

# Code Check Plumbing & Mechanical<sup>®</sup> Fourth Edition

By **DOUGLAS HANSEN & REDWOOD KARDON**  
 Illustrations & layout by **Paddy Morrissey**

© 2011 by The Taunton Press, Inc. ISBN 10 1-60085-339-0 ISBN 13 978-1-60085-339-5  
*Code Check<sup>®</sup> is a trademark of The Taunton Press, Inc., registered in the U.S. Patent & Trademark Office.*

**Code Check Plumbing & Mechanical 4th Edition** is an illustrated guide to common code questions in residential plumbing, heating, ventilation, and air conditioning systems. The book emphasizes the safety principles that are at the heart of the codes for these systems.

The primary code used in this book is the 2009 edition of the *International Residential Code for One- and Two-Family Dwellings*, published by the International Code Council (ICC). It is the most widely used residential code in the United States. The other major codes referenced here are the *2009 Uniform Plumbing Code* and *2009 Uniform Mechanical Code*, published by the International Association of Plumbing & Mechanical Officials (IAPMO). For most topics, these different codes are in agreement. Each of these codes also references standards, many of which are maintained by the organizations in Table 2 (T2).

Additional codes for specialized items are listed in T1. The National Fire Protection Association (NFPA) publishes several of these. They also maintain *NFPA 54 – The National Fuel Gas Code*, which forms the basis of the fuel gas provisions in the IRC, UPC, and UMC.

The 2009 cycle of codes is likely to remain in effect in most areas for at least 3 or 4 years after the cover date. Energy codes vary greatly from one area to another, and may modify or overrule the code requirements shown in this book. Before beginning any project, check with your local building department to determine the codes that apply in your area.

Thanks to Hamid Naderi of ICC for his editorial input.

TABLE 1 CODES & STANDARDS USED IN THIS BOOK		
Organization	Edition	Code
ASHRAE	2010	ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
ICC	2009	International Residential Code
ICC	2009	ISPDC - International Private Sewage Disposal Code
IAPMO	2009	Uniform Plumbing Code
IAPMO	2009	Uniform Mechanical Code
NFPA	2011	NFPA 31 Standard for Installation of Oil-burning Equipment
NFPA	2010	NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA	2009	NFPA 54 National Fuel Gas Code
NFPA	2011	NFPA 58 Liquefied Petroleum Gas Code
NFPA	2011	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
UL	Underwriters Laboratories

## KEY TO USING CODE CHECK

Code Check Plumbing & Mechanical condenses large amounts of code information by using several “shorthand” conventions that are explained here. Each rule described in code check begins with a checkbox and ends with the code citations. When only one code is shown, the code citation is inside of brackets, and when two codes are shown, the second code is shown inside of braces, as in the following example from page 14 (p.14):

All fixture traps req venting \_\_\_\_\_ [3101.2.1] {901.0}  
*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 901.0 of the UPC.*

References to figures and tables are preceded by an F or a T as in the following example from p.8:

Changes in direction req appropriate fittings **F9-12,T9** [3005.1] {706.1}  
*This line is stating that changes of directions must use appropriate fittings, as illustrated in F9-12 and in T9.*

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, where more information about the change is found. The following example is from p.36:

**Single-Wall Vents** 09 IRC 09 UMC  
 Not allowed in dwellings \_\_\_\_\_ [n/a] {802.7.4.1}<sup>30</sup>  
*This line is saying that single-wall gas appliance vents are not allowed in dwellings. The IRC does not have such a rule, so the citation there is “n/a”. In the UMC, the rule is in section 802.7.4.1 and it is a change from the 2006 edition. The change is explained further in T45 on the inside back cover.*

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.24:

Ignition source ≥18in above garage floor EXC **F53** \_\_\_\_\_ [2801.6] {508.14}  
 • FVIR water heaters **F54** \_\_\_\_\_ [2408.2X] {508.14}  
*These lines are stating that water heaters in garages (F53) must be elevated so the ignition source is at least 18 inches above the floor, unless the water heater is an FVIR type as shown in F54.*

If a rule does not apply to a particular code, that will be indicated by “n/a” in the code citation column, as in this example from p.24:

WH also used for space heating must be L&L for both \_\_\_\_\_ [2448.2] (n/a)  
*This line is stating that a water heater used for space heating must be listed and labeled for both purposes. The rule is in section 2448.2 of the IRC and it does not apply when using the UPC.*

Rules that are not explicitly stated in a model code are sometimes based upon other local ordinances, as indicated in this example from p.5:

Building sewer depth per local ordinance \_\_\_\_\_ [2603.6.1] {local}  
*This line is saying that IRC section 2603.6.1 directs us to consult local ordinances for required sewer depth. The UPC does not have this rule, and the local building department should be consulted for their requirements.*

For updates to this book, corrections, and additional valuable information visit:  
[www.codecheck.com](http://www.codecheck.com)

*The information contained in this document is believed to be accurate; however, it is being provided for informational purposes only and is not intended as a substitute for the full text of the codes referenced herein. Publication of this document by Taunton Press, ICC and the authors should not be considered by the user to be a substitute for the advice of a registered design professional.*

**TRAPS & TAILPIECES**

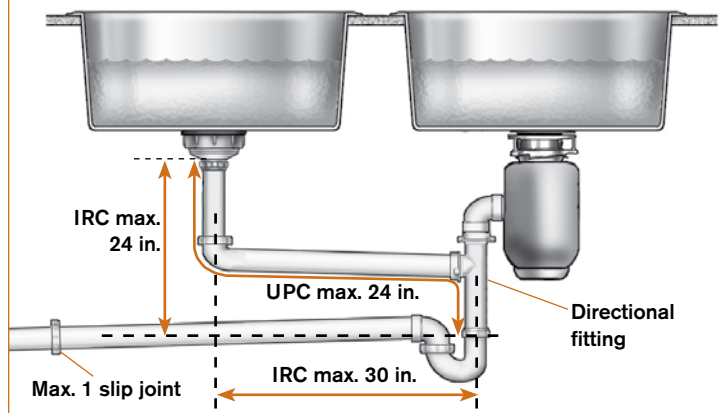
Traps prevent sewer gases, vermin and other contaminants from entering the dwelling. The trap seal must be a sufficient depth (2in) to maintain a seal and not so deep (4in max) as to become blocked with sludge or create a siphoning effect. Trap arms (fixture drains) must be vented, otherwise the negative pressure created by water moving down the pipe will cause air to be sucked through the trap seal. The maintenance of proper trap seals is the underlying principle behind the code rules for drainage, traps and venting.

