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Code Check[®] Mechanical Fourth Edition

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Code Check Mechanical 4th edition is an illustrated guide to common code questions in residential heating, ventilation & air conditioning systems.

The primary code used in this book is the 2009 edition of the *International Residential Code for One- & 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 code referenced here is the *2009 Uniform Mechanical Code*, published by the International Association of Plumbing & Mechanical Officials (IAPMO). For most topics, these different codes are in agreement. These codes also reference standards 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. The 2009 cycle of codes is likely to remain in effect in most areas for at least 4 or 5 years after the cover date. Energy codes vary greatly from one area to another & 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.

This file has bookmarks which can help quickly search for a specific topic; we recommend turning on your bookmarks through the view window. You can also navigate by using the “table of contents” button above and clicking on the page numbers there.

The buttons at the top of the page – table of contents, abbreviations, code changes, and glossary – take you immediately to those pages of the book. The left and right arrows at the upper corners can be used to advance or move forward one page at a time.

~~Every ICC code number is a hyperlink which will open an ICC E-Codes file in your web browser. The text of each cited code will appear in your browser in a separate window.~~

TABLE 1			CODES & STANDARDS USED IN THIS BOOK
Organization	Edition	Code	
ASHRAE	2010	ASHRAE 62.2 Ventilation & Acceptable Indoor Air Quality in Low-Rise Residential Buildings	
IAPMO	2009	Uniform Mechanical Code	
ICC	2009	International Residential Code	
NFPA	2011	NFPA 31 Standard for Installation of Oil-Burning Equipment	
NFPA	2011	NFPA 58 Liquefied Petroleum Gas Code	
NFPA	2010	NFPA 211 Standard for Chimneys, Fireplaces, Vents & Solid Fuel-Burning Appliances	
NFPA	2011	NFPA 70 National Electrical Code	

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TABLE 2	ORGANIZATIONS
Acronym	Name
ACCA	Air Conditioning Contractors of America
ASHRAE	American Society of Heating, Air Conditioning & Refrigeration Engineers
ASME	American Society of Mechanical Engineers
ASTM	ASTM International (formerly the American Society for Testing & Materials)
CSA	Canadian Standards Association
IAPMO	International Association of Plumbing & Mechanical Officials
ICC	International Code Council
NFPA	National Fire Protection Association
UL	Underwriters Laboratories

KEY TO USING CODE CHECK

Code Check 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 **p.6**:

- Maintain accessibility for service of gas appliances ____ [1305.1] {304.1}

This line is stating that all appliances must be accessible for service. The rule is found in section 1305.1 of the IRC & section 304.1 of the UMC. Clicking on the “1305.1” IRC reference will open a browser window directly to the code text.

References to figures & tables are preceded by an **F** or a **T** as in the following example from **p.25**:

Gas Vent Terminations

09 IRC 09 UMC

- B vents ≤ 12 in. diameter per **F31, T8** if > 8 ft. from wall _ [2427.6.4] {802.6.2}

*This line is stating that B vents more than 8 feet from a wall are to be installed in accordance with rules shown in Figure 31 & Table 8. Notice that clicking on **F31** or **T8** opens directly to the page containing that figure or table.*

A change from the previous code edition is shown by a code citation in a different color. The superscript blue number after the code citation refers to the table on **p.46**, where more information about the change is found. The following example is from **p.22**:

Single-Wall Vents

09 IRC 09 UMC

- Not allowed in dwellings _____ [n/a] {802.7.4.1}⁹

*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 & it is a change from the 2006 edition. The change is explained further on **p.46**. Clicking on the superscript number takes you directly to **p.46**.*

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.12**:

- C.A. req'd for natural draft appliances EXC _____ [2407.1] {701.1.1}
- Direct-vent appliances installed AMI _____ [2407.1] {701.1X1}

*These lines are stating that combustion air is required for natural draft appliances except direct-vent appliances installed in accordance with the manufacturer's instructions. The abbreviations C.A. & AMI are explained in the list on **p.3**.*

ABBREVIATIONS

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AC	= air conditioning	L&L	= listed & labeled
ACH	= air changes per hour	lb.	= pound(s)
AHJ	= Authority Having Jurisdiction	LP	= liquefied petroleum (LP gas)
AMI	= in accordance with manufacturer's instructions	manu	= manufacturer, manufacturer's
ASTM	= ASTM International, formerly the American Society for Testing & Materials	max	= maximum
AWG	= American Wire Gage	min	= minimum
BO	= building official	no.	= number
Btu	= British thermal unit	o.c.	= on center
C.A.	= combustion air	PE	= polyethylene tubing
cfm	= cubic feet per minute	PEX	= crossed-link polyethylene tubing
CPVC	= chlorinated PVC pipe	PL	= property line
cu.	= cubic, as in cubic feet	PRV	= pressure relief valve
Cu	= copper	psf	= pounds per square foot
EGV	= equipment grounding conductor	psi	= pounds per square inch
EXC	= exception to rule will follow in the next line	psig	= pounds per square inch gage
FAU	= forced-air unit (central heater)	PVC	= polyvinyl chloride pipe
ft.	= foot/feet	req	= require
gal	= gallon(s)	req'd	= required
gpm	= gallons per minute	req's	= requires
HP	= heat pump	SDC	= Seismic Design Category
hr	= hour(s)	sq.	= square, as in sq. ft.
in.	= inch(es)	TPRV	= temperature & pressure relief valve
kBtu	= 1,000 Btu	V	= volt(s)
		WH	= water heater(s)

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GENERAL MECHANICAL SYSTEM REQUIREMENTS

The IRC & UMC have many sections that are identical except for their numbering. The model code for systems using natural gas is *NFPA 54–The National Fuel Gas Code* & many provisions of the more commonly adopted IRC & UMC are taken directly from it.

Administration**09 IRC 09 UMC**

- New installations, alterations & repairs req permits EXC _ [105.1] {112.1}
 - Portable equipment & minor replacement parts _____ [105.2] {112.2}
 - Components (including piping) within L&L equipment ____ [105.2] {112.2}
- BO or AHJ may accept alternative materials, methods & equipment _____ [104.11] {105.0}
- Installations not covered by IRC must comply with International Mechanical Code or International Fuel Gas Code _____ [1301.1] {n/a}
- Continued use of existing installations OK if safe & compliant with code at time of construction _____ [1202.2] {104.2}

Listing & Labeling**09 IRC 09 UMC**

- All appliances L&L EXC _____ [1302.1] {302.1}
- UMC allows unlisted appliances if BO deems them safe ____ [n/a] {302.1}
- Install listed appliances AMI & per listing ____ [1307.1 & 1401.1] {303.1}
- Attach installation & operating instructions to appliance_ [1307.1] {303.1}
- Fuel-fired factory-applied nameplates must include: ____ [1303.1] {306.1}
 - Manu name, model & serial number
 - Operating & maintenance instructions
 - Hourly Btu rating
 - Type of fuel
 - Req'd clearances from combustibles

Appliance Maintenance**09 IRC 09 UMC**

- Maintain system in proper working order _____ [1202.3] {104.4}
- BO may order reinspections to determine compliance __ [1202.3] {104.4}

Minimum heating requirements**09 IRC 09 UMC**

- Habitable rooms req installed heat source capable of min 68°F at 3 ft. above floor & 2 ft. from exterior wall _____ [303.8] {n/a}
- Portable space heater not OK to meet above rule _____ [303.8] {n/a}

APPLIANCE ACCESS & LOCATION

Appliances must remain accessible for inspection, service, repair & replacement without the need to remove permanent construction. Appliances must be located where they are not subject to flooding or damage & with adequate clearances from combustible surfaces. Appliances in under-floor areas & attics have specific rules. The IRC does not address appliances on roofs, though it does state that in the absence of specific rules, those from the International Mechanical Code can apply.

Flood Elevation**09 IRC 09 UMC**

- Locate above design flood elevation EXC _____ [1301.1.1] [307.2]
 - If designed to prevent water entry & resist buoyancy [322.1.6X] [307.2]
- No equipment mounted on breakaway flood walls ____ [322.3.4] [307.2.1]

Appliance Access**09 IRC 09 UMC**

- Maintain accessibility for service of gas appliances ____ [1305.1] {304.1}
- Min 30 × 30 in. level work space on control side EXC __ [1305.1] {304.0}
 - 18 in. deep space OK for room heaters _____ [1305.1] {304.0X}
- Equipment room door min 24 in. wide **F32** _____ [1305.1.2] {n/a}
- Equipment must fit through door **F32** _____ [1305.1.2] {304.0}
- Oil-burning FAUs in alcoves clearances per **F32** EXC _ [1305.1.1] {n/a}
 - Replacement appliances clearances AMI _____ [1305.1.1X] {n/a}

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Appliances under Floors**09 IRC 09 UMC**

- Access opening min rough-framed size 22 × 30 in. __ [1305.1.4] {904.11.1}
- Appliance must fit through opening _____ [1305.1.4] {904.11.1}
- Passageway min 22 in. wide × 30 in. high _____ [1305.1.4] {904.11.1}
- Passageway max 20 ft. long EXC _____ [1305.1.4] {904.11.2}
 - Passageway ≥ 6 ft. high OK for unlimited length__ [1305.1.4X2] {904.11.2}
- Min 30 × 30 in. level space on service side **F1** _____ [1305.1.4] {904.11.4}
- Support on concrete slab above ground or suspend from floor min 6 in. above ground **F1** _____ [1305.1.4.1] {n/a}
- Excavations min 6 in. below appliance, 12 in. on sides, 30 in. on control side **F1** _____ [1305.1.4.2] {n/a}
- If excavation > 12 in. below adjacent grade, line with concrete extending 4 in. above adjacent grade **F1** _____ [1305.1.4] {n/a}
- Luminaire & receptacle outlet req'd near appliance __ [1305.1.4.3] {904.11.5}
- Switch for luminaire req'd at passageway entrance _ [1305.1.4.3] {904.11.5}

Heating & Cooling Appliances in Garages**09 IRC 09 UMC**

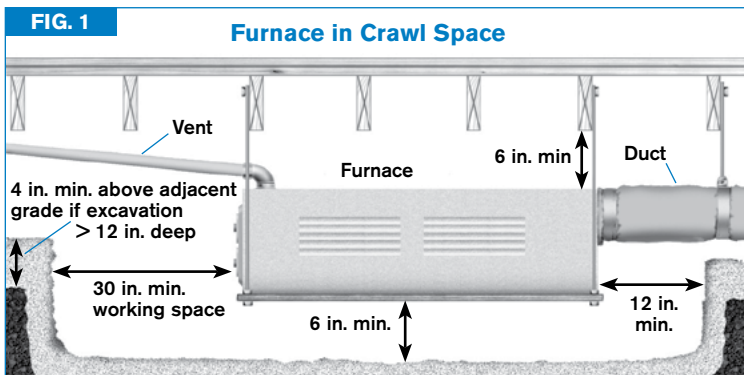
- Ignition source min 18 in. above floor EXC _____ [1307.3] {307.1}
 - Appliances in separate enclosed space accessible from outside garage & no combustion air from garage _____ [1307.3] {307.1}
- Protect appliances from impact _____ [1307.3.1] {307.1}
- Ducts through common wall to house min 26-gage steel [302.5.2] {n/a}
- No duct openings into garage _____ [302.5.2] {n/a}
- Openings around duct penetrations through common wall sealed with approved materials _____ [302.5.3] {n/a}

Heating & Cooling Appliances in Attics**09 IRC 09 UMC**

- Rough-framed access opening min 22 × 30 in. _____ [1305.1.3] {904.11.1}
- Appliance must fit through opening _____ [1305.1.3] {904.11.1}
- Solid floor min 24 in. wide from entrance to appliance [1305.1.3] {904.11.3}
- Max 20 ft. from access opening to appliance EXC __ [1305.1.3] {904.11.2}
 - 50 ft. OK if passageway ≥ 6 ft. high (unlimited length OK in UMC) _____ [1305.1.3X2] {904.11.2}
- Min 30 × 30 in. level work platform EXC _____ [1305.1.3] {904.11.4}
 - OK to omit if service possible from access opening [1305.1.3X1] {Ø}¹
- Luminaire & receptacle req'd near appliance **F17** __ [1305.1.3.1] {904.11.5}
- Switch for luminaire req'd at entrance **F17** _____ [1305.1.3.1] {904.11.5}

Clearances from Combustibles**09 IRC 09 UMC**

- Install with clearances AMI _____ [1306.1 & 2409.3.1] {303.1}
- Appliances in rooms "large in comparison to size of equipment" (not in alcove) clearance reduction allowed **T9** _____ [1306.2 & 2409.3.3] {303.2}
- Appliances installed in alcoves or closets must be L&L for same & no clearance reduction allowed _____ [2409.3.2] {303.2X}



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AIR-CONDITIONING & HEAT PUMPS

Central air-conditioning efficiency is measured in seasonal energy efficiency rating (SEER) & heat pumps are measured in heating seasonal performance factor (HSPF). The numbers are higher as efficiency is increased. Min efficiency standards for heat pumps & air conditioners have increased in recent years. Tax credits have been available for consumers upgrading their equipment to meet or exceed certain standards. As of this writing, the Department of Energy min SEER is 13, the min for an Energy Star rating is 14 & the min for a tax credit is 16. When replacing an existing system, both the indoor & outdoor units will likely have to be replaced to qualify.

Air-Conditioning (AC) & Heat Pumps (HPs) 09 IRC 09 UMC

- Factory-applied nameplates must include: _____ [1303.1] {306.3}
 - Label with manu name, model & serial number
 - Operating & maintenance instructions or publication number of manual
 - Rating in volts, amperes & Btus or watts, no. of phases if > 1
 - Req'd clearances
- HP return air duct min 6 sq. in. per kBtu output _____ [1403.1] {manu}
- Outdoor heat pump unit on min 3 in. raised pad **F2** _____ [1403.2]² {1106.2}
- Furnace with cooling coil reqs pressure capacity min 0.5 in. water column or L&L for cooling _____ [1411.2] {904.8A&B}
- Cooling coil downstream from heat exchangers unless L&L for upstream (stainless steel heat exchanger) _____ [1411.2] {904.8C}
- Central AC req's air filter **F2** _____ [1401.1] {311.2}
- Condenser not near clothes dryer vent _____ [manu] {manu}
- Refrigerant vapor (suction) lines insulated min R4 **F2** _____ [1411.5] {manu}

Refrigerant tubing should be secured, supported & protected from damage as recommended by the manu. Underground tubing must be protected from corrosion, and typically req's a chase or conduit that should also be seen emerging above grade.

*The **UL Marking and Application Guide for Electrical Heating & Cooling Equipment** contains additional information on the requirements & meaning of the label information.*

Window & Through-Wall Units 09 IRC 11 NEC

- Must have equipment grounding conductor; no adapters to existing 2-slot receptacles _____ [3908.1] {440.61}
- Max cord length 10 ft. if 120V, 6 ft. if 240V _____ [manu] {440.64}
- Cord plug OK as disconnect if controls ≤ 6 ft. of floor _____ [manu] {440.63}
- Arc fault circuit interrupter (AFCI) or leakage current detection interrupter (LCDI) req'd in attachment plug _____ [manu] {440.65}
- Max load rating 80% of individual circuit _____ [3702.12.1] {440.62B}
- Max load rating 50% of shared circuit _____ [3702.12.2] {440.62C}

Condensate Disposal 09 IRC 09 UMC

- Condensate may not drain to public way _____ [1411.3] {309.1}
- Drainpipe min ¾ in. with min 1/8 in./ft. slope **F2** _____ [1411.3] {309.1}
- Threaded female PVC fittings only on plastic male _____ [manu] {309.5}
- May drain to indirect waste (lavatory tailpiece, tub overflow) or other approved location **F2** _____ [1411.3] {309.1}
- No direct connection to waste or vent pipe _____ [1411.3] {309.1}
- If condensate stoppage would damage building components, install one of the following methods: **F2** _____ [1411.3.1] {309.2}
 - Secondary drain to conspicuous point of disposal _____ [1411.3.1] {309.2}
 - Auxiliary drain pan with drain to conspicuous point _____ [1411.3.1] {309.2}
 - Auxiliary drain pan with detector & drain fitting _____ [1411.3.1]³ {n/a}
 - Water level detection in primary with interlocked cutout [1411.3.1] {n/a}
- Down-flow units with no secondary & no way to install auxiliary drain pan req internal blockage detector with interlocked cutout _____ [1411.3.1.1] {n/a}
- No drilling (saddle fittings) of drain, waste, or vent (DWV) pipes to accept condensate drain _____ [3003.2] {UPC}

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FIG. 2

Heat Pump Operating in Cooling Mode

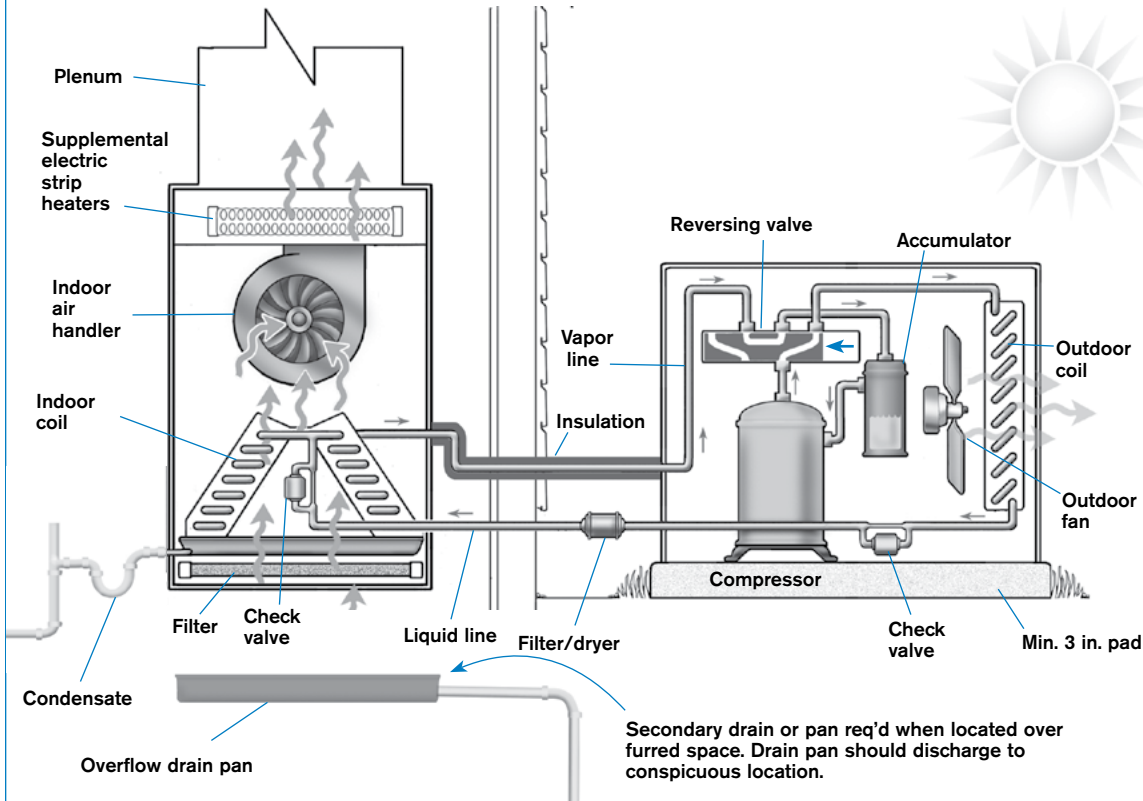
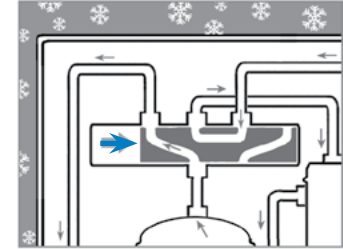


FIG. 3

Reversing Valve in Heating Mode



Heat pumps can be used for both heating & cooling.

