427.6.3 & UMC 802.6.2

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	1 ¼	>12/12 to 14/12	5
>7/12 to 8/12	1 ½	>14/12 to 16/12	6
>8/12 to 9/12	2	>16/12 to 18/12	7
>9/12 to 10/12	2 ½	>18/12 to 20/12	7 ½
>10/12 to 11/12	3 ¼	>20/12 to 21/12	8

FIG. 118

Location of Vent Termination

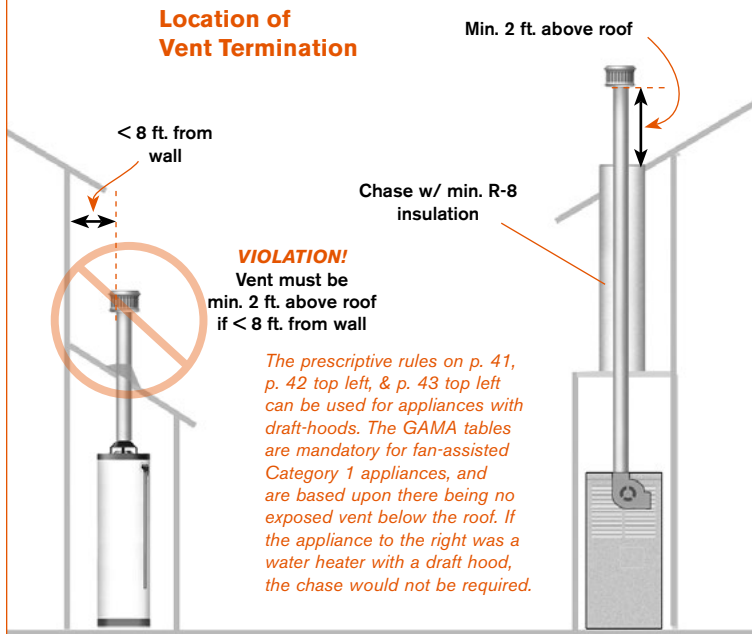
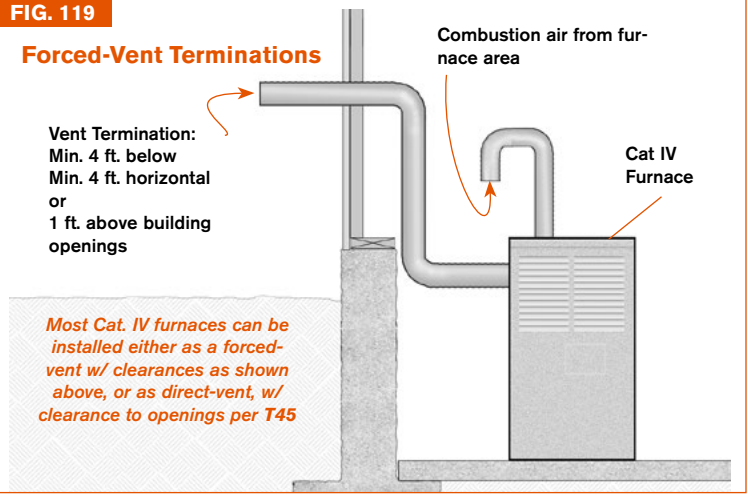


FIG. 119

Forced-Vent Terminations



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