- General**
- Each fixture reqs separate trap EXC \_\_\_\_\_ [3201.6] {1001.1}
    - Fixtures w/ integral traps (toilets) \_\_\_\_\_ [3201.6X1] {1001.1}
    - 2 or 3 lavs, laundry tubs, or sinks of same type OK on 1 center trap in the same room \_\_\_\_\_ [3201.6X2] {1001.2}
    - Laundry trap may drain to CW standpipe \_\_\_\_\_ [3201.6X3] {n/a}
  - Fixtures sharing trap max 30in apart horizontal \_\_\_\_\_ [3201.6X2] {1001.2}
  - Trap seal min 2in min, max 4in **F20** \_\_\_\_\_ [3201.2] {1005.0}
  - Set traps level & protect from freezing \_\_\_\_\_ [3201.3] {1005.0}
  - No "S" traps, bell traps, drum traps, traps w/ moving parts or traps w/ interior partitions EXC **F22** \_\_\_\_\_ [3201.5] {1004.0}
    - Lav traps w/ plastic or stainless partitions \_\_\_\_\_ [3201.5] {1004.0}
  - Size per **T6** \_\_\_\_\_ [3201.7] {1003.3}
  - Trap size ≥ fixture outlet size \_\_\_\_\_ [3201.7] {1003.3}
  - No double traps (in series) \_\_\_\_\_ [3201.6] {1004.0}

**09 IRC 09 UPC**

**FIG. 21**

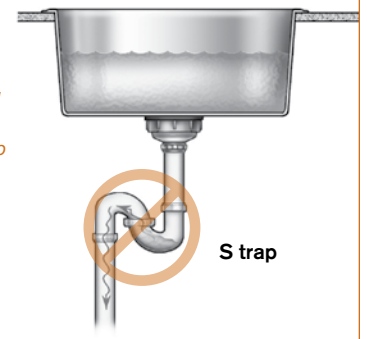
**Tailpiece Lengths**



**FIG. 22**

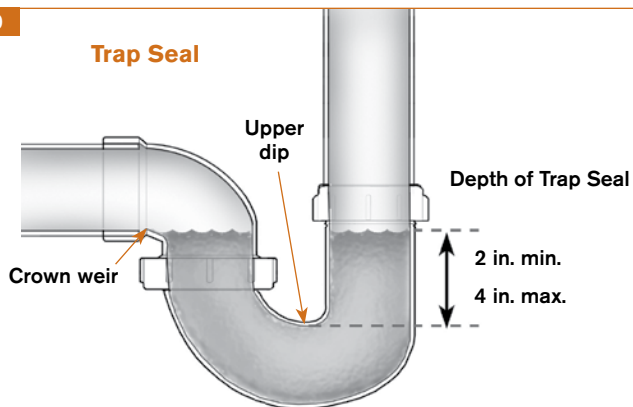
**S Trap**

Water filling the downstream vertical portion of the S trap will cause siphoning and loss of trap seals. Trap seals must be maintained to prevent sewer gases and vermin from entering the dwelling. The combination waste and vent (**F38**) is not an S trap because it has a horizontal arm and an increased size in the vertical drain.



**FIG. 20**

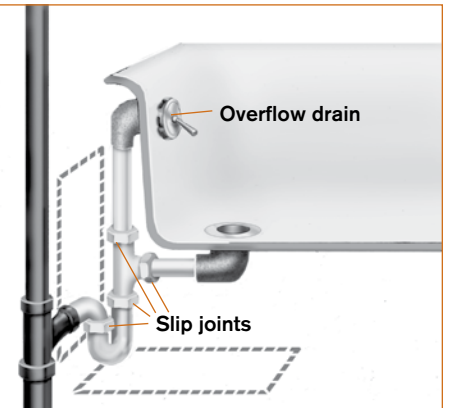
**Trap Seal**



**FIG. 23**

**Slip Joints & Access**

An access opening at least 12 in. by 12 in. is required for repair or replacement of concealed slip joints. The opening can be in a ceiling or a wall.



**Fixture Tailpieces**

**09 IRC 09 UPC**

- Fixture tailpiece max 24in vertical distance EXC **F21** \_\_\_\_\_ [3201.6] {1001.4}
  - CW standpipes 18in–42in {18in–30in UPC} **F62** \_\_\_\_\_ [2706.2] {804.1}
- IRC: Max 30in horizontal distance **F21** \_\_\_\_\_ [3201.6] {Ø}
- UPC: Max 24in total developed length **F21** \_\_\_\_\_ [n/a] {1001.4}
- Directional fittings req'd for continuous wastes from disposer or DW (i.e., wyes, combos, or tees w/baffles) **F21,25** \_\_\_\_\_ [2707.1] {404.4}