A **reversing valve** determines the direction of refrigerant flow.

In **heating mode**, the outdoor coil extracts heat from the atmosphere & the indoor coil gives up that heat to the interior space.

When the outdoor temperature is below the balance point, supplementary electric strip heaters are activated in the indoor air handler.

In **cooling mode**, the system operates as in **F2**.

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DUCTS**General**

- Factory-made ducts L&L & installed AMI _____ [1601.2] {602.3} **09 IRC 09 UMC**
- Max 2 stories for vertical riser on factory-made duct _____ [n/a] {604.3}
- Fireblocking around duct penetrations between floors _ [302.11] {n/a}

Return Air

- Must be open to min 25% area served _____ [1602.2 & 2442.5] {311.3}* **09 IRC 09 UMC**
- Not from bathroom, kitchen, mechanical room, closet, garage, or separate dwelling unit _____ [1602.2 & 2442.5] {311.3&4}* **09 IRC 09 UMC**
- Sole return can be from room with fuel-burning equipment if supply air provided, return min 10 ft. from equipment & room volume min 100 cu. ft./kBtu of equipment _____ [1602.2 & 2442.5] {311.3}* **09 IRC 09 UMC**
- Duct min size 2 sq. in./kBtu output rating _____ [2442.2] {n/a}

Installation

- Ground clearance min 4 in. _____ [1601.4.7] {604.2&3} **09 IRC 09 UMC**
- 18 in. vertical clearance where needed under duct to prevent cutting off access to crawl space _____ [n/a] {604.1A}
- Min 2 in. encasement for ducts under/in concrete ____ [1601.1.2] {604.2}
- Duct joints sealed, taped, or gasketed airtight _____ [1601.4.1] {602.4}
- Flex ducts req UL-181B pressure-sensitive tape **F4.6** _____ [1601.4.1] {602.4}
- Flex duct per L&L (1 1/2 in. strap every 4 ft.) **F5** _____ [1601.4.3] {T6-10}
- Round metal horizontal duct support: min 1/2 in. metal straps or 12-gauge wire every 10 ft. **F5** _____ [1601.4.3] {T6-7}
- Stud cavities prohibited as supply air duct [1103.2.3 & 1601.1.1] {n/a}
- Stud cavities & joist spaces OK as returns if no condensation [and not conveying air from one floor to another] _____ [1601.1.1] {602.1}

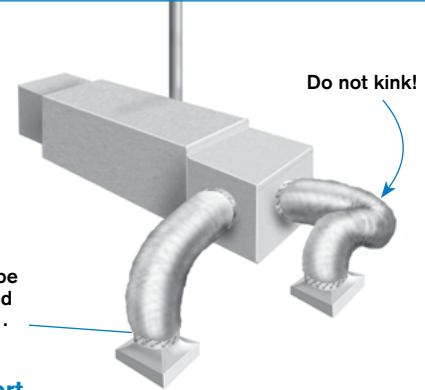
Insulation in Unconditioned Space**09 IRC 09 UMC**

- R-6 min in floor trusses, R-8 elsewhere EXC _____ [1103.2.1] {605.0}
- Ducts completely inside building thermal envelope [1103.2.1X] {605.0XB}
- Note: Energy codes may take precedence over mechanical code insulation reqs.*

FIG. 4**Stretch Flex Duct**

Manufactured ducts must be supported & stretched so they are as straight as possible without kinks that obstruct airflow.

Tape must be marked UL181.

**FIG. 5****Flex Duct Support**

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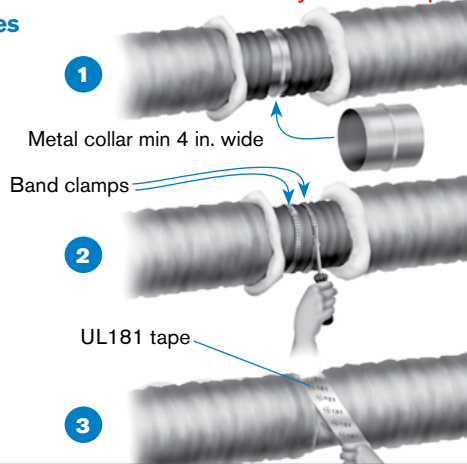
FIG. 6

Duct Splices

Step 1.
Peel jacket & insulation
from core & butt cores
together over collar.

Step 2.
Apply aproved tape
& secure with band
clamps.

Step 3.
Pull jacket & insulation
back together & apply 2
wraps of tape.



EVAPORATIVE (SWAMP) COOLERS

In dry climates evaporative coolers can reduce the sensible temperature & provide fresh air to the building interior. Care must be taken in locating these to ensure that objectionable odors are not brought into the building. They are also used to provide makeup air to commercial kitchens.

General F7

09 IRC 09 UMC

- Install AMI _____ [1413.1] {304.1}
- Ground-mounted units secured in place & level base min 3 in. above adjoining ground _____ [1413.1] {405.3}
- Platform-mounted unit min 6 in. above adjoining ground _____ [n/a] {405.3}
- Provide flashing at openings into building _____ [1413.1] {405.3}
- OFF switch or disconnect in sight if motor > 1/8hp _____ [4101.5] {308.0}

General F7 (cont.)

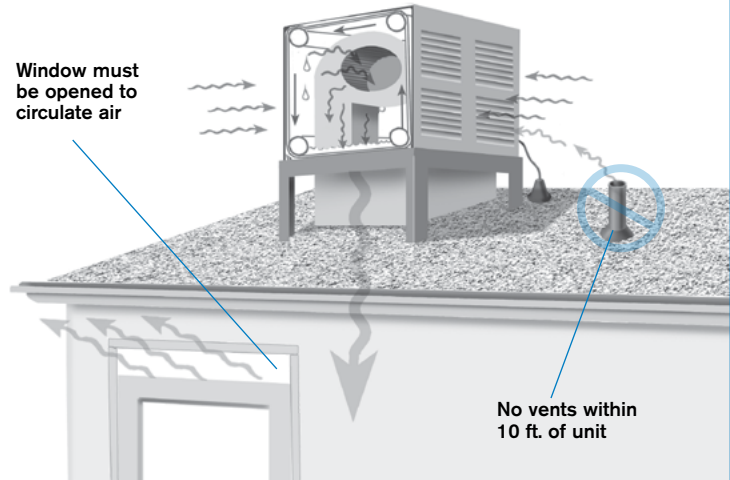
09 IRC 09 UMC

- Backflow protection on supply (internal air gap OK) _____ [1413.2] {UPC}
- Min 10 ft. horizontal clearance to plumbing or gas vents [303.4.1] {UPC}
- Electrical receptacle within 25 ft. (UPC) not req'd IRC [3901.11X] {308.0}

FIG. 7

Evaporative (Swamp) Cooler

Hot outside air is pulled through moist pads where it is cooled by evaporation & circulated through the house or building by a large blower, leaving the air much cooler & slightly more humid than when it entered the cooler. Evaporative cooling is especially well suited for climates where the air is hot & humidity is low.



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GAS APPLIANCE COMBUSTION AIR**General**

Note: The IRC & UMC address combustion air only for gas-burning appliances. Oil-fired appliances are governed by NFPA 31 (see p.26).

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

Mechanically Supplied Combustion Air

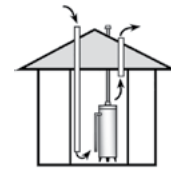
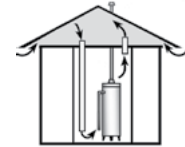
- | | | |
|--|------------|-----------|
| <input type="checkbox"/> Mechanical C.A. supply min 0.35 cu. ft./minute/kBtu__ | [2407.9] | {701.7} |
| <input type="checkbox"/> Appliance interlock req'd if mechanically supplied C.A. | [2407.9.2] | {701.8.2} |

Openings

- | | | |
|--|-----------|----------|
| <input type="checkbox"/> Outside air openings req screens with mesh $\geq 1/4$ in.____ | [2407.10] | {701.9B} |
| <input type="checkbox"/> No screens allowed on ducts terminating in attic _____ | [2407.11] | {701.10} |
| <input type="checkbox"/> Net free area of louvers 75% for metal, 25% for wood | [2407.10] | {701.9A} |
| <input type="checkbox"/> Motorized louvers/dampers req appliance interlock ____ | [2407.10] | {701.9C} |

Ducts

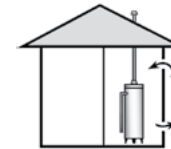
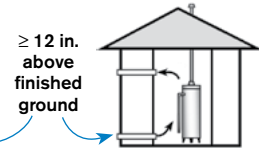
- | | | |
|---|------------|-----------|
| <input type="checkbox"/> Duct galvanized metal or material of equivalent performance _____ | [2407.11] | {701.10} |
| <input type="checkbox"/> Ducts to outdoors min dimension 3 in. _____ | [2407.6] | {701.4} |
| <input type="checkbox"/> No manual dampers in C.A. ducts _____ | [n/a] | {701.11} |
| <input type="checkbox"/> Joist/stud space as C.A. duct ≤ 1 fireblock removed | [2407.11X] | {701.10X} |
| <input type="checkbox"/> Exterior openings min 12 in. above finished ground F11, 12 _____ | [2407.11] | {701.10} |
| <input type="checkbox"/> Ducts may serve only 1 enclosure or appliance space | [2407.11] | {701.10} |
| <input type="checkbox"/> Horizontal ducts to upper part of enclosure may not slope down to source (upper duct not to originate from below) F12 _____ | [2407.11] | {701.10} |
| <input type="checkbox"/> Upper & lower ducts remain separate to source _____ | [2407.11] | {701.10} |

09 IRC 09 UMC**09 IRC 09 UMC****09 IRC 09 UMC****09 IRC 09 UMC****FIG. 8****Vertical Ducts to Outdoors**2 vertical ducts
min. 1 sq. in./4 kBtu each**FIG. 9****Vertical Ducts to Attic**2 openings to ventilated attic
min. 1 sq. in./4 kBtu each &
sleeved min 6 in. above joist**Single-Opening Method**

- | | | |
|--|-------------|-----------|
| <input type="checkbox"/> Single direct exterior opening OK in upper 12 in. of enclosure min 1 sq. in./3kBtu & \geq sum of vent connectors F10 _____ | [2407.6.2] | {701.4.2} |
| <input type="checkbox"/> Single opening can be to ventilated attic _____ | [F2407.6.2] | {F7-5} |

09 IRC 09 UMC**Two-Opening Method**

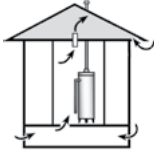
- | | | |
|---|------------|-----------|
| <input type="checkbox"/> 2 openings in upper & lower 12 in. F11, 12 _____ | [2407.6.1] | {701.4.1} |
| <input type="checkbox"/> 2 direct exterior openings min 1 sq. in./4 kBtu T3, F10 _____ | [2407.6.1] | {701.4.1} |
| <input type="checkbox"/> 2 vertical ducts min 1 sq. in./4 kBtu T3, F8, F9 _____ | [2407.6.1] | {701.4.1} |
| <input type="checkbox"/> 2 horizontal ducts min 1 sq. in./2 kBtu T3, F12 _____ | [2407.6.1] | {701.4.1} |

09 IRC 09 UMC**FIG. 10****Single-Opening Method**1 opening in upper
12 in. of exterior wall
min. 1 sq. in./3 kBtu**FIG. 11****2 Direct Exterior Openings**2 openings in exterior wall
min. 1 sq. in./4 kBtu each**FIG. 12****Horizontal Ducts**2 openings in exterior wall
min. 1 sq. in./2 kBtu each

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Attic & Crawl-Space Sources**09 IRC 09 UMC**

- Ventilated attics & crawl spaces considered equivalent to outdoors **F9,13** _____ [F2407.6.1 (1&2)] {F7-2&3}
- Crawl space only for lower C.A., not upper **F14** _____ [2407.11] {701.10}

FIG. 13**Crawl-Space & Attic Openings**

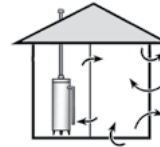
Attic & crawl space
min. 1 sq. in./4kBtu each

FIG. 14**Crawl Space Cannot Be Upper Air Source**

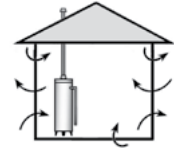
Crawl space may not provide
upper combustion air source

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 50 cu. ft./1 kBtu/hr. **T3, F15** _____ [2407.5.1] {701.2.1}
- Indoor air volume includes rooms directly communicating with appliance space **F16** _____ [2407.5] {701.2}
- Openings connecting indoor spaces req'd to be located in upper & lower 12 in. of appliance space **F15** _____ [2407.5.3.1] {701.3.1}
- Openings connecting indoor spaces min 100 sq. in. each & min 1 sq. in./kBtu if on same level, 2 sq. in. if on different levels **T3** _____ [2407.5.3] {701.3.1}
- If ACH < 0.40, 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 (15 cu. ft./ACH) per kBtu _____ [2407.5.2] {701.2.2}

FIG. 15**Confined Space Indoors**

Openings from enclosed
appliance space to building
interior min. 100 sq. in. each &
per **T3**. One in upper 12 in. & 1 in.
lower 12 in. of enclosed space.

FIG. 16**All Air from Indoors**

Space with > 0.40 ACH sufficient
if volume ≥ 50 cu. ft./kBtu.

TABLE 3**COMBUSTION AIR OPENING SIZES**

Btu	Indoor Air ^A		Outdoor Air Openings	
	Opening size ^B	cu. ft. min. (sq. ft. ^C)	1 in./2kBtu/hr.	1 in./4kBtu/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. in.
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 with known air infiltration rate > 0.40/hr.

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

C. Example: sq. ft. for 8 ft. ceiling—use actual room volume.

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FORCED-AIR FURNACES**General Rules & Clearances****09 IRC 09 UMC**

- Prohibited in bedroom, bathroom, or their closets EXC_ [2406.2] {904.1}
 - Direct-vent type installed AMI [2406.2] {904.1}
 - Separated by weather-stripped self-closing door & all combustion air from exterior [2406.2] {904.1}
- Equipment room door large enough to remove appliance [min 24 in. wide in IRC] [1305.1.2] {304.0}
- Work space min 30 in. deep & wide in front of appliance [1305.1] {304.0}
- FAUs in alcoves or closets must be L&L for alcove [2409.3.2] {904.2B}
- FAUs clearance AMI EXC [2409.3.2, 2409.4.2] {904.2}
 - Clearance reduction OK if room large in comparison with size of equipment [2409.3.3, 2409.4.3] {904.2A&B}
- Install above design flood elevation [1401.5] {307.2}
- Air filter req'd AMI [2442.1] {311.2}

Electrical Requirements**09 IRC 11 NEC**

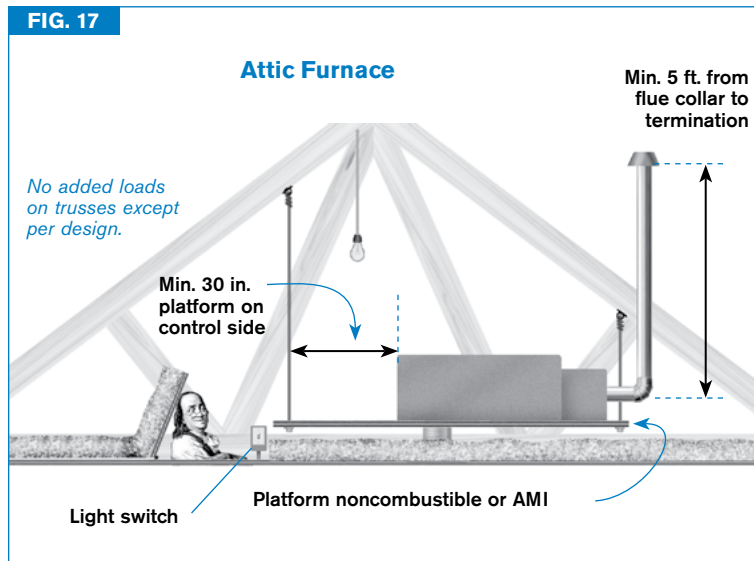
- Receptacle within 25 ft. of appliance [1305.1.3.1 & 1305.1.4.3] {210.63}
- Crawl space furnace req's light with switch at access [1305.1.4.3] {210.70A3}
- Attic furnace req's light with switch at access [1305.1.3.1] {210.70A3}
- Individual circuit req'd for central heating [3703.1] {422.12}
- No other equipment on central heating circuit EXC [3703.1] {422.12}
 - Associated pumps, humidifiers, air cleaners & AC [3703.1] {422.12X}