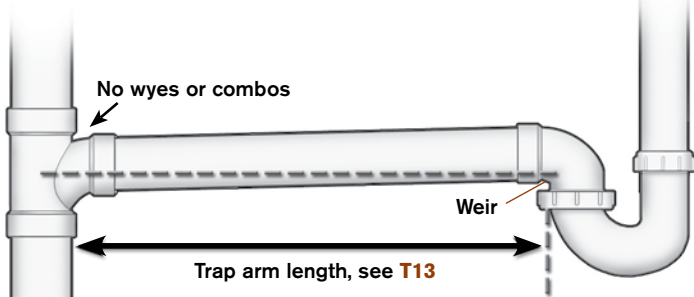
### Trap Arms

09 IRC 09 UPC

- Trap same size as trap arm \_\_\_\_\_ [3201.7] {1003.3}
- Trap arm length min 2× trap arm diameter **F27** \_\_\_\_\_ [3105.3] {1002.2}
- Trap arm length & slope per table **EXC T13** \_\_\_\_\_ [3105.1] {1002.2}
  - Trap arm length from WC unlimited (6ft in UPC) \_\_\_\_ [3105.1X] {T10-1}
- Trap arms <3in diameter min slope 1/4in/ft \_\_\_\_\_ [3005.3] {708.0}
- Total fall of trap arm max 1 pipe diameter **F24** \_\_\_\_\_ [3105.2] {n/a}
- Only 1 trap permitted on trap arm **EXC** \_\_\_\_\_ [3201.6] {1001.1}
  - 2 trap arms allowed to join through double-wye fitting to common vent **F34** \_\_\_\_\_ [3107.1&2] {Ø}
- Tubing traps req trap adapter **F26** \_\_\_\_\_ [n/a] {1003.2}
- Max 1 slip joint allowed on outlet side of trap **F21** \_\_\_\_\_ [n/a] {1003.2}
- CO req'd if direction change >90° in <3in arm \_\_\_\_\_ [n/a] {1002.3}
- Slip joints req'd to be accessible **F23** \_\_\_\_\_ [3201.1] {404.2}

FIG. 24

### Trap Arm Distances



The length and slope of the trap arm must allow air to be admitted above the dotted line in the figure. If the slope or length are excessive, the dotted line (trap weir elevation) would be above the vent opening.

TABLE 13 TRAP ARM DISTANCE TO VENT [T3015.1] [T10-1]

Trap Arm Diameter	Min.	IRC Max.	UPC Max.
1 1/4 in.	2 1/2 in.	5 ft.	2 ft. 6 in.
1 1/2 in.	3 in.	6 ft.	3 ft. 6 in.
2 in.	4 in.	8 ft.	5 ft.
3 in. <sup>A</sup>	6 in.	12 ft.	6 ft.
4 in. or larger <sup>A</sup>	8 in.	16 ft.	10 ft. <sup>B</sup>

A. In the IRC, these arms can have 1/8 in./ft. slope. In the UPC all arms must slope 1/4 in./ft.  
 B. The maximum length from a water closet to the vent is 6 ft. in the UPC and is unlimited in the IRC.

FIG. 25

### Directional Fittings

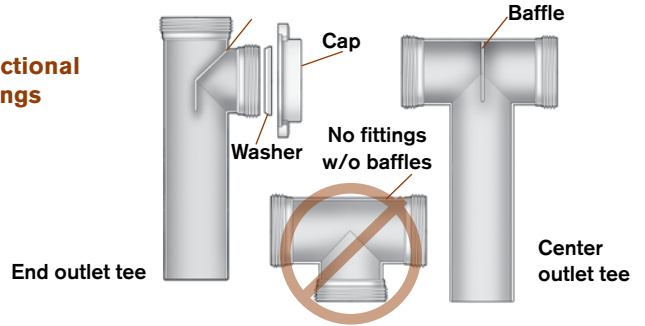


FIG. 26

### Trap Adapter for Tubing Traps

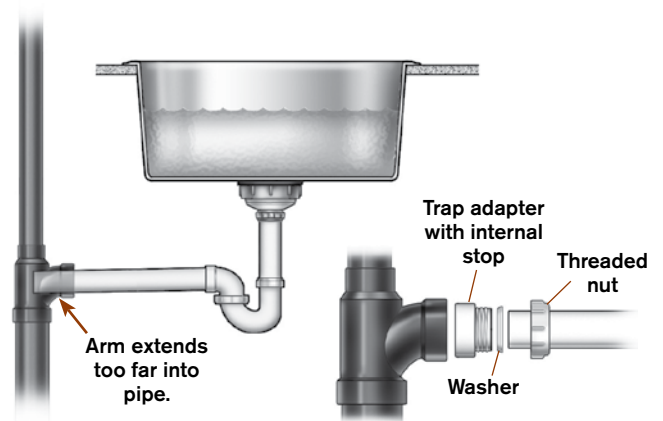
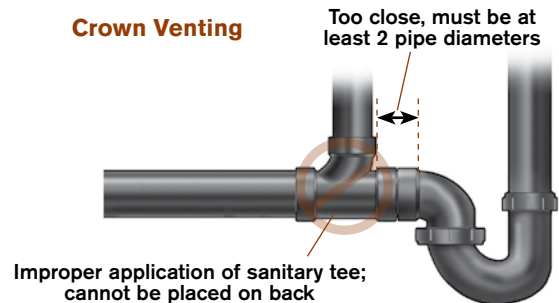


FIG. 27

### Crown Venting

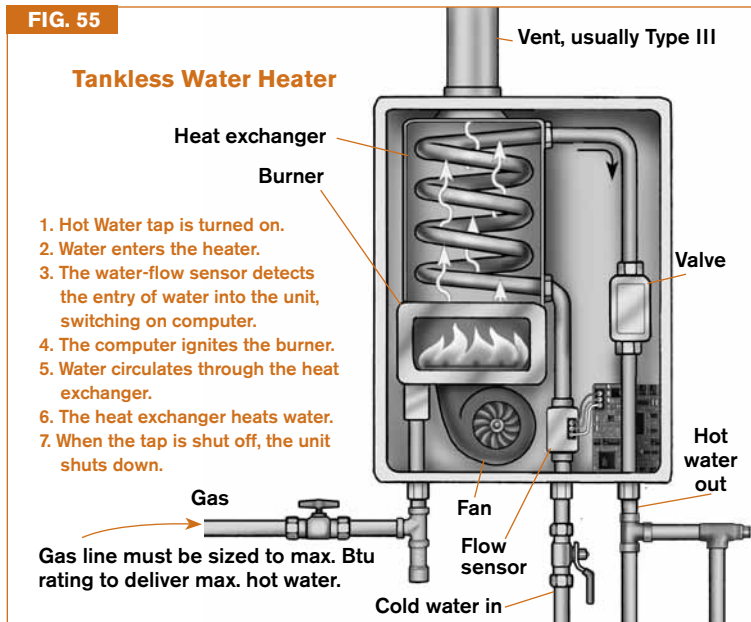


## Tankless Water Heater

**09 IRC 09 UPC**

- Type III vent typically req'd AMI **F55** \_\_\_\_\_ [2427.3.1] {510.1.2}
- PRV AMI \_\_\_\_\_ [2005.1] {505.6}
- Size gas line to max Btu rating **F52** \_\_\_\_\_ [2413.2] {1209.4.1}