Underfloor**09 IRC 09 UMC**

- Equipment support on grade req's min 3 in. pad [2408.4]⁵ {904.3.1.1}⁵
- Suspended equipment min 6 in. above grade [2408.4] {904.3.1.2}⁶
- Passageway min 22 in. wide × 30 in. high [1305.1.4] {904.11.1}
- Passageway max distance 20 ft. to equipment EXC [1305.1.4] {904.11.2}
 - Unlimited length if passageway 6 ft. high & 22 in. wide [1305.1.4X2] {904.11.2}

Attic**09 IRC 09 UMC**

- Opening min 20 in. wide {22 in. UMC} & > appliance size [1305.1.3] {904.11.1}
- Passageway min 22 in. wide × 30 in. high [1305.1.3] {904.11.1}
- Max distance from opening 20 ft. EXC [1305.1.3] {904.11.2}
 - [IRC: 50 ft. if ≥ 6 ft. high] [UMC: Unlimited if ≥ 6 ft.] [1305.1.3X2] {904.11.2}
- Solid floor min 24 in. wide to equipment [1305.1.3] {904.11.3}
- Min 30 × 30 in. platform in front of firebox EXC **F17** [1305.1.3] {904.11.4}
 - Not req'd if equipment can be serviced from opening [1305.1.3X1] {Ø}¹

FIG. 17

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Garage

- | | | | |
|--|---------------|---------------|---------|
| <input type="checkbox"/> Protect appliance from impact _____ [1307.3.1 & 2408.3X] | 09 IRC | 09 UMC | {307.1} |
| <input type="checkbox"/> Ignition source min 18 in. above floor EXC ____ [1307.3 & 2408.2] | | | {307.1} |
| • Flammable vapor ignition resistant (FVIR) appliances [2408.2X] | | | {307.1} |
| • Separate space not communicating with garage air ____ [2408.2] | | | {307.1} |
| <input type="checkbox"/> Ducts & penetrations min 26-gage steel _____ [302.5.2] | | | {n/a} |
| <input type="checkbox"/> No duct openings into garage _____ [302.5.2] | | | {n/a} |

Condensing Furnaces (Category IV) F18

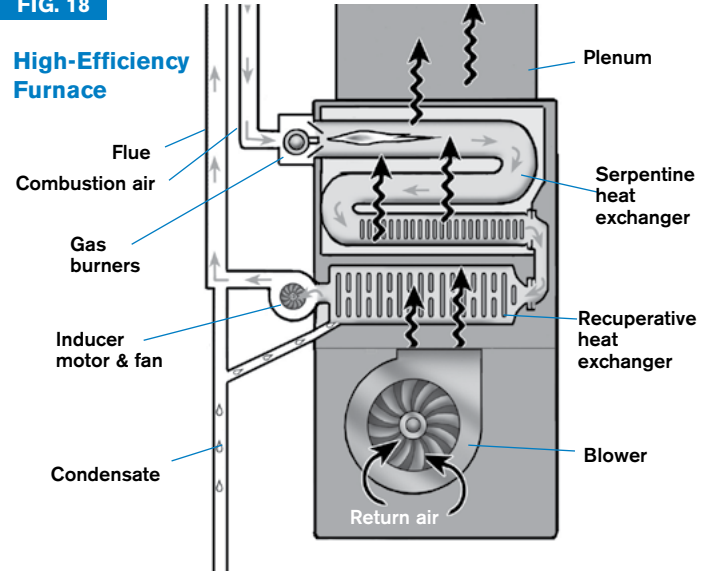
- | | | | |
|---|---------------|---------------|-------------|
| <input type="checkbox"/> Size venting AMI _____ [2426.5] | 09 IRC | 09 UMC | {802.6.3.2} |
| <input type="checkbox"/> Install vent & support AMI _____ [2426.5] | | | {802.6.1.1} |
| <input type="checkbox"/> Positive-pressure systems req'd to be gas tight ____ [2427.3.3] | | | {802.3.4.3} |
| <input type="checkbox"/> No mixing of natural to forced draft connectors or vents [2427.3.3] | | | {802.3.4.4} |
| <input type="checkbox"/> Burner interlock req'd to forced-vent fan ____ [2427.3.3] | | | {802.3.4.5} |
| <input type="checkbox"/> Furnaces with combustion air piping terminating in same location as vent piping typically considered direct-vent (see p.20) _____ [2427.8X1] | | | {802.8.1X1} |
| <input type="checkbox"/> Terminate min 3 ft. above forced-air inlets within 10 ft. ____ [2427.8] | | | {802.8.1} |
| <input type="checkbox"/> Termination clearances from building openings min 4 ft. below, 4 ft. horizontal & 1 ft. above _____ [2427.8] | | | {802.8.2} |
| <input type="checkbox"/> Terminate min 12 in. above grade _____ [2427.8] | | | {802.8.2} |
| <input type="checkbox"/> No vent termination where vapor would be a nuisance ____ [2427.8] | | | {802.8.4} |

Condensate Disposal

- | | | | |
|--|---------------|---------------|------------|
| <input type="checkbox"/> Provide means to collect & dispose of condensate _____ [2427.9] | 09 IRC | 09 UMC | {310.1} |
| <input type="checkbox"/> Condensate drains AMI _____ [2427.8]? | | | {802.8.4}? |
| <input type="checkbox"/> Auxiliary drain pan req'd if condensate stoppage could damage any building component EXC _____ [1411.4 & 2404.10] | | | {n/a} |
| • Automatic cutout installed in drain system _ [1411.4X & 2404.10X] | | | {n/a} |
| <input type="checkbox"/> May not drain to public way or nuisance location ____ [2427.9] | | | {309.1} |
| <input type="checkbox"/> Drainpipe min 3/4 in. with 1/8 in./ft. slope or AMI _____ [manu] | | | {309.1} |
| <input type="checkbox"/> May drain to indirect waste _____ [manu] | | | {309.1} |

FIG. 18

High-Efficiency Furnace



High-efficiency furnaces cool the flue gases below their dew point, producing condensation. The plastic flue & the appliance req. drains that must be kept separate from AC condensate. The joints in the plastic piping req primers & must be installed AMI.

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BOILERS & HYDRONICS

Modern high-efficiency boilers are often used with indirect WHs & for hydronic heating systems. Heat can be distributed through radiators, baseboard convectors, radiant slab-encased tubing, or duct heaters.

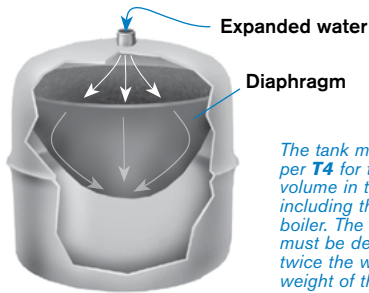
Steam & Hot Water Boilers

	09 IRC	09 UMC
<input type="checkbox"/> Install AMI _____	[2001.1]	{303.1}
<input type="checkbox"/> Installer to supply control diagram & operating manual _____	[2001.1]	{1020.0}
<input type="checkbox"/> Hot water boilers req pressure & temperature gauges F20 _____	[2002.2]	{1004.3}
<input type="checkbox"/> Steam boilers req sight-glass & pressure gauge _____	[2002.3]	{1004.3}
<input type="checkbox"/> Pressure regulator req'd on water feed F20 _____	[manu]	{manu}
<input type="checkbox"/> Shutoff valves req'd in supply & return piping EXC F20 _____	[2001.3]	{1011.0}
• Single low-pressure steam boiler _____	[2001.3X]	{1011.0}
<input type="checkbox"/> Low-water cutoff control req'd _____	[2002.5]	{1011.0}
<input type="checkbox"/> Hydronic boilers req expansion tanks F19 _____	[2003.1]	{1005.1}
<input type="checkbox"/> Tank support designed for twice waterlogged weight _____	[2003.1]	{1005.1}
<input type="checkbox"/> Tank capacity based on system volume T4 _____	[2003.2]	{1005.4}
<input type="checkbox"/> PRV req'd F20 _____	[2002.4]	{1011.0}
<input type="checkbox"/> PRV drain piped to within 18 in. of floor or receptor _____	[2002.4]	{1006.0}

FIG. 19

Expansion Tank

As water temperature increases & pressure rises, expanded water pushes against the diaphragm & compresses the air, preventing excessive pressure in the piping.



The tank must be sized per **T4** for the total volume in the system, including the water in the boiler. The tank support must be designed for twice the waterlogged weight of the tank.

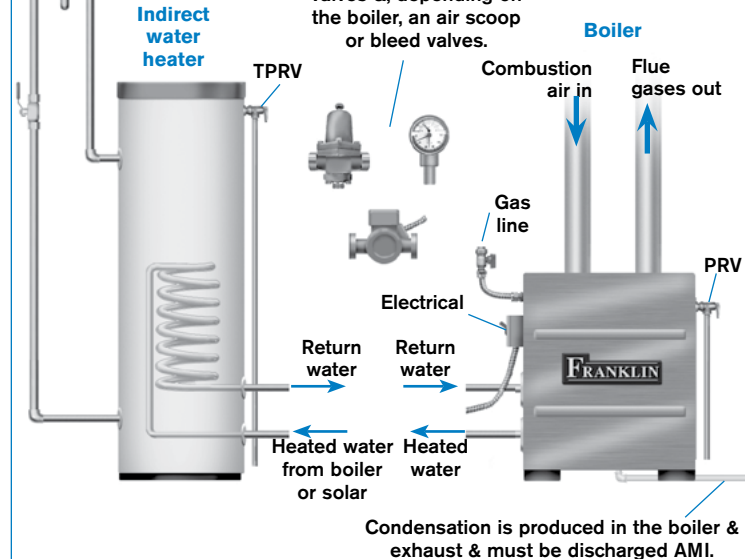
FIG. 20

Boiler & Indirect WH

Water from tank can reach scalding temperatures & must be tempered by a thermostatic mixing valve.

In addition to the expansion tank **F19**, every boiler must have a shutoff valve, pressure reducing regulator, temperature & pressure gauge, pumps, check valves &, depending on the boiler, an air scoop or bleed valves.

Boilers can serve as a heating system & can provide the energy source for an indirect-fired WH. A single high-efficiency boiler can be the energy plant for the whole house.



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Hydronic Piping: General**09 IRC 09 UMC**

- Provide means of system drain down _____ [2101.2] {1201.2.7.8.8}
- Maintain backflow protection to potable water _____ [2101.3] {UPC 603.0}
- No contact with material causing corrosion or damage _____ [2101.5] {1201.2.7.8.5}
- Drilling, notching & protection per building code _____ [2101.6] {1201.2.7.4}
- Provide for expansion & contraction _____ [2101.8] {1201.2.7.5}
- Enter tee fittings on supply side NOT branch opening [2101.7] {n/a}

Exposed Piping**09 IRC 09 UMC**

- Support piping to avoid strain _____ [2101.9] {1201.2.6}
- Pressure test min 100psi water for 15 {30 UMC} minutes [2101.10] {1201.2.8.3}
- Wrap/sleeve pipes through concrete walls or floors _____ [2603.3] {1201.2.7.8.1}

Embedded Piping (Radiant Heating)**09 IRC 09 UMC**

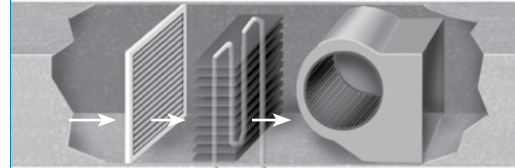
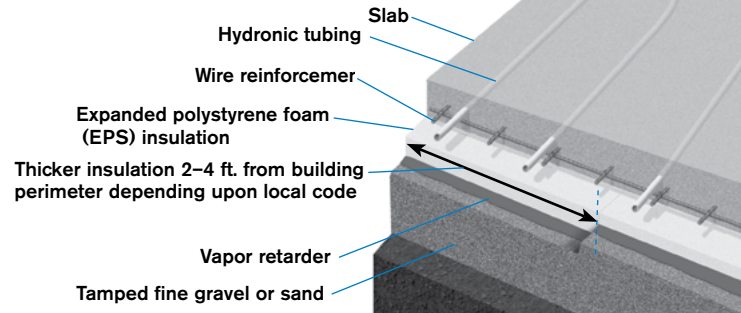
- Materials—steel pipe, Cu tubing {type L only in UMC}, PEX, PEX-AL-PEX, polybutylene CPVC, or polypropylene _____ [2103.1] {1204.1}
- Plastic pipe rated min 100psi at 180°F **F21** _____ [2103.1] {1204.1}
- Pressure test 100psi for 30 minutes _____ [2103.4] {1207.0}
- Maintain operating pressure on pipe when placing concrete _____ [n/a] {1203.2}

TABLE 4 MIN. EXPANSION TANK CAPACITY [T2003.2]

System Volume (gal.)	Pressurized Tank	Open Tank
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

FIG. 21**Hydronics**

Hydronic heating can be distributed through baseboard convectors, duct heaters, or in-slab radiant heating in either slab-on-grade construction or raised floors. Each zone will have its own thermostat & typically its own circulation pump or zone valve. Return lines will typically have manifolds that combine various sections of hydronic tubing.

Hydronic Duct Heater**Hydronic Tubing in Slab**

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GAS FLOOR FURNACES

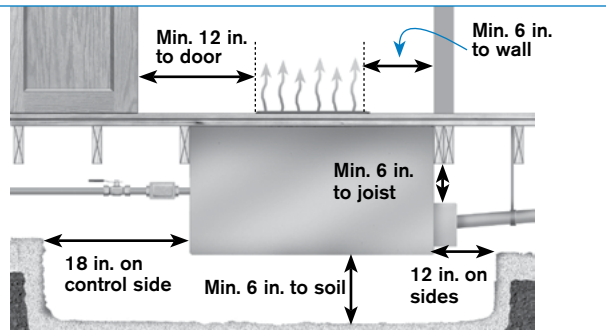
In addition to these specific rules for gas-burning floor furnaces, the access & passageway illumination requirements on **p.7** also apply. Grills for these furnaces can be hot & care must be taken to protect young children from them.

Underfloor Area **09 IRC** **09 UMC**

- Must be L&L & installed AMI _____ [2437.1] {912.1A}
- Unlisted furnaces only in noncombustible floors _____ [Ø] {912.1B}
- Appliance must fit through access opening _____ [1305.1.4] {304.0}
- IRC access opening min 22 × 30 in. (UMC trap door min 24 in. & wall opening 18 × 24 in.) _____ [1305.1.4] {912.8}
- May not be in concrete slab on grade _____ [2437.2] {912.1A}
 - May not project into habitable space below _____ [2437.5&6] {912.11}

Excavation Clearances **09 IRC** **09 UMC**

- 6 in. to ground (2 in. if factory sealed) **F22** _____ [2437.4] {912.7}
- 12 in. side clearance; 18 in. on control side **F22** _____ [2437.4] {912.7}

FIG. 22**Floor Furnace****Above Floor**

- Not in doorway, landing, passageway, or exit way _____ [2437.2] {912.4A}
- Flat-register type min 6 in. from wall **F22** _____ [2437.2] {912.4B}
- Min 12 in. from door swing or draperies **F22** _____ [2437.2] {912.4C}
- Two adjoining sides must have 18 in. clearance _____ [2437.2] {912.4B}
- Wall-register type min 6 in. to inner corner _____ [2437.2] {912.4B}
- Thermostat must be in same room _____ [2437.2] {912.1C}

09 IRC **09 UMC****GAS WALL FURNACES**

Gas-fired wall furnaces that are not direct vent can be located only in rooms that are large enough to meet the combustion air requirements of the appliance. Because they need indoor air for combustion, they are typically found only in older buildings with high air infiltration rates. If a building is upgraded in terms of energy compliance, it might not be possible to use wall furnaces as the heat source. Vent installation on wall furnaces is especially important, in that clearances inside the wall are less than the normal minimums for B vents. When a wall furnace is installed in an existing building, one side of the wall above the furnace should be opened for inspection of vent clearances.

Clearances

- From sidewall—install AMI (typical 6 in. min) **F23** _____ [2436.3] {928.1&2}
- From door swing [IRC: 12 in.] {UMC: AMI} **F23** _____ [2436.4] {928.1&2}
- Do not rely on doorstops to maintain clearance _____ [2436.4] {928.2}
- Clearance below structural projections AMI (typical 18 in.) [2436.3] {928.1&2}

09 IRC **09 UMC****Furnace Installation**

- OK in bedroom or bath that is not confined space _____ [2406.2] {902.0B}
- Fan assist only if L&L & AMI _____ [2436.1] {304.1}
- No ducts attached to wall furnaces _____ [2436.5] {928.1A}
- Panels, grills & access doors not attached to walls _____ [2436.6] {928.1E}
- Header plate at top of furnace AMI _____ [2436.1] {928.1C}
- Stud bay depth AMI _____ [2436.1] {928.1A}
- Unlisted furnaces not OK in combustible construction _____ [2404.3] {928.1B}

09 IRC **09 UMC**

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FIG. 23

Wall Furnace Clearances

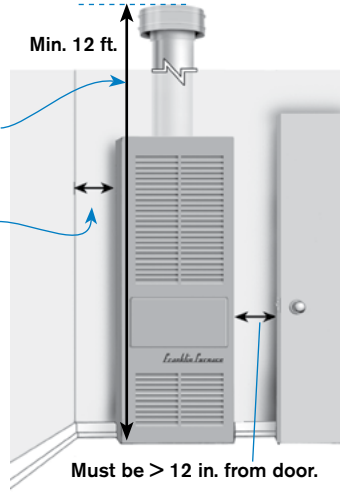
Vent termination min. 12 ft. above furnace bottom

Furnace must not be too close to corner.

Typical manu specification is 6 in. from inside corner.

Draperies must not touch heater.

Wall furnaces must remain accessible for cleaning. Dust or lint accumulating on the burner assembly can restrict the flow of oxygen necessary for complete combustion.