**FIG. 55**



## Temperature & Pressure Relief Valves General

**09 IRC 09 UPC**

- All WHs req pressure relief device **F56, F58** \_\_\_\_\_ [2803.1] {505.4}
- All WHs req temperature limiting device **F56, F57** \_\_\_\_\_ [2803.1] {505.5}
- Devices may be combination TPRV (mandatory for storage-tank water heaters in UPC) **F56** \_\_\_\_\_ [2803.5] {608.3}
- Temp probe [in top 6in of tank (AMI in UPC) **F53,59** \_\_\_\_\_ [2803.4] {505.6}
- Settings not >150psi OR 210°F \_\_\_\_\_ [2803.3&4] {608.4}
- Watts 210 also req's PRV **F57,58** \_\_\_\_\_ [2803.1] {505.6}

## TPRV Drain Piping

**09 IRC 09 UPC**

- No shutoff valves before or downstream of TPRV \_\_\_\_\_ [2803.6] {505.6}
- Piping may not be shared w/ condensate drain or relief valves of other systems \_\_\_\_\_ [2803.6.1] {608.4}
- Drain must end outside building or at other approved location (IRC allows floor, pan, exterior, or indirect waste \_\_\_\_\_ [2803.6.1] {608.5})
- TPRV may discharge into pan (not allowed in UPC) \_\_\_\_\_ [2803.6.1]<sup>17</sup> {Ø508.5}
- End ≤6in (6 to 24in UPC) from ground or receptor \_\_\_\_\_ [2803.6.1] {608.5}
- Drain size at least same as outlet of valve \_\_\_\_\_ [2803.6.1] {608.5}
- Must drain by gravity; cannot run uphill or be trapped [2803.6.1] {608.5}
- No kinks or restrictions in pipe \_\_\_\_\_ [2803.6.1] {608.5}
- End of pipe visible & no threads on end **F53,59** \_\_\_\_\_ [2803.6.1] {608.5}
- Material can be any allowed for water distribution (only Zi steel, CPVC, hard-drawn Cu, or listed TPRV drain in UPC) **F53,59** \_\_\_\_\_ [2803.6.2] {608.5}
- Protect from freezing (terminate through air gap to indirect receptor located in a heated space) \_\_\_\_\_ [2803.6.1] {608.5}
- May not drain to crawlspace \_\_\_\_\_ [2803.6.1] {608.5}

**FIG. 56**



## Temperature & Pressure-Relief Valve

When the water heater is in a basement or below grade, it may not be possible to arrange for a gravity drain of the TPRV valve. A Watts 210 valve (**F57**) can be installed. The temperature-sensing bulb of the valve goes in the upper portion of the tank & the gas piping runs through the valve. The Watts 210 shuts off the gas if the temperature is excessive. In addition, a separate water pressure-relief valve (**F58**) must be installed in the piping & must drain by gravity to an approved location. Check with the local AHJ to see if this method is accepted in your area.

**FIG. 57**

## Watts 210 Gas Shutoff Valve



**FIG. 58**

## Pressure-Relief Valve



## Required Pans & Drain

**09 IRC 09 UPC**

- Watertight corrosion-resistant pan req'd for WHs in attics or where leakage could cause damage **F53,59** \_\_\_\_\_ [2801.5]<sup>18</sup> {508.4}
- Pan 24 gage Zi or listed corrosion-resistant material \_\_\_\_\_ [2801.5] {508.4}
- Pan drain size min 3/4in **F53,59** \_\_\_\_\_ [2801.5.1] {508.4}
- Pan drain req'd to end in indirect waste or outdoors 6 to 24in above grade (to any approved location in UPC) \_\_\_\_\_ [2801.5.2] {508.4}
- Pan min 1 1/2in deep **F53,59** \_\_\_\_\_ [2801.5.1] {n/a}

**FIG. 59**

## TPRV Discharge Pipes

### TPRV discharge pipe:

- No threads on end
- Not trapped
- No smaller than relief valve outlet
- No valves or fittings
- Discharge to readily observable location
- Max. 6 in. above receptor in IRC
- Not to drain to pan in UPC



Pan & TPR drain only with materials approved for interior water pipe (no PVC)



## GAS APPLIANCE COMBUSTION AIR (C.A.)

### General 09 IRC 09 UMC

Note: The IRC & UMC address combustion air only for gas-burning appliances. Oil-fired appliances are governed by NFPA 31 (see p.38).

- C.A. req'd for natural draft appliances EXC \_\_\_\_\_ [2407.1] {701.1.1}
  - Direct-vent appliances installed AMI \_\_\_\_\_ [2407.1] {701.1X1}
- Draft hood in same space as appliance \_\_\_\_\_ [2407.3] {701.1.3}
- Provide make-up air to offset exhaust fans (kitchen, bath) [2407.4] {701.1.4}

### Mechanically Supplied Combustion Air 09 IRC 09 UMC

- Mechanical C.A. supply min 0.35cu.ft./minute/kBtu \_\_\_\_\_ [2407.9] {701.7}
- Appliance interlock req'd if mechanically supplied C.A. [2407.9.2] {701.8.2}

### Openings 09 IRC 09 UMC

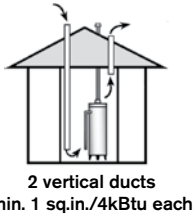
- Outside air openings req screens w/ mesh  $\geq 1/4$ in \_\_\_\_\_ [2407.10] {701.9B}
- No screens allowed on ducts terminating in attic \_\_\_\_\_ [2407.11] {701.10}
- Net free area of louvers 75% for metal, 25% for wood [2407.10] {701.9A}
- Motorized louvers/dampers req appliance interlock \_\_\_\_\_ [2407.10] {701.9C}