**Vent Installation****09 IRC 09 UMC**

- Cut top & floor plates flush to stud **F24** _____ [2427.6.1]__ (928.1C)
- Furnace stud space vented by ceiling plate spacers
AMI **F24** _____ [2427.6.1]__ (928.1C)
- Subsequent ceiling stud plates firestopped AMI **F24** _____ [2427.6.1]__ (928.1C)
- Single-story systems OK only in single story or top of multistory _____ [2427.6.1]__ (928.1C)
- Multistory systems OK in single story or multistory _____ [2427.6.1]__ (928.1C)
- Sleeve around vent in insulated assembly **F25** _____ [2426.4]__ {n/a}
- Sleeve min 2 in. above insulation in insulated attic **F25** _____ [2426.4]__ {n/a}
- Vent min height 12 ft. above bottom of furnace **F23** _____ [2427.6.4] {802.6.2.2}

FIG. 24

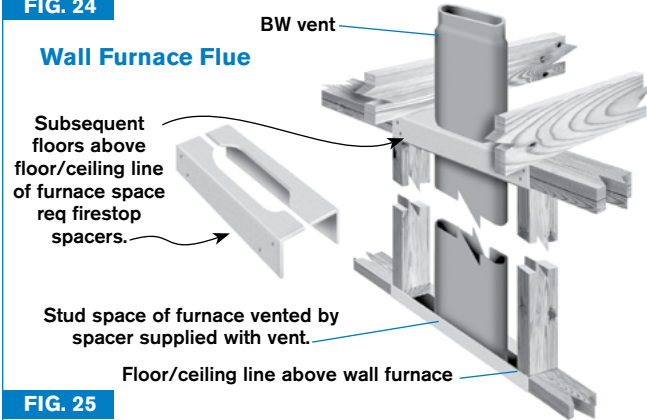
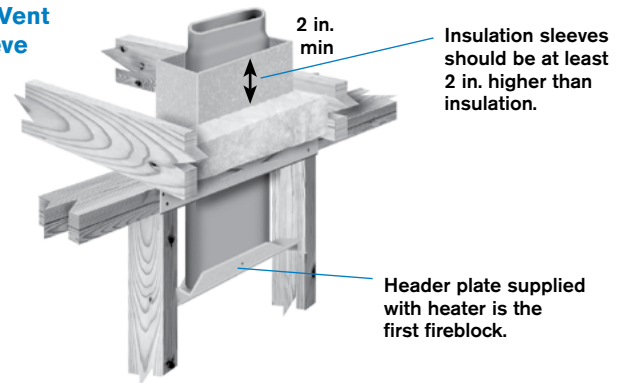
Wall Furnace Flue

FIG. 25

BW Vent Sleeve

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ROOM HEATERS

Room heaters that are not direct vent must be supplied with sufficient combustion air from the interior & are typically found only in older buildings with high air-infiltration rates. Because these must connect to a venting system, they should be secured to prevent displacement of the vent. Though unvented heaters are recognized in the model codes, many jurisdictions prohibit their use. If they are in bedrooms or baths they should be provided with a nontamperable oxygen depletion sensor.

General

09 IRC 09 UMC

- Secure to floor _____ [1307.2] {303.4}
- Install AMI _____ [2446.1] {303.1}
- Flame safeguard (pilot safety) req'd _____ [2446.1] {305.0}

Unvented Heaters

09 IRC 09 UMC

- Unvented heater may NOT be sole heat source _____ [2445.2] {924.1}
- Unvented heater ≤ 6kBtu OK in bath _____ [2406.2] {924.1.1X1}
- Unvented heater ≤ 10kBtu OK in bedroom _____ [2406.2] {924.1.1X2}
- Rooms must meet unconfined space requirements _____ [2406.2] {924.1}
- Max size 40kBtu _____ [2445.3] {n/a}
- Max input ratings ≤ 20Btu/cu. ft. of room or space _____ [2445.5] {n/a}
- Adjacent spaces with permanent large openings (doorway or archway) part of room volume _____ [2445.5] {701.2}
- Unvented heater req's oxygen-depletion sensor _____ [2445.6] {924.1.1X}

DIRECT-VENT APPLIANCES

Direct-vent appliances draw their source of combustion air from the same area where they vent combustion gases. This arrangement equalizes pressure on the inlet & outlet of the firebox, which is sealed & has no open flame on the building interior. Because these appliances do not use the interior air for combustion, they can be located in rooms that are considered confined spaces.

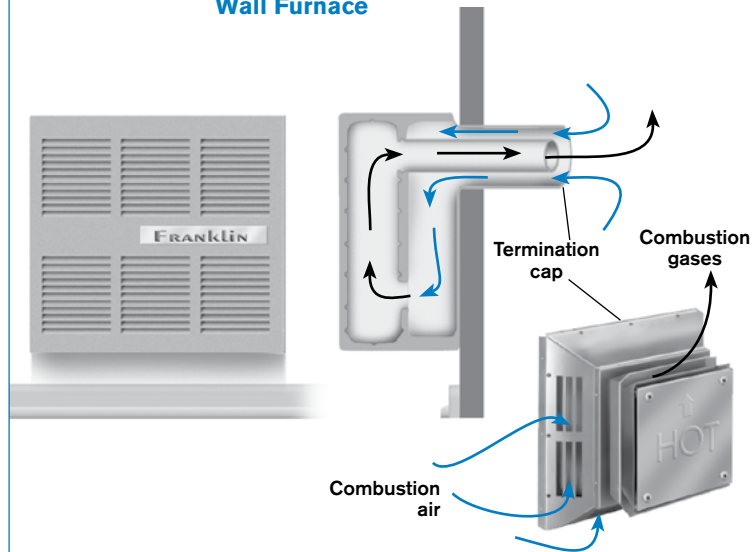
Direct-Vent Gas Wall Heaters F26

09 IRC 09 UMC

- Install AMI _____ [2427.2.1 & 2429.1] {304.1}
- Indoor combustion air not req'd _____ [2407.1] {928.1D}

FIG. 26

Direct-Vent Wall Furnace



Direct-Vent Gas Fireplaces F27

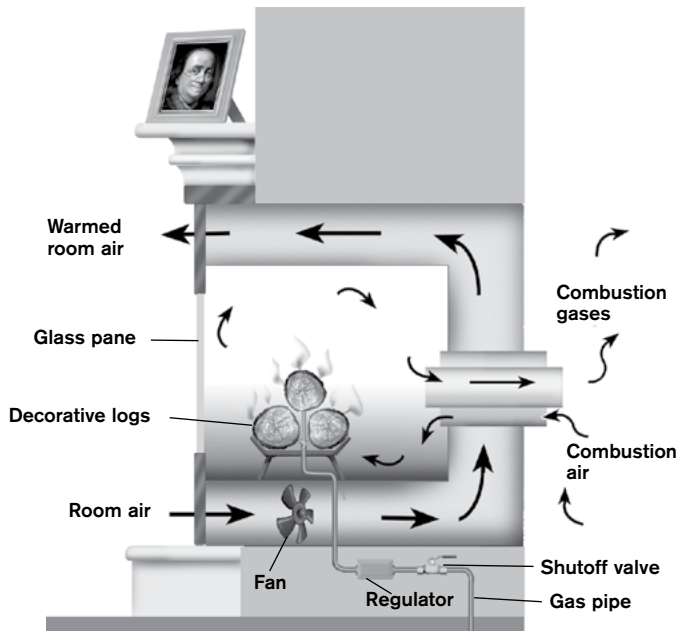
09 IRC 09 UMC

- OK in bedroom or bath _____ [2406.2] {908.1X}
- Must be L&L & AMI _____ [2427.2.1] {908.2D}
- Corrugated stainless steel tubing (CSST) or flex req's grommet through appliance wall _____ [2422.1.2.3X] {1313.1}
- Vent termination clearances T5 _____ [2427.8] {802.8.3}

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FIG. 27

Direct-Vent Gas Fireplace



A direct-vent fireplace can vent horizontally out a sidewall or vertically to the roof. With a completely enclosed chamber, it draws in outside air for combustion & expels gases to the outside. The front glass enclosure allows radiant heat to pass into the room. It heats a room without robbing it of oxygen or of the heated air it provides & keeps it free of fumes & combustible materials, such as embers or ash.

Direct-Vent Appliance Vent Termination

09 IRC 09 UMC

- OK to terminate through wall **F26,27** _____ [2427.8] {802.8.3}
- Termination clearances **T5** _____ [2427.8] {802.8.3}
- Bottom of vent terminal min 12 in. above grade _____ [2427.8] {802.8.3}

TABLE 5

DIRECT VENT TERMINATION CLEARANCES FROM BUILDING OPENINGS [2427.8] {802.8.3}

Appliance Rating	Clearance ^A from Openings
≤ 10kBtu	6 in.
> 10kBtu to 50kBtu	9 in.
> 50kBtu	12 in.

A. Measure stretched-string distance from edge of vent opening.

GAS APPLIANCES IN FIREPLACES

Vented Decorative Appliances in Fireplaces

09 IRC 09 UMC

- Not allowed in bedroom if confined space _____ [2406.2] {907.1}
- Must be L&L & installed AMI _____ [2432.1] {907.2}
- Maintain open vent (block damper in open position) _____ [manu] {manu}
- Fireplace screen req'd _____ [manu] {907.3}
- Appliance with pilot or ignition system req's pilot safety_ [2432.2] {305.0}
- Shutoff inside firepit OK if AMI _____ [2420.5.1] {1313.4}

Log Lighters

09 IRC 09 UMC

- Log lighters must be AMI _____ [2433.1] {manu}
- Req'd valve ≤ 6 ft. of fireplace & in same room _____ [2420.5] {1313.4}
- Hard gas pipe inside firepit (no flex) _____ [2422.1.1] {1313.1}

Unvented Gas Log Heaters

09 IRC 09 UMC

- Not in factory-built fireplace unless L&L to UL127 & AMI [1004.4] {n/a}

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GAS APPLIANCE VENTING

Common forms of gas appliances, like WHs, have traditionally used a “gravity” vent system, where combustion gases are lighter than the surrounding air, so they rise by gravity to the outdoors. As appliances are becoming more efficient, other types of venting systems are being used, as shown in **T6**. The type of vent should match the appliance category & the manu’s recommendations. The venting tables that are supplied by the manu & shipped with gas appliances must be used in vent systems that include induced draft appliances. Those tables are also in the codes.

TABLE 6 APPLIANCE VENTING CATEGORIES			
Category	Condensation	Static Pressure	Typical vent
I	No	Nonpositive	B Vent
II	Yes	Nonpositive	AMI
III	No	Positive	Stainless
IV	Yes	Positive	Plastic

General**09 IRC 09 UMC**

- Choose vent material based on appliance category **T6** _ [2427.1] {802.1}
- Category I induced draft is “gravity” vent appliance ____ [2427.1] {802.1}
- Select type of venting system from **T7** _____ [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]* {802.4.3}*
- 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 2 in. above attic insulation **F29** ____ [2426.4] {n/a}
- Protect vents closer than 1½ in. from face of wall with steel shield plates extending min 4 in. beyond framing inside wall ____ [2426.7] {n/a}
- No solid fuel & 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 7 TYPE OF VENTING SYSTEM TO BE USED [T2427.4] {T8-1}			
Appliances	Type of Vent	IRC	UMC
Listed Category I Listed appliances with 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
Listed vented wall furnaces	Type B-W gas vent	2427.6	802.6 928.0
		2427.4.1 2427.4.2	802.4.2 802.4.3
Category II, III & IV appliances	AMI	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	AMI	2427.2.1	802.2.5
Appliances with integral vent	AMI	2427.2.2	802.2.6

Single-Wall Vents**09 IRC 09 UMC**

- Not allowed in dwellings _____ [n/a] {802.7.1.1}*
- 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 6 in. clear to combustible for single wall pipe _____ [2427.7.8] {n/a}
- Termination min 2 ft. above roof _____ [2427.7.3] {n/a}
- Termination min 2 ft. higher than building within 10 ft. _ [2427.7.3] {n/a}
- Not allowed outdoors in cold (freezing) climates _____ [2427.7.2] {n/a}

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Appliances typically ship with installation instructions that include the tables in IRC 2428.2 & UMC 8-5.

Vent Size Tables

09 IRC 09 UMC

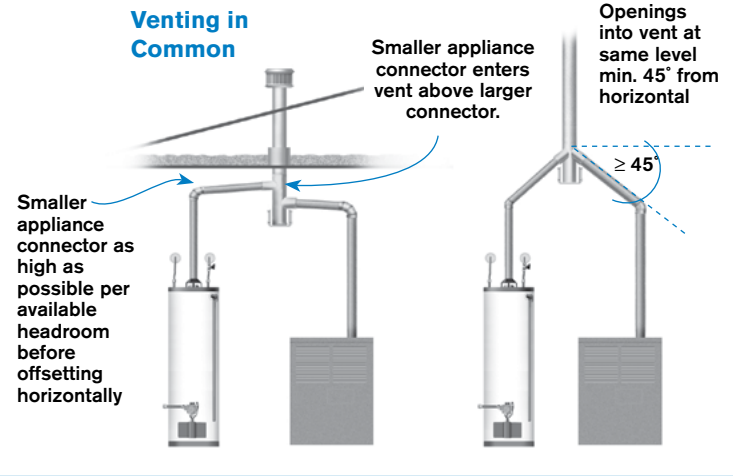
- Tables can be used for all Category I appliances ___ [2427.6.8.1] {802.6.3.1}
- Connector req'd to be sized per tables ___ [2427.10.3.1] {802.10.3.1}
- Connector not > 2 sizes larger than flue collar ___ [2428.3.17] {803.1.1.0}
- When vertical vent > than connector, use vertical diameter to determine 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 roofline (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 with 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 _ [2427.10.3.3] {802.10.3.3}
- Join multiple connectors as high as possible per available headroom & clearance **F28** ___ [2427.10.3.4] {802.10.3.4}
- Connect smaller above larger EXC **F28** ___ [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° **F28** ___ [2428.3.7] {803.2.7}

FIG. 28



Forced Vents (Category IV)

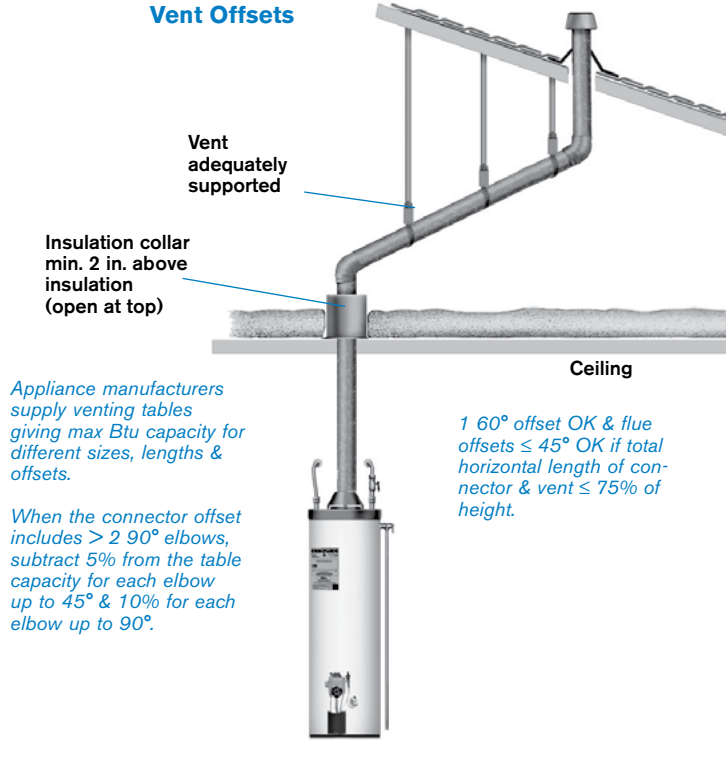
09 IRC 09 UMC

- 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 7 ft. above ground where adjacent to public walkways ___ [2427.3.3] {802.3.4.6}
- Terminate 3 ft. above forced air inlets within 10 ft. ___ [2427.8] {802.8.1}
- Terminate min 4 ft. to side or below or 1 ft. above building openings, min 1 ft. above ground level EXC ___ [2427.8] {802.8.2}
 - Termination same as direct vent (p.21) if AMI **T5** ___ [2427.8] {802.8.1&2}
- Collect & dispose of condensate from vent (see p.8) ___ [2427.9] {802.9}

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FIG. 29

Vent Offsets

**Connectors: General****09 IRC 09 UMC**

- Must be as straight as practical _____ [2427.10.6] {802.10.6}
- Min ¼ in./ft. slope toward appliance **F28** _____ [2427.10.8] {802.10.8}
- No dips or sags _____ [2427.10.8] {802.10.8}
- Must be as short as practical _____ [2427.10.9] {802.10.9.1}
- Provide adequate support **F29** _____ [2427.10.10] {802.10.10}
- Entire connector must be accessible _____ [2427.10.12] {802.10.12}
- Attach to appliance with screws or AMI _____ [2427.10.7] {802.10.7}
- Necessary size increases req'd to be made only at appliance outlet connection _____ [2427.10.3.5] {802.10.3.5}
- Max horizontal 18 in. per in. of connector diameter __ [2428.3.2] {803.2.2}

Single-Wall Connectors for Category I Appliances 09 IRC 09 UMC

- No single wall in attic, crawl space, or other unconditioned space EXC _____ [2427.10.2.2] {802.10.2.2}
 - OK [in unconditioned basement or garage] within exterior walls if local 99% winter design temperature ≥ 5°F ____ [2427.10.2.2X] {802.10.2.2X}
- Horizontal connector max 75% of vertical vent ____ [2427.10.9] {802.10.9.2}
- Min 6 in. clearance to combustibles _____ [2427.10.5] {802.10.5}
- May not pass through interior wall, floor, or ceiling __ [2427.10.14] {802.10.14.1}

Type B Double-Wall Vent Connectors**09 IRC 09 UMC**

- Min clearance to combustibles per L&L (typical 1 in.) [2427.10.5] {802.10.5}
- Max horizontal length 100% of vertical vent _____ [2427.10.9] {802.10.9.3}

Connectors to Chimneys**09 IRC 09 UMC**

- Inspection req'd before connecting to existing chimney [2427.5.5] {802.5.4}
- Must be lined with clay or metal EXC _____ [2427.5.5.1] {802.5.4.2}
 - OK for replacement of like appliance if inspects __ [2427.5.5.1]¹⁰ (802.5.4.2)¹⁰
- Enter chimney above bottom (min 12 in. IRC) _____ [2425.9] {802.10.11}
- Chimney cross-sectional area not > 7× size of gas vent [2427.5.4] {802.5.3}

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Connectors to Chimneys (cont.)**09 IRC 09 UMC**

- No connection to chimney serving solid fuel _____ [2427.10.13] {802.10.13}
- Secure connector to prevent blocking chimney _____ [2427.10.11] {802.10.11}
- No decorative shrouds unless L&L & AMI _____ [2427.5.3] {802.5.2.4}

Vent Size (Appliances with Draft Hoods)**09 IRC 09 UMC**

The simplified rules in this section can be used in addition to the prescriptive rules on p.23 and in the tables that come with the appliance.

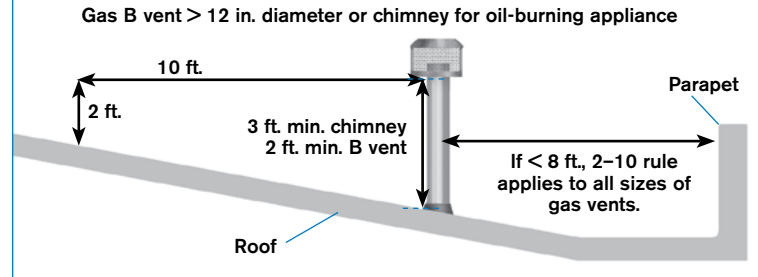
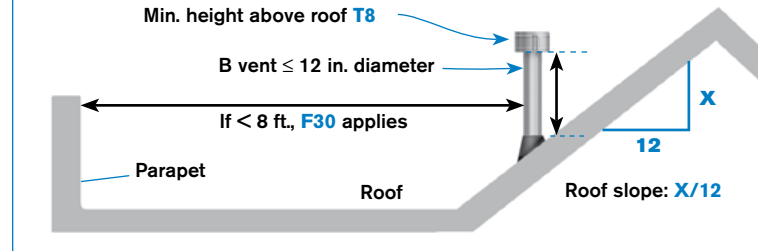
- Min size same as flue collar _____ [2427.6.8.1] {802.6.3.1}
- Max size 7× area of smallest flue collar _____ [2427.6.8.1] {802.6.3.1}
- If 2 appliances, 100% of larger + 50% of smaller _____ [2427.6.8.1] {802.6.3.1}
- Offsets 45° max except one of 60° OK **F29** _____ [2427.6.8.2] {802.6.1.1}

Gas Vent Terminations**09 IRC 09 UMC**

- Gas vents must extend above roof EXC _____ [2427.6.3] {802.6.2}
 - Direct-vent appliances _____ [2427.6.3] {802.6.2}
 - Appliances with integral vents _____ [2427.6.3] {802.6.2}
 - Mechanical-draft appliances AMI (see **p.23**) _____ [2427.6.3] {802.6.2}
- Roof penetration req's flashing _____ [2427.6.5] {802.6.1}
- Must have listed cap (cannot end inside roof jack) _____ [2427.6.5] {802.6.1}
- Decorative shrouds only if L&L & AMI _____ [2427.6.3.1] {802.6.2.4}
- Chimneys min 3 ft. above roof **F30** _____ [2427.5.3] {802.5.2.1}
- Chimneys min 2 ft. higher than building within 10 ft. **F30** [2427.5.3] {802.5.2.1}
- Vent termination min 5 ft. vertical above flue collar _____ [2427.6.4] {802.6.2.1}
- B vents ≤ 12 in. diameter per **F31, T8** if > 8 ft. from wall _____ [2427.6.4] {802.6.2}
- B vents min 2 ft. above vertical walls within 8 ft. **F31** _____ [2427.6.3] {802.6.2}
- B vents > 12 in. diameter min 2 ft. above roof & per **F30** [2427.6.4] {802.6.2}
- Type B or L min 5 ft. vertical above flue collar _____ [2427.6.3] {802.6.2.1}
- Wall furnace min 12 ft. from bottom of furnace **F23** _____ [2427.6.4] {802.6.2.2}
- Direct vent per **T5** _____ [2427.8] {802.8.3}

Vent Terminations (cont.)**09 IRC 09 UMC**

- "L" vent (oil vent used for gas or oil) termination:
 - Min 2 ft. above roof **F30** _____ [1804.2.4] {801.2}
 - Min 2 ft. above any portion of building within 10 ft. **F30** [1804.2.4] {801.2}

FIG. 30**Chimney & Vent Terminations****FIG. 31****B Vent Termination**

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TABLE 8 B VENT TERMINATION HEIGHT (F31) [F2427.6.3] {F8-2}			
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

OIL-FIRED APPLIANCES

The IRC provides specific rules for oil-burning appliances in Chapters 14 & 18. The UMC defers to NFPA 31 for these appliances. Jurisdictions using the UMC would use the NFPA 31 columns below.

General	09 IRC	NFPA 31
<input type="checkbox"/> Appliance clearances AMI EXC _____ [1306.1]		{4.3.2}
• New central furnaces in closets req clearances to F32 _ [1305.1.1]		{n/a}
<input type="checkbox"/> Oil shutoff valve req'd _____ [2204.2]		{10.5.1}
Oil-Fired Floor Furnaces	09 IRC	NFPA 31
<input type="checkbox"/> Must be L&L for combustible construction _____ [1408.1]		{10.9.1}
<input type="checkbox"/> Install AMI _____ [1408.1]		{4.3.2}
<input type="checkbox"/> Floor register types min 6 in. from wall _____ [1408.3]		{10.9.4}
<input type="checkbox"/> Wall register type min 6 in. from inside corners _____ [1408.3]		{10.9.5}
<input type="checkbox"/> Min 12 in. from draperies or door in any position _____ [1408.3]		{10.9.4}
<input type="checkbox"/> Draperies OK above furnace if min 5 ft. clearance _____ [1408.3]		{n/a}
<input type="checkbox"/> Not OK to project into habitable space below _____ [1408.3]		{10.9.9}
<input type="checkbox"/> Must be supported independently of grill _____ [1408.5]		{10.9.3}
<input type="checkbox"/> Not OK to support from ground _____ [1408.5]		
<input type="checkbox"/> Furnace must be accessible (not OK in slab) _____ [1408.3&4]		{10.9.7}

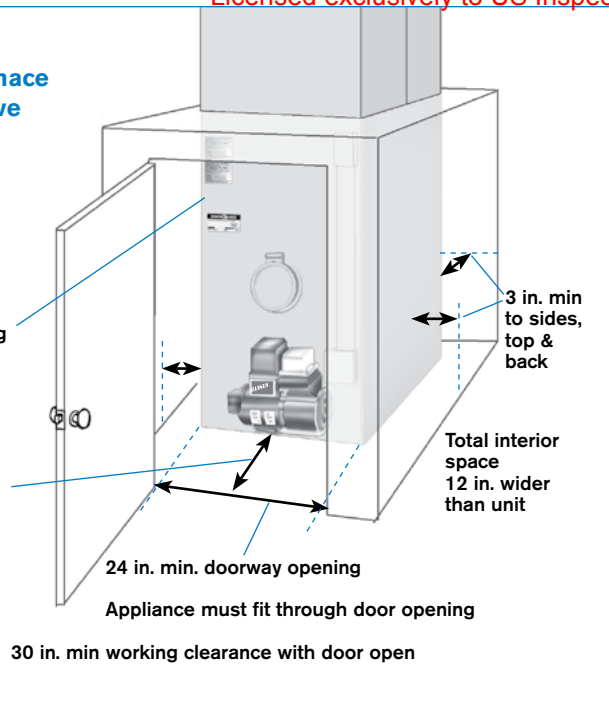
Oil-Fired Floor Furnaces (cont.)	09 IRC	NFPA 31
<input type="checkbox"/> Opening to underfloor area min 18 × 24 in. EXC _____ [1408.4]		{10.9.7.1}
• Floor trap door min 22 × 30 in. _____ [1408.4]		{n/a}
<input type="checkbox"/> Min 6 in. clearance to ground _____ [1408.5]		{10.9.6}
<input type="checkbox"/> Min 6 in. clearance to sides below floor _____ [n/a]		{10.9.9.2}
<input type="checkbox"/> Provide adequate combustion air AMI _____ [1701.1]		{10.9.8}
<input type="checkbox"/> Chimney connector clearance min 9 in. EXC _____ [1803.3.4]		{10.9.11}
• Lesser clearances with clearance reduction system T9 _____ [1803.3.4]		{10.9.11}

Oil-Fired Recessed Wall Furnaces	09 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]		{10.13.4}
<input type="checkbox"/> Locate so no fire hazard to walls, floors, or furnishings _____ [1409.2]		{10.13.4}
<input type="checkbox"/> No doors within 12 in. of face of furnace _____ [1409.2]		{10.13.4}
<input type="checkbox"/> Doorstop cannot be used to maintain req'd clearance _____ [1409.2]		{10.13.4}
<input type="checkbox"/> Min 3 ft. from wall opposite register _____ [1409.1]		{10.13.5}
<input type="checkbox"/> Panels, grills & access doors not attached to walls _____ [1409.4]		{10.13.6}
<input type="checkbox"/> Provide adequate combustion air _____ [1701.1]		{10.13.7}

Oil-Fired Room Heaters	09 IRC	NFPA 31
<input type="checkbox"/> Must be L&L & installed AMI _____ [1410.1]		{n/a}
<input type="checkbox"/> Noncombustible floor or assembly min 18 in. (12 in. NFPA 31) beyond all sides of appliance EXC _____ [1410.2]		{10.6.3.1}
• Appliances L&L for installation AMI without protection [1410.2X]		{10.6.3}
<input type="checkbox"/> Clearances 24 in. front, 6 in. sides, rear & above _____ [manu]		{T10.6.1}

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FIG. 32

**Oil Furnace
in Alcove**Oil-burning
furnace6 in. front
clearance
of open
firebox**COMBUSTION AIR FOR OIL-FIRED APPLIANCES**

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

General

- Source from outside building if unusually tight construction _____ {5.2.1}
- Consider effect from exhaust fans (kitchen, bath, laundry) _____ {5.2.3}
- Screen req'd on outside openings, mesh openings \geq 1/4 in. _____ {5.6.2}
- 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

NFPA 31**Indoor Air Source**

- OK only for buildings of ordinary tightness _____ {5.3.1}
- Infiltration sufficient for unconfined space _____ {5.3.1}
- Unconfined space = \geq 50 cu. ft./kBtu/hr. of all appliances
in space **F16** _____ {3.3.60}
- Confined space req's openings to unconfined space _____ {5.4.1.3}
- Openings to unconfined space min 1 sq. in./kBtu/hr. **T3** _____ {5.4.1.2}
- Openings located near top & bottom of confined space **F15** _____ {5.4.1.1}

NFPA 31**Outside Air Source**

- Openings located near top & bottom of confined space **F11** _____ {5.4.2.1}
- Openings to vented attic or crawlspace equivalent to outdoors **F13** _____ {5.4.2.2}
- Direct exterior openings each sized at 1 sq. in./4kBtu/hr. **T3, F11** _____ {5.4.2.3}
- Vertical ducts each sized at 1 sq. in./4kBtu/hr. **T3, F8, 9** _____ {5.4.2.3}
- Horizontal ducts each sized at 1 sq. in./2kBtu/hr. **T3, F12** _____ {5.4.2.3}

NFPA 31

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OIL-FIRED APPLIANCE CHIMNEYS & VENTS

Oil-fired appliances can be vented to listed L vents or to 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 & for consistency with the rest of the codes in this section we are providing the NFPA 31 rules below.

General

- | | 09 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 F33 EXC_ [1802.3] | | {6.4.1} |
| • Arrangements that prevent excessive chimney draft _____ | [n/a] | {6.4.1} |
| • Appliances L&L for use without 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} |

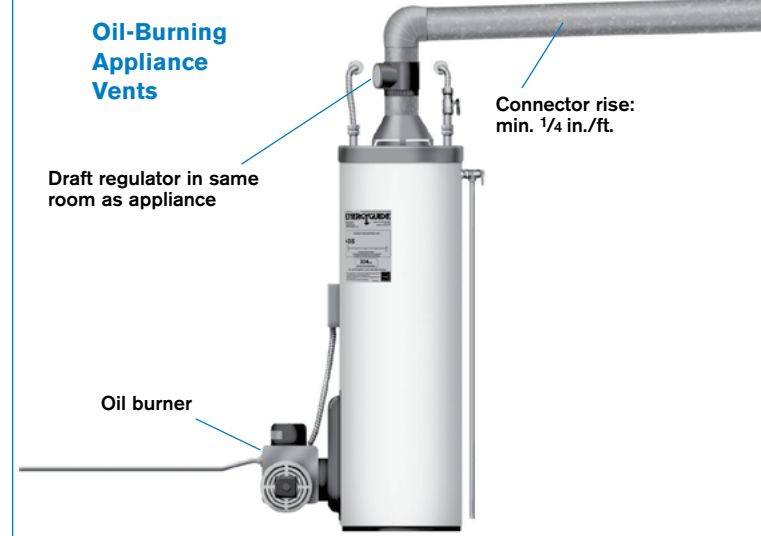
Chimneys & Type L Vents

- | | 09 IRC | NFPA 31 |
|---|---------------------|-----------|
| <input type="checkbox"/> Chimneys min size \geq flue collar, max size 3 \times _____ | [1805.3.1] | {manu} |
| <input type="checkbox"/> Inspect chimney before installing replacement appliance _____ | [n/a] | {6.6.7} |
| <input type="checkbox"/> Installer to verify that chimney is proper size _____ | [n/a] | {6.6.7}'' |
| <input type="checkbox"/> If deterioration seen, inspect per NFPA 211 (p.33) _____ | [n/a] | {6.6.7.2} |
| <input type="checkbox"/> Type L vents must be L&L & installed AMI _____ | [1804.3] | {6.7.1.2} |
| <input type="checkbox"/> Type L vent termination min 2 ft. above roof F30 _____ | [1804.2.4] | {6.7.1.4} |
| <input type="checkbox"/> Chimney termination min 3 ft. above roof F30 _____ | [1805.1] | {6.6.6} |
| <input type="checkbox"/> Vent or chimney termination 2 ft. above any portion of building within 10 ft. F30 _____ | [1804.2.4 & 1805.1] | {6.7.1.4} |
| <input type="checkbox"/> Masonry chimneys req cleanout opening _____ | [1801.3.3] | {6.6.1} |
| <input type="checkbox"/> Masonry chimneys req liner _____ | [1805.1] | {6.6.8} |

Chimney Connectors

- | | 09 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. F33 _____ | [1803.3] | {6.5.10} |
| <input type="checkbox"/> Secure support req'd _____ | [1803.3] | {6.5.13} |
| <input type="checkbox"/> Joints screwed (min 3 screws NFPA 31) _____ | [1803.3] | {6.5.14} |
| <input type="checkbox"/> Diameter min size of flue collar of appliance _____ | [1803.3.3] | {6.5.7} |
| <input type="checkbox"/> Horizontal distance max 75% of vertical _____ | [1803.3.2] | {6.5.1.2} |
| <input type="checkbox"/> Horizontal distance max 10 ft. without draft fan _____ | [n/a] | {6.5.1.1} |
| <input type="checkbox"/> Draft fans req's burner interlock _____ | [n/a] | {6.3.2} |

FIG. 33



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OIL TANKS & PIPING

While the IRC & NFPA 31 provide rules for buried tanks, many jurisdictions do not permit them, as the potential for groundwater contamination is present should they develop a leak. Storage tanks may also be under the jurisdiction of the local fire protection district. There are special considerations with tanks in flood-prone areas or those with high seismic risk.

Tanks: General _____ 09 IRC NFPA 31

- Tanks must be L&L _____ [2201.1] {7.2.1}¹²
- Install above design flood elevation or per NFPA 30__ [2201.6] {7.2.8.1}
- Restrain against earthquake movement per local codes[1307.2] {7.3.8.2}
- Tanks & supports req solid concrete foundations _____[n/a] {7.3.1}¹³
- Design foundation to minimize settling & corrosion __ [2201.2] {7.3.2}
- Max 660 gal above ground or inside building EXC __ [2201.2] {n/a}
- Systems compliant with NFPA 31 _____ [2201.2X] {7.2.7.2-5}

Outside Tanks _____ 09 IRC NFPA 31

- Outside tank supports firmly anchored to foundation _____ [n/a] {7.3.3}
- Tanks ≤ 275 gal (660 gal IRC) min 5 ft. from PL__ [2201.2.2] {7.8.2}
- Tanks > 275 gal & ≤ 660 gal min 10 ft. from PL _____ [n/a] {7.8.2}
- Tanks > 660 gal per NFPA 30 _____ [2201.2X] {7.8.3}
- External tanks req corrosion-resistant coating _____ [2201.2.2] {7.8.4}

Inside Tanks _____ 09 IRC NFPA 31

- Inside tanks > 60 gal only on lowest floor EXC _____ [2201.2X] {7.5.4}
- Spill containment & no floor or open space below _ [2201.2X] {7.5.5}
- Tanks > 10 gal min 5 ft. from any fire or open flame [2201.2.1] {7.5.7}

Abandoned Tanks _____ 09 IRC NFPA 31

- Temporarily unused tanks emptied, cleaned & fill pipe filled with concrete & all other piping capped [2201.7] {7.12}
- Remove per International Fire Code or NFPA 30 [2201.7] {7.14}
- Also remove exterior piping of abandoned tanks [2201.7] {7.13.1}

Fill & Vent Piping**09 IRC NFPA 31**

- Each tank or tank system req's separate fill & vent **F34** _ [2203.4] {7.5.9}
- Fill & vent pipes must terminate outside building **F34** _ [2203.3&5] {8.4.7}
- Tank fill & vent piping min schedule 40 steel or brass __ [2202.1] {8.2.1.1}
- No cast-iron fittings _____ [2202.2] {8.3.4}
- Fill pipe min 1/4 in. & pitched toward tank _____ [manu] {8.5.1}
- Vent pipe min 1/4 in. & pitched toward tank _____ [2203.4] {8.6.1}
- Fill piping min 2 ft. from building openings _____ [2203.3] {8.5.2}
- Each tank req's fill gauge (only inside tanks IRC) _____ [2201.5] {7.5.10}
- Fill gauge may be visual or audible _____ [n/a] {8.10.3}
- No glass gauges or gauges subject to breakage _____ [2201.5] {8.10.4}
- Vent termination min 2 ft. from building openings _____ [2203.5] {8.6.2}
- Vent terminal screened & with weatherproof cap **F34** _ [2203.5] {8.6.3&4}
- Vent terminal above snow level & visible from fill _____ [2203.5] {8.6.2.1&2}

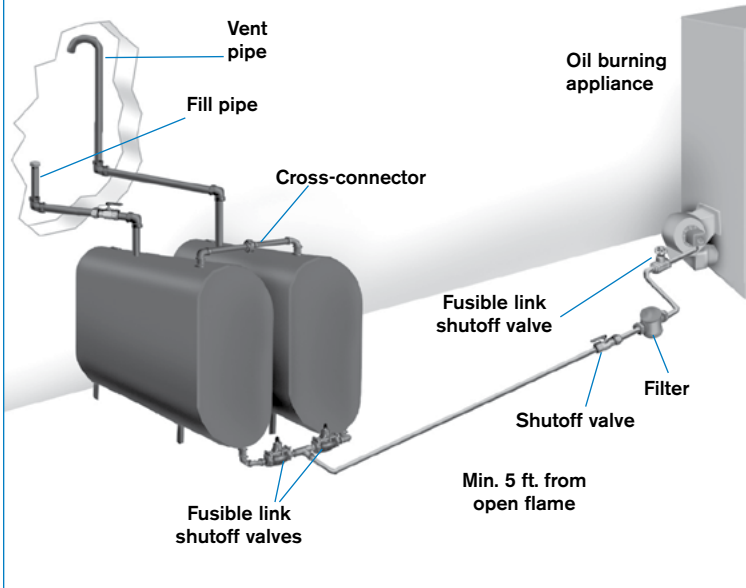
Piping & Tubing to Appliances**09 IRC NFPA 31**

- Fuel supply schedule 40 steel or brass or seamless Cu, brass, or steel tubing _____ [2202.1] {8.2.2.1}
- Tubing req's corrosion-resistant coating or protective conduit to within 12 in. of tank or appliance _____ [n/a] {8.2.2.2.1}
- Min tubing size ³/₈ in. outside diameter Type L Cu _____ [2203.2] {8.7.1}
- Manual shutoff req'd at tank outlet _____ [2204.2] {8.7.1}
- Shutoff req'd at building entrance if tank outdoors _____ [n/a] {9.2.11.1}
- Cross-connection of tanks to 660 gal total OK **F34** _____ [2203.6] {8.9.1}
- Fusible link safety shutoffs req'd within 6 in. of filter on tank side & within 12 in. of inlet connection to burner **F34** _____ [n/a] {8.10.6}¹⁴

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FIG. 34

Indoor Oil Tanks



Compared to other fuels, heating oil has the greatest number of Btus per gallon (approximately 139k). It can be safely stored indoors as it is less readily ignitable than gasoline or propane. It is a commonly used fuel in the Northeast & relatively rare in western states or areas where natural gas is readily available. It displaced coal as the primary fuel source in many areas of the country. Heating oil typically has a red dye added to distinguish it from diesel oil.