### Ducts 09 IRC 09 UMC

- Duct galv metal or material of equivalent performance [2407.11] {701.10}
- Ducts to outdoors min dimension 3in \_\_\_\_\_ [2407.6] {701.4}
- No manual dampers in C.A. ducts \_\_\_\_\_ [n/a] {701.11}
- Joist/stud space as C.A. duct  $\leq 1$  fireblock removed [2407.11X] {701.10X}
- Exterior openings min 12in above finished ground **F79,80** \_\_\_\_\_ [2407.11] {701.10}
- Ducts may serve only 1 enclosure or appliance space [2407.11] {701.10}
- Horizontal ducts to upper part of enclosure may not slope down to source (upper duct not to originate from below) **F80** \_\_\_\_\_ [2407.11] {701.10}
- Upper & lower ducts remain separate to source \_\_\_\_\_ [2407.11] {701.10}

**FIG. 76**

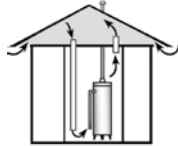
**Vertical Ducts to Outdoors**



2 vertical ducts  
min. 1 sq.in./4kBtu each

**FIG. 77**

**Vertical Ducts to Attic**



2 openings to ventilated attic  
min. 1 sq.in./4kBtu each & sleeved min 6 in. above joist

### Single-Opening Method 09 IRC 09 UMC

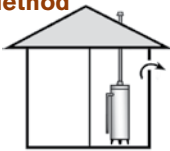
- Single direct exterior opening OK in upper 12in of enclosure min 1sq.in./3kBtu &  $\geq$ sum of vent connectors **F78** \_\_\_\_\_ [2407.6.2] {701.4.2}
- Single opening can be to ventilated attic \_\_\_\_\_ [F2407.6.2] {F7-5}

### Two-Opening Method 09 IRC 09 UMC

- 2 openings in upper & lower 12in **F79,80** \_\_\_\_\_ [2407.6.1] {701.4.1}
- 2 direct exterior openings min 1sq.in./4kBtu **T34,F78** \_\_\_\_\_ [2407.6.1] {701.4.1}
- 2 vertical ducts min 1sq.in./4kBtu **T34,F76,77** \_\_\_\_\_ [2407.6.1] {701.4.1}
- 2 horizontal ducts min 1sq.in./2kBtu **T34,F80** \_\_\_\_\_ [2407.6.1] {701.4.1}

**FIG. 78**

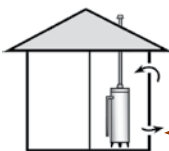
**Single-Opening Method**



1 opening in upper 12in. of exterior wall  
min. 1 sq.in./3kBtu

**FIG. 79**

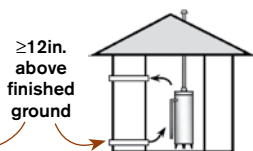
**2 Direct Exterior Openings**



2 openings in exterior wall  
min. 1 sq.in./4kBtu each

**FIG. 80**

**Horizontal Ducts**



2 openings in exterior wall  
min. 1 sq.in./2kBtu each

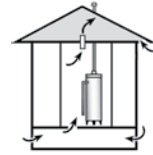
### Attic & Crawl-Space Sources

**09 IRC 09 UMC**

- Ventilated attics & crawl spaces considered equivalent to outdoors **F77, 81** \_\_\_\_\_ [F2407.6.1(1&2)] {F7-2&3}
- Crawl space only for lower C.A., not upper **F82** \_\_\_\_\_ [2407.11] {701.10}

**FIG. 81**

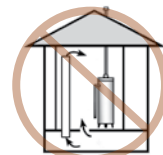
**Crawl-Space & Attic Openings**



Attic & crawl space  
min. 1 sq.in./4kBtu each

**FIG. 82**

**Crawl Space Cannot Be Upper Air Source**



Crawl space may not provide upper combustion air source

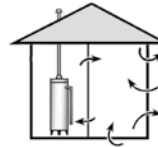
### Indoor Air Source

**09 IRC 09 UMC**

- ACH = air changes per hour \_\_\_\_\_ [2407.5.2] {701.2.1.1}
- Indoor air source alone only OK if infiltration  $> .40$  ACH [2407.5] {701.2}
- Min volume of space 50cu.ft./1kBtu/hr. **T34, F83** \_\_\_\_\_ [2407.5.1] {701.2.1}
- Indoor air volume includes rooms directly communicating w/ appliance space **F84** \_\_\_\_\_ [2407.5] {701.2}
- Openings connecting indoor spaces req'd to be located in upper & lower 12in of appliance space **F83** \_\_\_\_\_ [2407.5.3.1] {701.3.1}
- Openings connecting indoor spaces min 100sq.in each & min 1sq.in./kBtu if on same level, 2sq.in if on different levels **T34** \_\_\_\_\_ [2407.5.3] {701.3.1}
- If ACH  $< .40$ , min volumes for known air infiltration method:
  - Non fan-assisted appliance (21 cu.ft./ACH) per kBtu [2407.5.2] {701.2.2}
  - Fan-assisted appliance (15cu.ft./ACH) per kBtu \_\_\_\_\_ [2407.5.2] {701.2.2}

**FIG. 83**

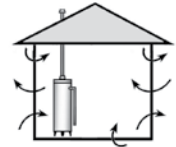
**Confined Space Indoors**



Openings from enclosed appliance space to building interior min. 100sq.in. each and per **T34**. One in upper 12 in. & 1 in. lower 12 in. of enclosed space.

**FIG. 84**

**All Air from Indoors**



Space w/  $> .40$  ACH sufficient if volume  $\geq 50$  cu.ft./kBtu.