PROPANE (LP GAS)

The IRC & UMC defer to NFPA 58, the *Liquefied Petroleum Gas Code*, published by NFPA. LP gas liquefies under moderate pressure & vaporizes upon release of the pressure. Horizontal storage tanks are manufactured to standards from the American Society of Mechanical Engineers (ASME) & portable cylinders are manufactured to U.S. Department of Transportation (DOT) standards. As a liquid or gas, propane is heavier than air & when gas leakage occurs in a pit or basement, an invisible pool of combustible material can accumulate until it rises to the level of an ignition source, such as the pilot or igniter on an appliance. One method of protection against this hazard is an interlock that would shut off the gas flow. Another method is to install a drain from the area containing the equipment & piping, as in [F36](#).

Horizontal ASME Tanks

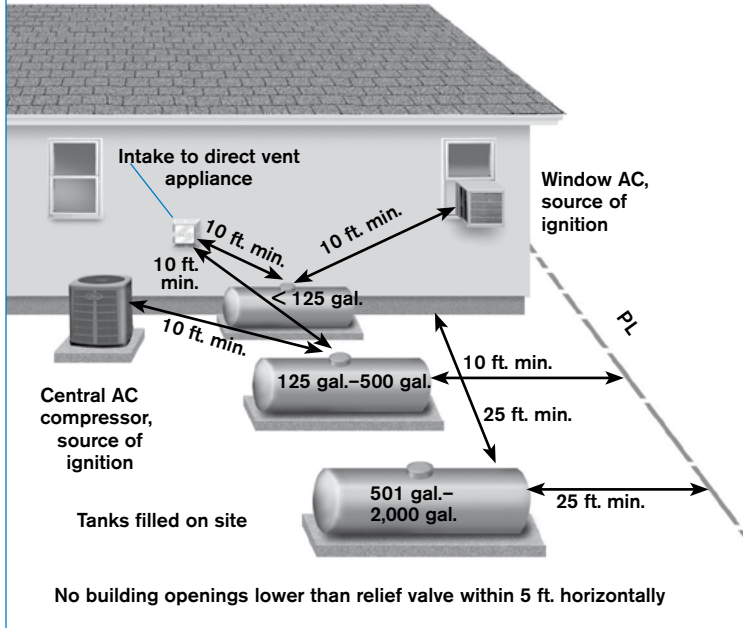
NFPA 58

- Tank clearances [F35](#) _____ [6.3.3&8&9 & Annex I]
- Tank not allowed indoors _____ [6.2.1]
- Protect tanks from damage by vehicles _____ [6.6.1.2]
- Masonry or concrete foundation req'd under tanks _____ [6.6.3.1]
- Supports must be corrosion resistant & noncombustible _____ [6.6.3.5]
- Secure tank against flotation in flood hazard areas _____ [6.6.1.6]
- Secure tanks in seismic areas as approved by local AHJ _____ [5.2.4.3D]
- Min 10 ft. from easily ignitable material (weeds, firewood, dry grass) _____ [6.4.5.2]
- Replace containers with excessive dents or corrosion _____ [5.2.1.4]

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FIG. 35

Propane Tank Clearances



Tank Valves & Regulators

NFPA 58

- Vapor & liquid shutoff valve req'd _____ [5.7.4.1]
- Shutoff valve req'd to be readily accessible _____ [5.7.8.1 G]
- PRV req'd _____ [5.7.4.1 & 5.7.2.5]
- Rain cap req'd over PRV _____ [6.7.2.4]
- No shutoff valve between tank & PRV _____ [6.7.2.8]
- No shutoff valves on outlet of PRV _____ [6.7.2.10]
- First-stage or high-pressure regulator req'd outdoors _____ [6.8.1.4]
- Regulator must be designed to resist elements (freezing) _____ [6.8.1.5]

Piping & Tubing Systems

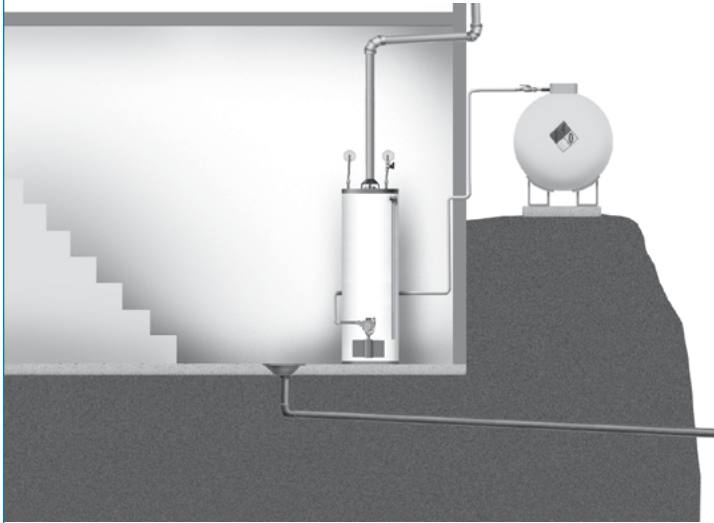
NFPA 58

- Piping material black, galvanized, brass, PE, or polyamide AMI _____ [5.9.3.1]
- Tubing brass, Cu L or K, CSST PE, or polyamide AMI _____ [5.9.3.2]
- Plastics OK only underground & outdoors _____ [6.9.4.1]
- Min 14AWG tracer wire req'd to be run with plastic pipe _____ [6.9.4.6]
- No cast-iron pipe fittings _____ [5.9.4.1]
- Buried metal pipe min 12 in. cover (18 in. if damage likely) EXC _____ [6.8.3.12]
 - Conduit or shielding OK when 12 in. cover not possible _____ [6.9.3.12]
- Underground metal piping req's corrosion protection _____ [6.9.3.14]
- LP gas piping not OK as grounding electrode _____ [6.9.3.15]
- Grounding & bonding for static electricity protection not req'd _____ [6.22.1.3]
- Dielectric fitting req'd between above- & below-ground pipe _____ [6.9.3.16]¹⁵
- Dielectric fitting to be above ground & outdoors _____ [6.9.3.16]¹⁵

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FIG. 36

Propane Appliance in Basement



To prevent accumulation of an explosive concentration of propane from a leak, below-grade pits or basements should have a detector interlocked to the fuel line or a gravity drain to daylight.

FREESTANDING FIREPLACE STOVES (SOLID FUEL)

The IRC (section 1414.1) req's fireplace stoves to be listed, labeled & tested in accord with UL737, which in turn references the current edition of NFPA 211. NFPA 211 also recognizes unlisted appliances & provides specific rules to maintain safe clearances & protection of adjacent combustible material.

Fireplace Stoves & Solid-Fuel Room Heaters

NFPA 211

- Install listed equipment per L&L & AMI _____ [12.1]
- Install unlisted equipment AMI & per NFPA 211 _____ [12.1]
- Fire screen req'd per L&L _____ [12.1]
- Not in alcove or enclosed space < 512 cu. ft. unless so listed _____ [12.2.2]
- Not OK in garage _____ [12.2.4]
- Noncombustible floor material 18 in. beyond stove on all sides EXC _____ [12.5.1.4]
 - L&L floor protection assemblies OK AMI _____ [12.5.1.5]
- List appliance floor protection AMI _____ [12.5.1.1]
- Unlisted appliance floor protection: _____ [12.5.1.2]
 - If legs provide ≥ 6 in. of ventilated clearance under stove, 2 in. thick masonry + metal **F37** _____ [12.5.2.1]
 - If legs provide 2 in. to 6 in. of ventilated clearance, 4 in. thick hollow masonry + metal **F37** _____ [12.5.2.2]
- If legs provide < 2 in. clear, floor req'd to be noncombustible _____ [12.5.2.3]
- Fuel storage (firewood) min 36 in. from appliance _____ [T12.6.1 note a]
- 36 in. side, top & front clearance from appliance to combustibles EXC [12.6.1]
 - Listed appliance clearance to combustibles AMI _____ [12.6.1.1]
 - Lesser clearances OK per **T9, F37,38** _____ [12.6.2.1]

Connectors

NFPA 211

- Must be accessible for inspection, cleaning & replacement _____ [9.7.1.1]
- Single wall min 18 in. clear to combustibles EXC **F37** _____ [T9.5.1.1]
 - Lesser clearance with approved clearance-reduction system **T9** _____ [9.5.1.2.1]

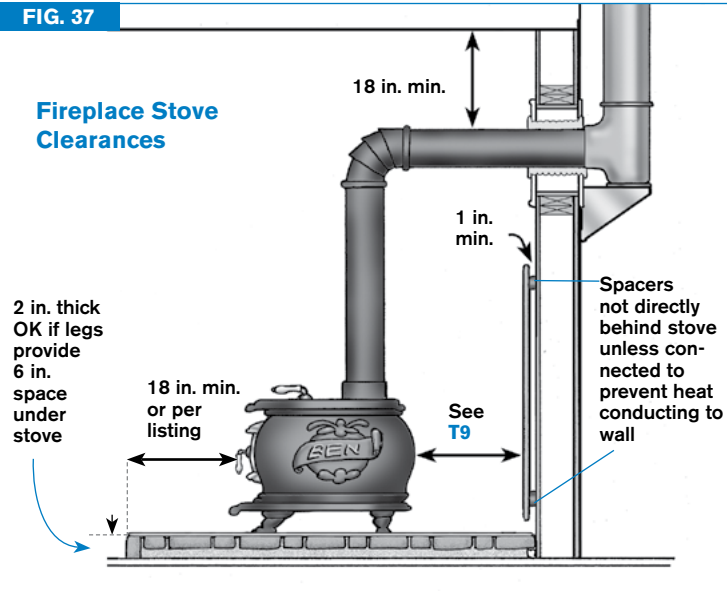
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Connectors (cont.)

- Not to pass through wall EXC _____ [9.7.4]
 • Listed pass-through system _____ [9.7.4]
 System designed per NFPA 211 figure 9.7.5 _____ [9.7.5]
 Maintain min ¼ in./ft. rise from appliance collar to chimney _____ [9.7.7]

NFPA 211**Connection to Masonry Fireplace (Stoves & Fireplace Inserts) NFPA 211**

- Connector must extend to flue liner—not just to firebox _____ [12.4.5.1]
 If connector enters direct through chimney wall above smoke chamber, noncombustible seal req'd below entry _____ [12.4.5.1]
 No dilution of combustion products in flue with habitable space air _____ [12.4.5.1]
 Flue not less than size of appliance collar _____ [12.4.5.1]
 Flue diameter max 2× appliance collar if chimney walls exposed to exterior below roof _____ [12.4.5.1]
 Flue diameter max 3× appliance collar if no part of chimney walls exposed to exterior below roof _____ [12.4.5.1]
 Installation must allow for chimney inspection & cleaning _____ [12.4.5.1]

FIG. 37**Fireplace Stove Clearances****RECOMMENDED INSPECTIONS OF EXISTING CHIMNEYS NFPA 211 14.3**

Level 1: All readily accessible areas of chimney, structure & flue. To be performed annually, during routine cleaning & when replacing appliances with a similar appliance.

Level 2: Level 1 + video scan of flue. Verify clearances & suitability of flues. To be performed upon resale of property; upon addition or removal of appliances, adding or replacing with dissimilar appliance, or after operating malfunction.

Level 3: Level 1 & 2 + removal of components as necessary to gain access. To be performed when Level 1 or Level 2 cannot identify conditions deemed critical to renewed or continued use; fire or damage investigations.

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CLEARANCE REDUCTION SYSTEMS

Clearance reduction systems are used with solid-fuel, oil-burning & gas-burning appliances. They provide a practical means of installing appliances in spaces where they otherwise might not fit or would take too much space in a room. They may not be used with appliances in closets (alcoves); those appliances req clearances in accordance with the nameplate label. Tables 9.5.1.2 & 12.6.2.1 in NFPA 211 have the same values as **T9** for fireplace stoves, which otherwise req 36 in. clearance. The UMC uses **T9** as Table 5-3 & in NFPA 54 it is table 10.2.3(b).

General

- Clearance reductions allowed per **T9** _____ [1306.2, 1803.3.4, 2409.2]
- Gas appliance & vent connector reductions per **F39, T9** _____ [2409.2]
- Solid fuel appliances not allowed to be reduced to < 12 in. EXC ____ [1306.2.1]
 - Appliances listed for < 12 in. & installed AMI _____ [1306.2.1]
- No spacers directly behind appliance or connector **F37,38** _____ [F1306.2]
- Spaces noncombustible (stacked washers, conduit, etc.) _____ [F1306.2]
- Ventilated air space min 1 in. & open at edges **F37, 38, T9** _____ [1306.2]
- Air space in corner open top & bottom **F38, T9** _____ [1306.2]
- Air space on flat wall open top & bottom or side & top **F37, T9** _____ [1306.2]

09 IRC

- Clearance reductions allowed per **T9** _____ [1306.2, 1803.3.4, 2409.2]
- Gas appliance & vent connector reductions per **F39, T9** _____ [2409.2]
- Solid fuel appliances not allowed to be reduced to < 12 in. EXC ____ [1306.2.1]
 - Appliances listed for < 12 in. & installed AMI _____ [1306.2.1]
- No spacers directly behind appliance or connector **F37,38** _____ [F1306.2]
- Spaces noncombustible (stacked washers, conduit, etc.) _____ [F1306.2]
- Ventilated air space min 1 in. & open at edges **F37, 38, T9** _____ [1306.2]
- Air space in corner open top & bottom **F38, T9** _____ [1306.2]
- Air space on flat wall open top & bottom or side & top **F37, T9** _____ [1306.2]

FIG. 38

Clearance Reduction System for Fireplace Stove

The spacers that hold out the clearance reduction system from the wall must not be located directly behind the appliance or connector. The appliance's distance from the wall must be in accordance with **T9**.

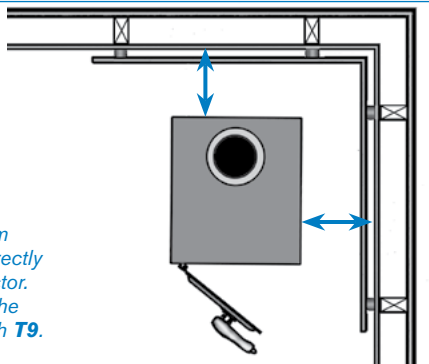


TABLE 9 CLEARANCE REDUCTION (in.) [T1306.2] {T5-3}

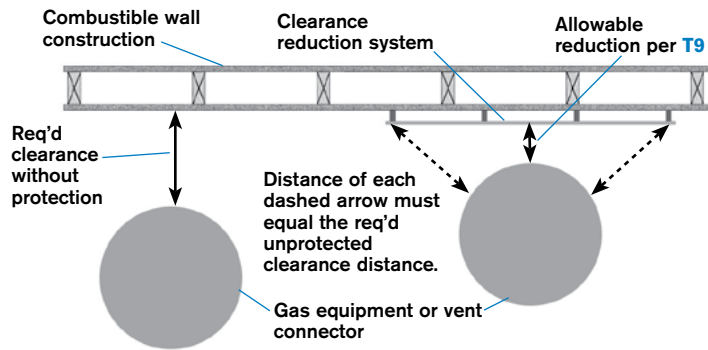
Unprotected	36	18	12	9	6	36	18	12	9	6
Method ^A	Protected Wall Clearance					Protected Ceiling Clearance				
3½ in. masonry	24	12	9	6	5	n/a	n/a	n/a	n/a	n/a
3½ in. masonry with air space ^B	12	6	6	6	6	n/a	n/a	n/a	n/a	n/a
½ in. insulation board over fiber or mineral wool batts ^C	18	9	6	5	3	24	12	9	6	4
½ in. insulation board with air space ^B	12	6	4	3	3	18	9	6	5	3
24 gage Zi steel with air space ^B	12	6	4	3	2	18	9	6	5	3
1 in. insulating batts between 2 sheets 0.024 Zi steel with air space	12	6	4	3	3	18	9	6	5	3
24 gage Zi steel over reinforced batts with air space ^B	12	6	4	3	3	18	9	6	5	3

- A. Clearances are measured in closest stretched-string distance. In no case can a solid-fuel burning appliance clearance be reduced to < 12 in.
- B. Air spaces must be a min. of 1 in. & ventilated by being open at bottom & top edges or sides & top edges. Spacers must be noncombustible & cannot be mounted directly opposite the appliance or connector.
- C. Insulation fiber or mineral wool must have thermal conductivity ≤ 1.0 Btu/sq. ft. Mineral wool blankets or board min. density 8 lbs./cu. ft. & min. melting point 1500°F.