**TABLE 34**

### COMBUSTION AIR OPENING SIZES

Btu	Indoor Air <sup>A</sup>		Outdoor Air Openings	
	Opening size <sup>B</sup>	cu.ft. min. (sq.ft. <sup>C</sup> )	1 in./4kBtu/hr.	1 in./2kBtu/hr.
30k	100 sq.in.	1,500 (188)	15 sq.in.	7.5 sq.in.
40k	100 sq.in.	2,000 (250)	20 sq.in.	10sq. n.
50k	100 sq.in.	2,500 (313)	25 sq.in.	12.5 sq.in.
60k	100 sq.in.	3,000 (375)	30 sq.in.	15 sq.in.
80k	100 sq.in.	4,000 (500)	40 sq.in.	20 sq.in.
100k	100 sq.in.	5,000 (625)	50 sq.in.	25 sq.in.
125k	125 sq.in.	6,250 (781)	62.5 sq.in.	31.3 sq.in.
150k	150 sq.in.	7,500 (938)	75 sq.in.	37.5 sq.in.

A. For construction w/ known air infiltration rate  $> .40$ /hr.

B. Req'd opening between confined space ( $< 50$  cu.ft. per kBtu's) & unconfined space.

C. Ex: sq. ft. for 8 ft. ceiling – use actual room volume.

**GAS APPLIANCE VENTING**

The most common forms of gas appliances, such as water heaters, have traditionally used a "gravity" vent system, where combustion gases are lighter than the surrounding air and therefore rise by gravity to the outdoors. As appliances are becoming more efficient, other types of venting systems are being used, as shown in T37. The type of vent should match the appliance category and the manufacturer's recommendations. The venting tables that are supplied by the manufacturer and shipped with gas appliances must be used in vent systems that include induced draft appliances.

TABLE 37 APPLIANCE VENTING CATEGORIES			
Category	Condensation	Static Pressure	Typical vent
I	No	Non-positive	B Vent
II	Yes	Non-positive	Per manu
III	No	Positive	Stainless
IV	Yes	Positive	Plastic

- General** **09 IRC 09 UMC**
- Choose vent material based on appliance category **T37** [2427.1] {802.1}
  - Category I induced draft is "gravity" vent appliance [2427.1] {802.1}
  - Select type of venting system from **T38** [2427.4] {802.4.1}
  - Properly support all vents AMI [2426.6] {802.6.5}
  - All vents L&L except plastic installed AMI or single wall [2426.1] {n/a}
  - Plastic vents AMI & primer contrasting color [2427.4.1.1]<sup>29</sup> {802.4.3}<sup>29</sup>
  - Condensate drain also req'd for Category I or III if local experience shows need (recommended for some tankless WH) [2427.8&9] {802.9.2}
  - Sheet-metal shield to 2in above attic insulation **F97** [2426.4] {n/a}
  - Protect vents closer than 1 1/2in from face of wall w/steel shield plates extending min 4in beyond framing inside wall [2426.7] {n/a}
  - No solid fuel and gas in same chimney flue [2427.5.6.1] {802.5.5.1}
  - Size Category II, III & IV appliance vents AMI [2427.6.8.3] {802.6.3.2}

TABLE 38 TYPE OF VENTING SYSTEM TO BE USED [T2427.4] {T8-1}			
Appliances	Type of Vent	IRC	UMC
Listed Cat. I Listed appliances w/ draft hoods Appliances listed for B vent	Type B gas vent	2427.6	802.6
	Chimney	2427.5	802.5
	Single-wall metal pipe	2427.7	Ø
	Listed chimney lining for gas	2427.5.2	802.5.1.3
	Special vent listed for appliance	2427.4.2	802.4.3
Listed vented wall furnaces	Type B-W gas vent	2427.6	802.6 928.0
Cat. II, III & IV appliances	As specified by manu.	2427.4.1 2427.4.2	802.4.2 802.4.3
Unlisted appliances	Chimney	2427.5	802.5
Decorative appliances in vented fireplaces	Chimney	2427.5	907.2
Direct-vent appliances	As specified by manu.	2427.2.1	802.2.5
Appliances w/ integral vent	As specified by manu.	2427.2.2	802.2.6

- Single-Wall Vents** **09 IRC 09 UMC**
- Not allowed in dwellings [n/a] {802.7.4.1}<sup>30</sup>
  - Only for runs from appliance space directly to outside [2427.7.4] {n/a}
  - May not originate in attic or pass through inside wall [2427.7.6] {n/a}
  - Min 6in clear to combustibles for single wall pipe [2427.7.8] {n/a}
  - Termination min 2ft above roof [2427.7.3] {n/a}
  - Termination min 2ft higher than building within 10ft [2427.7.3] {n/a}
  - Not allowed outdoors in cold (freezing) climates [2427.7.2] {n/a}

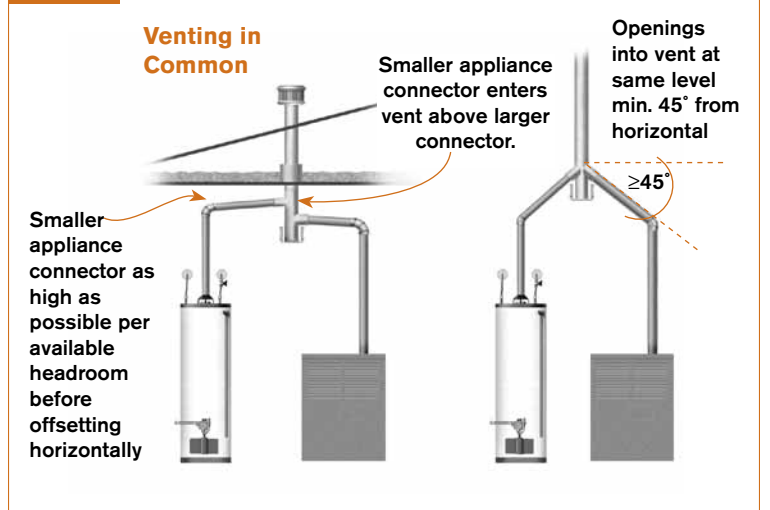
**Vent Size Using Manufacturer's Tables** **09 IRC 09 UMC**

- Tables can be used for all Category I appliances [2427.6.8.1] {802.6.3.1}
- Req'd to be used if appliance is induced draft [2427.10.3.1] {802.10.3.1}
- Connector not >2 sizes larger than flue collar [2428.2.11] {803.1.10}
- When vertical vent > than connector, use vertical diameter to determine table min & connector diameter for table max [2428.2.8] {803.1.7}
- 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) [2428.2.9] {803.1.8.1}
- Zero lateral values only if straight vertical vent connects directly to top outlet draft hood or flue collar [2428.2.4] {803.1.3}
- No elbows if using "zero lateral length" part of table [2428.2.3] {803.1.2}
- Vent tables w/ lateral length allow for 2-90° elbows [2428.2.3] {803.1.2}
- Reduce table capacity 5% each elbow up to 45° & 10% each elbow >45° up to 90° [2428.2.3] {803.1.2}
- Reductions for elbows in common vents as above [2428.3.6] {803.2.6}
- Reductions for common vent connectors as above [2428.3.7] {803.2.7}

**Multiple Appliances Vented in Common** **09 IRC 09 UMC**

- Tables req'd to be used if induced draft included [2427.10.3.1] {802.10.3.1}
- Join multiple connectors as high as possible per available headroom & clearance **F96** [2427.10.3.4] {802.10.3.4}
- Connect smaller above larger EXC **F96** [2427.10.4] {802.10.4.1}
  - OK if both at same level if max 45° from vertical [2427.10.4.1] {802.10.4.1}
- If both appliances have draft hoods, OK to size vent for 100% of larger + 50% of smaller [2427.10.3.4] {802.10.3.4}
- Reduce connector table capacity 5% each elbow up to 45° & 10% each elbow >45° up to 90° **F96** [2428.3.7] {803.2.7}

FIG. 96



**Forced Vents (Category IV)** **09 IRC 09 UMC**

- All mechanical draft systems L&L & installed AMI [2427.3.3] {802.3.4.1}
- Forced draft system must be gas tight [2427.3.3] {802.3.4.3}
- No natural & forced-vent to common flue [2427.3.3] {802.3.4.4}
- Terminate min 7ft above ground where adjacent to public walkways [2427.3.3] {802.3.4.6}
- Terminate 3ft above forced air inlets within 10ft [2427.8] {802.8.1}
- Terminate min 4ft to side or below or 1ft above building openings, min 1 ft above ground level EXC [2427.8] {802.8.2}
  - Termination can be same as direct vent (p.35) if AMI [2427.8] {802.8.1&2}
- Collect & dispose of condensate from vent (see p.29) [2427.9] {802.9}

**ELECTRIC HEAT**

Electric resistance heating can be in the form of central forced-air furnaces, baseboard heaters, radiant ceiling panels, duct heaters, and even exotic systems such as electric heat in ceramic tile bath floors. The wiring for electric heating must be sized to 125% of the load to assure that it does not also become a heater.

- General** **09 IRC** **11 NEC**
- Circuits considered continuous load \_\_\_\_\_ [3702.10] {424.3B}
  - Circuits for continuous loads must be sized to 125% of load \_\_\_\_\_ [3701.2] {210.20A}
  - All electric heating equipment must be L&L \_\_\_\_\_ [3403.3] {424.6}
  - Factory-applied nameplates must include: \_\_\_\_\_ [1303.1] {424.6}
    - Label with manu name, model & serial number
    - Operating & maintenance instructions or publication number of manual
    - Rating in volts, amperes, or watts, no. of phases if >1
    - Req'd clearances from combustibles

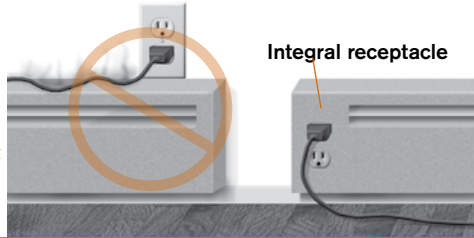
- Central Electric Heat** **09 IRC** **11 NEC**
- Disconnect in sight of equipment unless breaker capable of being locked in OFF position \_\_\_\_\_ [4101.5] {424.19}
  - Locking means must remain with or without lock installed \_\_\_\_\_ [T4101.5] {424.19}

- Baseboard Heaters** **09 IRC** **11 NEC**
- Must be L&L and installed AMI \_\_\_\_\_ [3403.3] {424.6}
  - Branch circuits for 2 or more units can be 15, 20, 25, or 30 amps \_\_\_\_\_ [3702.10] {210.3}
  - No receptacles above heaters: integral receptacles with heaters can substitute for req'd receptacles in rooms **F108** \_\_\_\_\_ [1405.1] {424.9}

**FIG. 108**

**Electric Baseboard Heaters**

Listing instructions prohibit installation of baseboard heaters under receptacles



- Electric Radiant Heat Systems** **09 IRC** **11 NEC**
- Install AMI \_\_\_\_\_ [1406.1] {424.93A1}
  - Install panels parallel to framing \_\_\_\_\_ [1406.3] {424.93B2}
  - Fasteners >1/4in from heating element \_\_\_\_\_ [1406.3] {424.93B3}
  - Min 8in distance from surface-mounted fixture boxes \_\_\_\_\_ [n/a] {424.93A3}
  - Min 2in distance from recessed fixtures & trim \_\_\_\_\_ [n/a] {424.93A3}
  - No field modification of panels unless so listed \_\_\_\_\_ [1406.3] {424.93B4}
  - Wiring above heated ceiling min 2in clearance \_\_\_\_\_ [n/a] {424.94}
  - Wiring above heated ceiling considered as 50°C ambient unless over ≥2in thermal insulation \_\_\_\_\_ [n/a] {424.94}