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FIG. 39

Clearance Reduction for Gas Equipment or Gas Vent Connectors



ELECTRIC HEAT

Electric resistance heating can be in the form of central forced-air furnaces, baseboard heaters, radiant ceiling panels, duct heaters & 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 ensure that it does not also become a heater.

General

- | | | | | |
|--|-----------|---------------|---------------|-----------|
| <input type="checkbox"/> Circuits considered continuous load _____ | [3702.10] | 09 IRC | 11 NEC | {424.3B} |
| <input type="checkbox"/> Circuits for continuous loads sized to 125% of load _____ | [3701.2] | | | {210.20A} |
| <input type="checkbox"/> All electric heating equipment must be L&L _____ | [3403.3] | | | {424.6} |
| <input type="checkbox"/> Factory-applied nameplates must include: _____ | [1303.1] | | | {424.6} |
- Label with manu name, model & serial no.
 - Operating & maintenance instructions or publication no. 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 without lock installed ____ [T4101.5] {424.19}

Baseboard Heaters

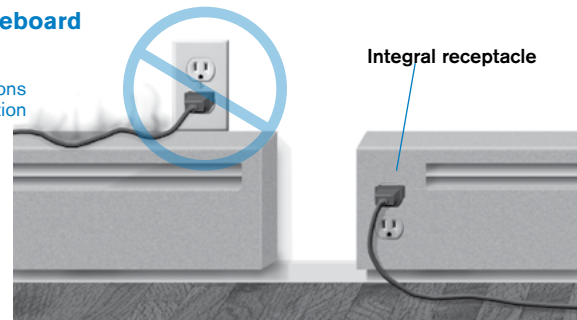
09 IRC **11 NEC**

- Must be L&L & 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 **F40** _____ [1405.1] {424.9}

FIG. 40

Electric Baseboard Heaters

Listing instructions prohibit installation of baseboard heaters under receptacles



Heating Cables in Concrete or Masonry Floors

11 NEC

- Min 1 in. 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}

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Electric Radiant Heat Systems**09 IRC 11 NEC**

- Install AMI _____ [1406.1] {424.93A1}
- Install panels parallel to framing _____ [1406.3] {424.93B2}
- Fasteners > ¼ in. from heating element _____ [1406.3] {424.93B3}
- Min 8 in. distance from surface-mounted fixture boxes _____ [n/a] {424.93A3}
- Min 2 in. 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 2 in. clearance _____ [n/a] {424.94}
- Wiring above heated ceiling considered as 50°C ambient
unless over ≥ 2 in. 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 < 4 ft. from heat pump/air-conditioning, both must be listed
for such clearances _____ [1407.3] {424.61}
- Install with 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}

TABLE 10**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.

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 100 sq. in. [n/a] {504.3.2}
- Flexible transition ducts L&L & single piece [1502.4.3] {504.3.2.1X}
- Connectors not concealed & max 8 ft. {6 ft. UMC} **F41** [1502.4.3] {504.3.2.1X}
- Duct smooth metal, no screws in air flow **F41** [1502.4.1] {504.3.2.1}
- Support & secure at max 4 ft. intervals [1502.4.2]¹⁶ {n/a}
- Duct min 4 in. diameter [1502.4.1]¹⁷ {504.3.2}
- IRC: Max length AMI or 25 ft. minus bends per **T10** [1502.4.4]¹⁸ {n/a}
- UMC: Max length 14 ft. minus 2 ft. each 90° turn > 2 [n/a] {504.3.2.2}
- No mixing with or passage through other systems [1502.2] {504.3.1}
- End outside in backdraft damper & no screens **F42** [1502.3] {504.3.1}
- Min 3 ft. from other building openings [1502.3] {n/a}
- Shield plates < 1 ¼ in. from framing surface **F41** [1502.5]¹⁹ {n/a}
- Length of concealed duct on tag ≤ 6 ft. of connection [1502.4.5]²⁰ {n/a}

Gas Clothes Dryer Exhaust**09 IRC 09 UMC**

- Closet req's makeup air opening [min 100 sq. in. IRC] [2439.4] {905.3A}
- Flexible transition ducts (connectors) L&L & single
piece [2439.5.4] {905.4C}
- Connectors not concealed [& max 8 ft. in IRC] **F41** [2439.5.4] {905.4C}
- Duct smooth metal, no screws in air flow **F41** [2439.5.1] {905.4B}
- Support intervals max 4 ft. spacing [2439.5.2]¹⁶ {n/a}
- Duct min 4 in. diameter [2439.5.1] {n/a}
- Max 35 ft. minus bends per **T10** or AMI **F41** [2439.5.5.1]¹⁸ {n/a}
- No mixing with or passage through other systems [2439.1] {905.4A}
- End outside in backdraft damper & no screens **F42** [2439.3] {n/a}
- Shield plates < 1 ¼ in. from framing surface **F41** [2439.5.3]¹⁹ {n/a}
- Length of concealed duct on tag ≤ 6 ft. of connection [2439.5.6]²⁰ {n/a}

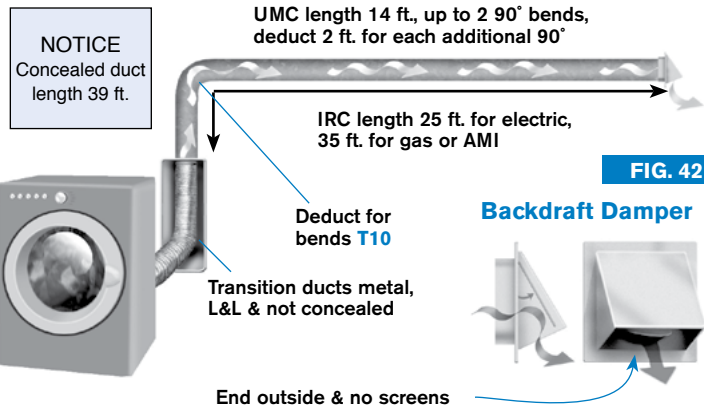
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FIG. 41

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 to the interior of the duct as they accumulate lint, which leads to blockage.



Dryers with specific manu instructions are allowed longer lengths than otherwise permitted by code.

VENTILATION & EXHAUST SYSTEMS

Building codes tell us when we must provide ventilation for interior spaces & mechanical codes tell us how to provide it. These topics overlap with energy codes & green building standards. The standard recognized in many energy codes is *ASHRAE 62.2, Ventilation & Acceptable Indoor Air Quality in Low-Rise Residential Buildings*. Check with your local jurisdiction to determine if these standards apply in your area. Whole-house ventilation is intended to dilute the contaminants from materials found in furnishings, furniture & building products. Localized exhaust removes contaminants from specific sources, such as kitchens & baths.

Whole Building Ventilation

ASHRAE 62.2

- Mechanical exhaust, supply, or combination system req'd _____ [4.1]
- Min ventilation rate must comply with **T11** _____ [4.1]
- Local exhaust fans can supply whole-house continuous ventilation _____ [4.2]
- Central-fan-integrated supply timer must operate min 10% of time _____ [4.4X]
- OK to override with "fan on" control at thermostat _____ [4.4]
- Whole building or continuous ventilation fans max 1.0 sone EXC _____ [7.2.1]
 - Heating, venting & air-conditioning (HVAC) air handlers _____ [7.2X]
 - Remote-mounted fans with min 4 ft. ductwork between grill & fan _____ [7.2X]

TABLE 11 MIN. VENTILATION RATES (CFM) (ASHRAE 62.2 T4.1A)

Floor Area (sq. ft.)	Number of Bedrooms				
	0-1	2-3	4-5	6-7	> 7
< 1,500	30	45	60	75	90
1,501-3,000	45	60	75	90	105
3,001-4,500	60	75	90	105	120
4,501-6,000	75	90	105	120	135
6,001-7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

The requirement can be met from multiple sources, such as 2 or more continuously operating exhaust fans adding up to at least the req'd amount in the table.

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Local Exhaust

ASHRAE 62.2

- Mechanical exhaust req'd each kitchen _____ [5.1]
- Kitchen exhaust min 100cfm intermittent or 5ACH continuous ___ [T5.1 & T5.2]
- Vented range hood req'd if 100 cfm is < 5 kitchen ACH _____ [T5.1]
- Bathroom 50cfm intermittent or 20cfm continuous _____ [T5.1 & T5.2]
- Controls may be humidistat, timer, or occupancy sensor provided that occupant has ability to override control _____ [5.2.1]

Additional Air Quality Requirements

ASHRAE 62.2

- 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 15cfm/100 sq. ft.) _____ [6.4]
- Door from attached garage to house weatherstripped _____ [6.5.1]
- Duct leakage outside pressure boundary max 6% _____ [6.5.2]
- Central furnace or AC system filter min efficiency reporting value MERV 6 _____ [6.7]
- Habitable spaces req ventilation openings \geq 4% of floor area _____ [6.6.1]
- Utility rooms req ventilation openings \geq 4% of floor area EXC _____ [6.6.2]
 - Utility rooms with dryer exhaust duct _____ [6.6X]

Bathroom Exhaust & Ventilation

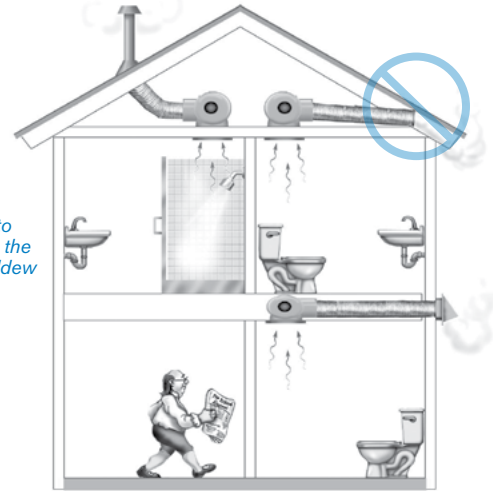
09 IRC ASHRAE

- Ventilation from 1.5 sq. ft. window opening OK or _____ [303.3] {Ø}
 - Mechanical ventilation 50cfm intermittent or 20cfm continuous direct to exterior (req'd in ASHRAE 62.2) **F43** _____ [303.X] {5.1}
- Air may not be exhausted into attic _____ [1501.1] {n/a}
- Toilet rooms req vent openings \geq 4% of floor area EXC _____ [n/a] {6.6.2}
 - Toilet compartments within bathrooms _____ [n/a] {6.6X}
- Air exhaust & intake openings req screens _____ [303.5] {n/a}

FIG. 43

Bathroom Exhaust Venting

Exhaust air is vented to the outside to prevent the buildup of mold or mildew from condensation.

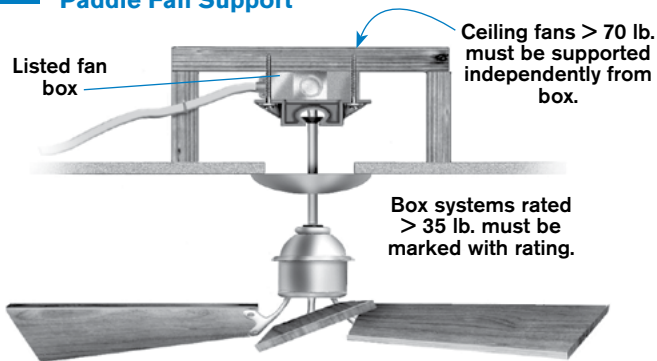


Ceiling-Suspended Paddle Fans **F44**

09 IRC 11 NEC

- Listed box for fan support (no standard boxes) _____ [3905.9] {314.27C}
- Listed fan boxes without weight marking OK up to 35 lb. [3905.9] {314.27C}
- Fan > 35 lb. & < 70 lb., fan box L&L for suitable weight _ [3905.9] {314.27C}
- Independent support for fans > 70 lb. _____ [3905.9] {314.27C}

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FIG. 44 Paddle Fan Support

KITCHENS

Freestanding Ranges

- | | | | |
|---|---------------|---------------|----------|
| <input type="checkbox"/> Must be listed as household type—not commercial _____ [2447.3] | 09 IRC | 09 UMC | {n/a} |
| <input type="checkbox"/> Vertical clearance to combustibles min 30 in. EXC _____ [1901.1] | | | {916.1B} |
| • Lesser clearances AMI _____ [1901.1] | | | {916.1B} |
| • 24 in. OK with metal hood or metal over millboard _____ [n/a] | | | {916.1B} |
| <input type="checkbox"/> Side clearance to combustibles AMI EXC _____ [1901.2] | | | {916.1A} |
| • 6 in. min sides & rear for unlisted appliances _____ [Ø] | | | {916.1A} |

Built-in Ranges

- | | | | |
|--|---------------|---------------|------------|
| <input type="checkbox"/> Install AMI _____ [1901.2 & 2447.1] | 09 IRC | 09 UMC | {916.2A&C} |
| <input type="checkbox"/> Vertical clearance to combustibles min 30 in. EXC F45 _____ [1901.1] | | | {916.2B} |
| • Lesser clearances AMI F45 _____ [1901.1] | | | {916.2B} |
| • 24 in. OK with metal hood or metal over millboard _____ [n/a] | | | {916.2B} |
| <input type="checkbox"/> Must be level _____ [n/a] | | | {916.2D} |

Hood for Open-Top Broilers

- | | | | |
|--|---------------|---------------|---------|
| <input type="checkbox"/> Hood req'd & must extend as wide as broiler unit _____ [1505.1] | 09 IRC | 09 UMC | {920.3} |
| <input type="checkbox"/> Min ¼ in. clearance to combustibles _____ [1505.1] | | | {920.3} |
| <input type="checkbox"/> Min 24 in. from cooking surface to combustible materials [1505.1] | | | {920.3} |
| <input type="checkbox"/> Must be ducted to outdoors & have backdraft damper _____ [1505.1] | | | {504.1} |

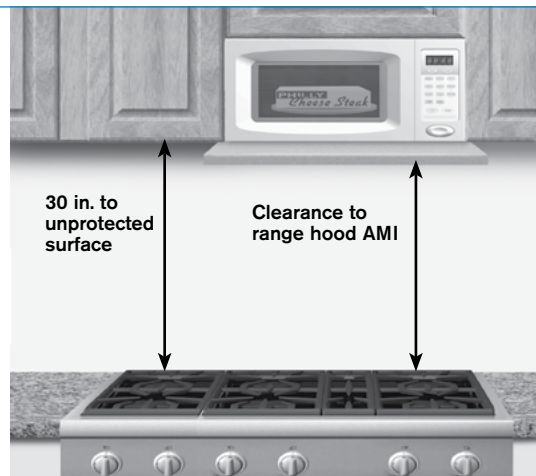
Range Hoods

- | | | | |
|---|---------------|---------------|----------|
| <input type="checkbox"/> Must go outdoors (min 3 ft. from openings UMC) EXC _____ [1503.1] | 09 IRC | 09 UMC | {504.5} |
| • Ductless (recirculating) range hoods OK _____ [1503.1X] | | | {303.1} |
| <input type="checkbox"/> Exterior openings screened with ¼ in. to ½ in. mesh _____ [1503.1] | | | {n/a} |
| <input type="checkbox"/> Min 100 cfm intermittent or 25 cfm continuous _____ [1503.3] | | | {n/a} |
| <input type="checkbox"/> PVC OK for downdraft duct under slab _____ [1503.2X] | | | {504.2X} |

FIG. 45

Range Clearances

Lesser clearances allowed for listed appliances per terms of listing.



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GLOSSARY

A

ABS (acrylonitrile-butadiene-styrene): A plastic pipe that is usually black and used for DWV. It can also be used for building water supply and for vent piping of high-efficiency condensing appliances.

Accessible: Capable of being exposed without damage to the building or component structure or finishes, and that may req removal of access doors or fasteners req tools.

AHJ (Authority Having Jurisdiction): An organization responsible for enforcing the code, typically the building department & its authorized representatives.

Airbreak: A physical separation in which a discharge pipe from a fixture, appliance, or device drains indirectly into a receptor & enters below the flood level rim of a receptor, such as a clothes washer standpipe.

Air conditioning: The process of heating, cooling, humidifying, dehumidifying, filtering, or otherwise treating air in a building. Most nontrade persons relate this term to cooling only.

Air handler: A blower or fan enclosed in a metal box used for the purpose of distributing supply air to a room, space, or area.

Alcove: A room or space such as a closet that is not large in relationship to the appliances within it. It would be less than 16 times the volume of a boiler or 12 times the volume of a furnace. For measurement purposes, only the portion of the room up to 8 ft. above the floor counts in determining volume. *Also see "Room large in comparison to size of equipment."*

Approved: Accepted by the Authority Having Jurisdiction (AHJ). UL & other testing laboratories do not approve materials; they test products & determine their conformity to published standards. Only the AHJ can approve them.

B

Backflow: A flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from any source other than its intended source.

Bathroom: In ASHRAE, a bathroom is a room containing a tub, shower, spa, or other source of moisture. A half bath contains only a water closet & lavatory & is not considered a bathroom. In the NEC, a bathroom is a room containing a basin & another plumbing fixture.

Btu (British thermal unit): The quantity of heat necessary to raise the temperature of 1 lb. of water 1°F.

Building thermal envelope: The basement walls, exterior walls, floor, roof & any other building element that encloses conditioned spaces.

C

Central-fan-integrated supply system: A method of supplying whole-house ventilation through a makeup air duct connected to the supply ducts of a forced-air system & a timer on the furnace fan control.

Check valve: A device used to prevent the flow of liquids in a direction not intended in the design of the system. Check valves are not backflow preventers. They are often used in solar systems.

Chimney: A primarily vertical structure containing one or more flues, for the purpose of carrying gaseous products of combustion & air from an appliance to the outside atmosphere. Factory-built chimneys must be listed & labeled. Masonry chimneys are field constructed of solid masonry units, bricks, stones, or concrete.

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Chimney connector: A pipe connecting a fuel-burning appliance to a chimney flue.

Closet: See “Alcove.” **F32**

Combustible material: Any material not defined as noncombustible. The extent of combustibility of surface materials is measured in flame spread index & smoke-developed index. Many HVAC components req specified clearances from combustible material, including the paper facing of gypsum board.

Combustion air: Air req’d for combustion of a fuel. It includes air that is burned with the fuel, air for dilution of the flue gases and that is introduced into draft hoods, and ventilation air that cools appliances.

Common vent: A pipe venting two trap arms on the same branch, either back to back or one above another.

Concealed: Not exposed to view without removal of building surfaces or finishes.

Confined space: A room or space having a volume less than 50 cu. ft. for each 1,000Btu input rating of all fuel-burning appliances in the room or space.

CPVC (chlorinated polyvinyl chloride): Plastic pipe designed for hot & cold water. Water distribution pipe is typically cream-colored, and orange CPVC is used for automatic fire sprinkler piping.

D

Decorative appliance for installation in fireplaces: An assembly with artificial logs & with gas burners to simulate a solid-fuel fire, installed inside a fireplace otherwise capable of burning solid fuel. They can be either manually or automatically operated. If automatic, they must include a flame safeguard device.

Decorative shroud: A partial enclosure for aesthetic purposes that surrounds or conceals the termination of a chimney or vent. Decorative shrouds must be specifically listed for the chimney or vent assembly & are often installed incorrectly.

Dilution air: Air that combines with flue gases at the draft hood of an appliance. See “Combustion air.”

Direct-vent appliances: Appliances that are constructed & installed so that all air for combustion is derived from the outside atmosphere & all flue gases are discharged directly to the outside atmosphere, usually by a coaxial flue pipe inside the combustion air pipe.

Draft: The flow of gases or air through a chimney or flue caused by pressure differences. An induced draft appliance has a fan to overcome the resistance of the combustion chamber while still delivering flue gas to the vent at nonpositive pressure relative to the atmosphere. A forced draft appliance delivers flue gas under positive pressure. Natural draft is caused by the height of the chimney & the difference in temperature of hot gases & outside atmosphere.

Draft hood: A nonadjustable device integral to an appliance or made part of the appliance connector. It provides for the escape of flue gases from the appliance in the event of insufficient draft, backdraft, or stoppage. A draft diverter (typical on WH) prevents backdraft from entering the appliance & neutralizes the stack effect on the operation of the appliance.

Draft regulator: A device that functions to maintain a desired draft in the appliance by automatically reducing the draft to the desired value. These are usually adjustable, such as the barometric damper on an oil-burning appliance flue. A double-acting barometric draft regulator is free to move in either direction & protect against both excessive draft (that could allow the flame to lift) & backdraft.

Duct: A continuous passageway for the transmission of air (usually forced) made of factory-built components.

E

Energy-recovery ventilator (ERV): Same as heat-recovery ventilator, with a heat exchanger core that removes humidity. ERVs req a drain to remove water that condenses in them.

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Evaporative cooler: A device used for reducing the sensible heat of air for cooling by the process of evaporation of water into an airstream. Also known as a "swamp cooler." Evaporative coolers are used in hot, dry climates & for makeup air in commercial kitchens.

F

Factory-built fireplace: A fireplace composed of listed factory-built components assembled in accordance with the terms of the listing to form the completed fireplace. The appliance must be suitable for solid fuel & be equipped with a listed & properly installed chimney.

Fan-assisted appliance: An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber &/or heat exchanger.

Fireblock: Building materials installed to resist the free passage of flame to other areas through small concealed spaces of the building.

Fireplace stove: A freestanding solid-fuel burning device designed to be operated with the firebox door either open or closed.

Firestop: Until the early 1990s, this term was used for what today is called fireblocking. A penetration firestop assembly is a group of materials installed to resist free passage of flame through an assembly, typically around a duct, vent, or chimney passing through a rated ceiling, floor, or wall.

Flame safeguard: A device that will automatically shut off the fuel supply to a main burner or group of burners when the means of ignition of those burners becomes disabled & when flame failure occurs.

Flue: A passageway intended to carry hot gases through a chimney. The term is also used as a substitute for "vent."

Flue collar: The outlet of an appliance designed for the attachment of a draft hood, vent connector, or venting system.

Flue gases: Products of combustion plus excess air in appliance flues or heat exchangers.

Forced draft: A vent system using a fan or other mechanical means to expel flue gases under positive static vent pressure.

Furnace: A device that is completely self-contained & designed to supply heated air to spaces remote from or adjacent to the furnace location. A central furnace uses ducts to supply heat to spaces.

G

Gas connector: Tubing or piping that connects the gas supply piping to the appliance.

H

Habitable room: A room used for living, sleeping, eating, or cooking. Bathrooms, closets, halls, storage spaces & laundry rooms are not considered habitable rooms.

Hangers: See "Supports."

Hearth: The floor area with the fire chamber of a fireplace or fireplace stove.

Hearth extension: The surfacing applied to the floor area in front of & to the sides of the hearth opening of a fireplace or fireplace stove.

Heat pump: A system that uses the change of state of a refrigerant to extract heat from one substance & transfer it to another area of the same or a different substance. Heat pumps can provide both heating & cooling.

Heat-recovery ventilator (HRV): A combination ventilation system that replaces indoor air with outdoor air that passes through a heat exchanger. The heat exchanger tempers the outdoor air to minimize energy losses. HRVs that also remove humidity from the indoor air are referred to as energy-recovery ventilators.

Horizontal: Any pipe or vent that is less than 45° from horizontal.

H.S.P.F. (Heating seasonal-performance factor): The measure of a system's efficiency in heating mode. The higher the number, the more efficient the system.

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In sight: See “*Within sight.*”

Indirect-fired WH: A water heater with a storage tank equipped with a heat exchanger used to transfer heat from an external source to heat potable water. The storage tank could derive its heat source from an external source, such as solar or a boiler, or an internal source.

Induced draft appliance: An appliance that utilizes a fan to overcome resistance of a heat exchanger & to assist in the delivery of flue gases to the appliance outlet (flue collar). Induced draft appliances typically deliver the flue gases to the flue collar at non-positive pressure due to the temperature of those gases relative to outside atmosphere. See “*Vented gas appliance categories.*”

Induced draft burner: A burner that depends upon a draft that is induced by a fan that is integral to the appliance & is downstream from the burner.

J

Joint: Connection between two pipes:

Brazed joint: Joint obtained by joining metal parts with alloys that melt at temperatures > 840°F (449°C), but lower than the melting temperature of the parts to be joined.

Expansion joint: Loop, return bend, or return offset that accommodates pipe expansion & contraction.

Flexible joint: Joint that allows movement of one pipe without deflecting the other pipe.

Mechanical joint: Joint that uses compression to seal the joint.

Slip joint: Joint that incorporates a washer or special packing material to create a seal.

Soldered joint: Joint obtained by joining of metal parts with metallic mixtures or alloys that melt at a temperature < 800°F (427°C) & > 300°F (149°C).

Welded joint or seam: Joint or seam obtained by the joining of metal parts in the plastic molten state.

L

Label: A marking applied on a product that identifies the manu, the function or designation of the product, and the agency that has evaluated a sample of that product.

Labeled: Equipment, materials, or products affixed with a label or other identifying mark to attest that the product complies with identified standards or has been found suitable for a specific purpose. See “*Listed.*”

Liquefied petroleum (LP) gas: LP or propane gas is composed primarily of propane, propylene, butanes, or butylenes or mixtures thereof that are gaseous under normal atmospheric conditions but capable of being liquefied under moderate pressure at normal temperatures. LP gas is typically stored in tanks on site. Unlike natural gas (CH₄), LP gas (C₃H₈) is heavier than air.

Listed: Equipment or materials on a list published by an approved organization that is concerned with product evaluation and that maintains periodic inspection of production of listed equipment or materials. The listing will state that the product meets specified standards or has been found suitable for a specific purpose.

Log lighter, gas-fired: A manually operated solid-fuel ignition device for installation in a vented solid-fuel burning fireplace. These devices are intended to help initiate a fire in a fireplace, as compared to a decorative appliance for installation in a fireplace.

Low-pressure hot-water heating boiler: A boiler furnishing hot water at pressures not exceeding 160 psi or temperatures not exceeding 250°F.

Low-pressure steam-heating boiler: A steam boiler that operates at pressures not exceeding 15 psi.

Luminaire: A complete lighting fixture including the lamp(s), mounting assembly & cover.

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M

Makeup air: Air provided to replace air being exhausted.

N

Nationally Recognized Testing Laboratory (NRTL): A testing facility recognized by OSHA as qualified to provide testing & certification of products & services. Examples of NRTLs are CSA, NDF & UL.

Natural-draft burner: A burner in which proper combustion depends on establishing a draft of flue gases that will rise by the pressure difference between the flue gases & outside atmosphere.

Noncombustible material: Material that passes a test procedure as set forth in ASTM E136 for defining noncombustibility of materials. This includes materials that will not ignite & burn when subjected to fire, or material having a structural base of noncombustible material with a surfacing material not > 1/8 in. thick & a flame-spread index not higher than 50. This does not apply to surface-finish materials, the entire material of which must be noncombustible from the standpoint of clearances to heating appliances.

O

Offset: A combination of elbows or bends in a line of piping that brings a section of pipe or a vent out of line, but into a line parallel with the other section.

Ordinary tightness: Buildings of ordinary tightness are those that do not meet the standards for "unusually tight construction."

P

PEX tubing: Water-supply or hydronic heat tubing made of cross-linked polyethylene. PEX-AL-PEX has a layer of aluminum sandwiched between layers of PEX.

Plenum: A chamber, other than the occupied space being conditioned, that forms part of the air circulation system.

Power vent: See "Forced draft."

Pressure boundary: The boundary separating indoor from outdoor air. A ventilated crawl space or attic would be outside the pressure boundary.

Pressure-relief valve (PRV): A device designed to protect against high pressure & to function as a relief mechanism.

R

Readily accessible: Access that does not req removing a panel or door. For electrical equipment, this also means not having to resort to use of a ladder.

Room heater, circulating: A room heater with an outer jacket surrounding the heat exchanger & with openings at the top & bottom designed to circulate air between the heat exchanger & outer jacket.

Room heater (liquid or gas fuel): A room heater installed in the space to be heated & not connected to duct.

Room heater, radiant: A room heater designed to transfer heat primarily by direct radiation.

Room heater (solid fuel): A solid-fuel burning appliance designed to be operated with the fire chamber door closed. See "Fireplace stove."

Room large in comparison to size of equipment: A room having at least 12 times the volume of a furnace or other air-handling device, or 16 times the volume of a boiler. When the ceiling is greater than 8 ft., the volume is calculated based on an 8 ft. height. See "Alcove."

S

Slope: Fall or pitch along a line of a pipe or vent.

Supports: Devices used to support or secure pipes, fixtures, or equipment.

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T

Ton (cooling): The amount of heat energy req'd to melt 1 ton of ice (288,000 Btus). Air-conditioners & heat pumps are typically sized in terms of tonnage, based on melting 1 ton of ice in 1 day. Therefore 1 ton of AC = 288,000Btus/24hr. = 12,000 Btus. The tonnage of a unit is usually encoded in the model number as a multiplier of 12, i.e., the number 36 would equal a 3-ton unit.

U

Unconfined space: A room or space having at least 50 cu. ft. for each 1,000 Btu of the fuel-burning appliances contained in the room or space.

Unlisted: An appliance not shown to comply with nationally recognized standards by an approved testing agency. An unlisted appliance might still have nameplate instructions. The IRC does not accept unlisted appliances. The UMC leaves their acceptance to the AHJ.

Unusually tight construction: Construction with walls & ceilings having a vapor retarder of 1 perm or less with sealed or gasketed openings, weatherstripping on openable windows & doors, and caulking or sealant at joints. Buildings of unusually tight construction are req'd by many energy codes & have a targeted air infiltration rate < 0.35ACH.

V

Vent (fuel-burning appliances): A passageway for conveying flue gases from an appliance to the outside atmosphere.

Vent, Type B: A vent listed & labeled for use with appliances with draft hoods & other Category I appliances

Vent, Type BW: A vent listed & labeled for use with wall furnaces.

Vent, Type L: A vent listed & labeled for appliances requiring either type L (oil-fired appliance) vents or Type B vents.

Vent connector: A device that connects an appliance to a vent.

Vented decorative gas appliance: A vented appliance that does not provide heat & whose only function is the aesthetic effect of the gas flames.

Vented gas appliance categories:

Category I: An appliance that operates with nonpositive vent static pressure & with a gas vent temperature that avoids excessive condensate production in the vent.

Category II: An appliance that operates with nonpositive vent static pressure & a vent gas temperature that is capable of causing excessive condensate production in the vent.

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

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

Vertical: Any pipe or vent that is 45° or more from horizontal.

W

Within sight: Visible, unobstructed & not more than 50 ft. away.

Wood stove: See "Fireplace stove" or "Room heater (solid fuel)."

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TABLE 12**SIGNIFICANT CODE CHANGES – 2009 IRC, UPC & UMC; 2011 NFPA 31 & NFPA 58**

No.	Page	Code	Description
1	7, 14	2006 UMC 931.3X	Rule allowing furnace to be service from a ladder and placed at edge of attic access opening removed in 2009 UMC; platform now req'd.
2	8	IRC 1403.2	Raised pad for heat pumps still req'd in IRC 1403.2. A broader section, 1308.3, deleted in 2009 IRC. It req'd outdoor AC equipment to be raised at least 3 in. above finished grade.
3	8	IRC 1411.3.1	Option added for pan with interlocked detector & fitting to allow the pan to drain.
4	10	UMC 311.3&4	2006 UMC did not regulate these return air sources.
5	14	IRC 2408.4 & UMC 904.3.1	Gas appliances supported on grade req a slab or equivalent extending at least 3 in. above grade. In UMC, this section applies only for under-floor appliances.
6	14	UMC 904.3.1.2	UMC now req's 6 in. clearance for suspended under-floor appliances.
7	15	IRC 2427.8 & UMC 802.8.4	Condensate drain fittings from Category IV appliances to be in accordance with manu instructions. These include a requirement for primer.
8	22	IRC 2427.4.1.1 & UMC 802.4.3	New specification that primers used with plastic vent piping be a contrasting color. Appliance manu instructions also apply to fittings.
9	22	UMC 802.7.4.1	UMC no longer allows single-wall gas vents in dwellings. Single-wall connectors still allowed.

No.	Page	Code	Description
10	24	IRC 2427.5.5.1 & UMC 802.5.4.2	Prior code editions had no exception allowing unlined masonry chimneys for gas-burning appliances. They are now acceptable for replacement appliances of same size & characteristics provided chimney passes an NFPA 211 inspection.
11	28	NFPA 31 6.6.7	Requirement added that installer verify that chimney is proper size for connected appliances.
12	29	NFPA 31 7.2.1	Storage tanks must now be listed to one of standards recognized in NFPA 31.
13	29	NFPA 31 7.3.1	In 2005 NFPA 31, tanks could be supported on ground or on foundations of concrete, steel, masonry, or pilings.
14	29	NFPA 31 8.10.6	2011 edition specifies locations of thermally operated safety shutoff valves.
15	31	NFPA 58 6.9.3.16	New requirement for dielectric fitting to electrically isolate above ground & below-ground portions of propane piping. Note that while propane piping is not req'd by NFPA 58 to be electrically bonded, NEC does req bonding of any interior piping system capable of becoming energized.
16	36	IRC 1502.4.2 & 2439.5.2	New requirement that dryer exhaust ducts be supported & secured at 4 ft. intervals.
17	36	IRC 1502.4.1	New requirement that electric dryer exhaust ducts be min 4 in. diameter.

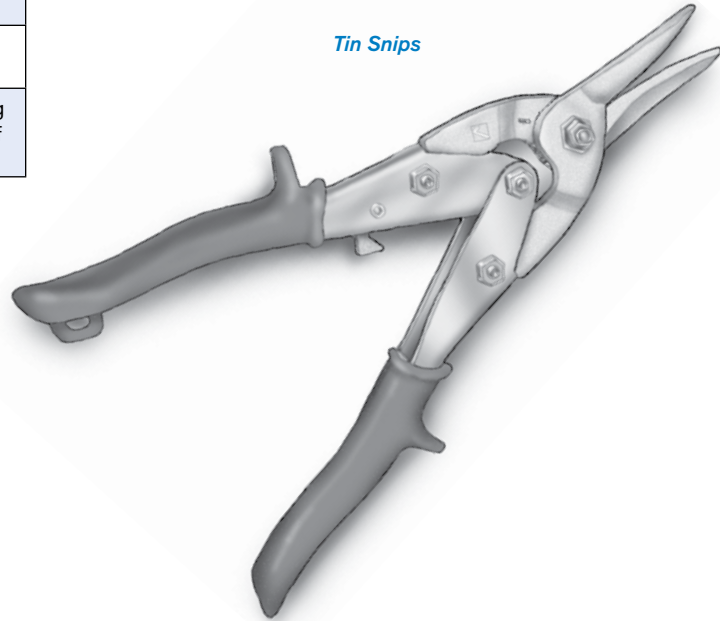
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TABLE 45

**SIGNIFICANT CODE CHANGES –
2009 IRC, UPC & UMC; 2011 NFPA 31 &
NFPA 58 (cont.)**

No.	Page	Code	Description
18	36	IRC 1502.4.4 & 2439.5.5.1	New rules provide tables for equivalent length of fittings & allow for concealed duct runs of any length allowed by manu.
19	36	IRC 1502.5 & 2439.5.3	Protective shield plates req'd when duct is less than 1 ¼ in. from face of framing.
20	36	IRC 1502.4.5 & 2439.5.6	When duct concealed within framing, label or tag stating equivalent duct length req'd within 6 ft. of duct connection.

Tin Snips



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In colonial America, most homes were warmed by building a fire in a fireplace. This method resulted in sending most of the heat up the chimney, using a lot of wood and causing many house fires. In 1742, Ben Franklin invented an iron furnace stove, equipped with loose fitting iron plates through which air circulated & warmed before passing into the room. It warmed homes more efficiently, less dangerously & with less wood—resulting in less air pollution. He named this furnace stove the “Pennsylvania Fireplace,” although today it is known as the “Franklin Stove.”