- Electric Duct Heaters** **09 IRC** **11 NEC**
- Install AMI \_\_\_\_\_ [1407.1] {424.66}
  - If used in system with AC, must be L&L for same \_\_\_\_\_ [1407.1] {424.62}
  - If <4ft from heat pump/air-conditioning, both must be listed for such clearances \_\_\_\_\_ [1407.3] {424.61}
  - Install w/ manu recommended clearance from Class 1 ducts unless L&L for direct connection \_\_\_\_\_ [1407.2] {424.66}
  - Lockable breaker req'd or disconnect within sight \_\_\_\_\_ [4101.5] {424.65}
  - Each unit req's integral limit controls & manual reset \_\_\_\_\_ [1407.1] {424.64}
  - Must be accessible for servicing \_\_\_\_\_ [1407.4] {424.66}
  - Interlock req'd to prevent heat if fan not operating \_\_\_\_\_ [1407.5] {424.63}

- Heating Cables in Concrete or Masonry Floors** **11 NEC**
- Min 1in spacing between cables \_\_\_\_\_ [424.44B]
  - Leads protected where leaving floor \_\_\_\_\_ [424.44E&F]
  - GFCI protection req'd for cables in bathroom floors \_\_\_\_\_ [424.44B]
  - Secure in place while concrete or other finish applied \_\_\_\_\_ [424.44C]
  - Inspection & approval req'd before covering \_\_\_\_\_ [424.44G]

**CLOTHES DRYER EXHAUST**

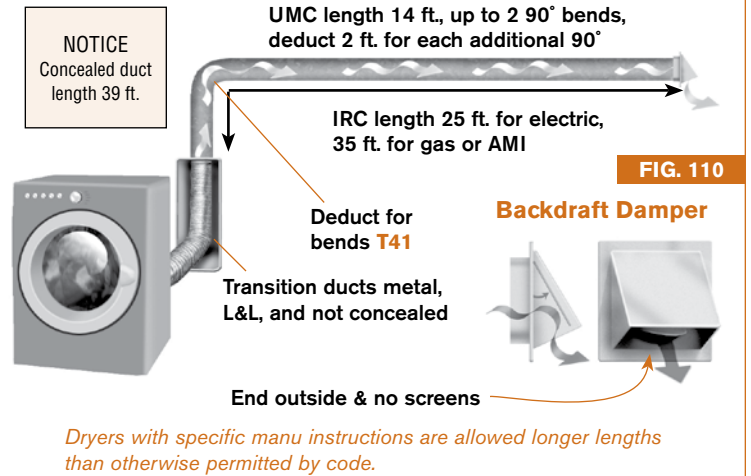
- Electric Clothes Dryer Exhaust** **09 IRC** **09 UMC**
- L&L ductless (condensing) dryers OK per L&L \_\_\_\_\_ [1502.2X] {n/a}
  - Closet installation req's make-up air opening min 100sq.in [n/a] {504.3.2}
  - Flexible transition ducts L&L & single piece \_\_\_\_\_ [1502.4.3] {504.3.2.1X}
  - Connectors not concealed & max 8ft {6ft UMC} **F109** [1502.4.3] {504.3.2.1X}
  - Duct smooth metal, no screws in air flow **F109** \_\_\_\_\_ [1502.4.2] {504.3.2.1}
  - Support & secure at max 4ft intervals \_\_\_\_\_ [1502.4.2]<sup>37</sup> {n/a}
  - Duct min 4in diameter \_\_\_\_\_ [1502.4.1]<sup>38</sup> {504.3.2}
  - IRC: Max length AMI or 25ft minus bends per **T41** [1502.4.4]<sup>39</sup> {n/a}
  - UMC: Max length 14ft minus 2ft each 90° turn more than 2 [n/a] {504.3.2.2}
  - No mixing w/ or passage through other systems \_\_\_\_\_ [1502.1] {504.3.1}
  - End outside in backdraft damper & no screens **F110** \_\_\_\_\_ [1502.3] {504.3.1}
  - Min 3ft from other building openings \_\_\_\_\_ [1502.3] {n/a}
  - Length of concealed duct on tag ≤6ft of connection [1502.4.5]<sup>41</sup> {n/a}
  - Shield plates <1 1/4in from framing surface **F109** \_\_\_\_\_ [1502.5]<sup>40</sup> {n/a}

**FIG. 109**

**Dryer Exhaust**

If duct length based on manu instructions, copy must be provided to AHJ & duct must be inspected.

The Consumer Product Safety Commission (CPSC) estimates that up to 16,000 home fires a year originate at clothes dryers. Common causes of these fires are lint buildup from improperly installed or maintained exhaust ducts. Screws should not penetrate the interior of the duct as they accumulate lint which leads to blockage.



**FIG. 110**

**TABLE 41 DRYER FITTING EQUIVALENT LENGTH [T1502.4.4.1 & T2439.5.5.1]**

Fitting Radius	Equivalent Length	
	45° Elbow	90° Elbow
4 in. mitered	2 ft. 6 in.	5 ft.
6 in. smooth	1 ft.	1 ft. 9 in.
8 in. smooth	1 ft.	1 ft. 7 in.
10 in. smooth	9 in.	1 ft. 6 in.

**Gas Clothes Dryer Exhaust**

- Closet req's make-up air opening [min 100sq.in IRC] \_\_\_\_\_ [2439.4] {905.3A}
- Flexible transition ducts (connectors) L&L & single piece [2439.5.4] {905.4C}
- Connectors not concealed [& max 8ft in IRC] **F109** [2439.5.4] {905.4C}
- Duct smooth metal, no screws in air flow **F109** \_\_\_\_\_ [2439.5.1] {905.4B}
- Support intervals max 4ft spacing \_\_\_\_\_ [2439.5.2]<sup>37</sup> {n/a}
- Duct min 4in diameter \_\_\_\_\_ [2439.5.1] {n/a}
- Max 35ft minus bends per **T41** or AMI **F109** \_\_\_\_\_ [2439.5.5.1]<sup>39</sup> {n/a}
- No mixing w/ or passage through other systems \_\_\_\_\_ [2439.1] {905.4A}
- End outside in backdraft damper & no screens **F110** \_\_\_\_\_ [2439.3] {n/a}
- Shield plates <1 1/4in from framing surface **F109** \_\_\_\_\_ [2439.5.3]<sup>40</sup> {n/a}
- Length of concealed duct on tag ≤6ft of connection [2439.5.6]<sup>41</sup> {n/a}