**Code Check Building** is a condensed guide to the building portions of the 2009 International Residential Code (IRC) for One- & Two-Family Dwellings. The IRC is the most widely used residential building code in the United States. Significant code changes are highlighted in the text and summarized in the inside back cover, which means that the book is also applicable in areas using older editions of the IRC. Check with the local building department to determine which code is used in your area, and for local amendments.

**Based on Chapters 1 through 10 of the 2009 International Residential Code®**

For updates and information related to this book, visit www.codecheck.com

**KEY TO USING THIS BOOK**

The line for each code rule starts with a checkbox and ends with an IRC code reference in brackets. Exceptions and lists start with a bullet and also end with the code reference in brackets. Changes to the 2009 code are highlighted by having the reference in a different color and an endnote to the table on the inside back cover.

Example from p.8:

- Floor or landing min 36in deep on each side of door EXC ___________ [311.3]  
  - Balconies <60sq. ft OK for landing to be <36in deep _________ [311.3X]19

These lines give the basic rule that landings at least 36 inches deep are required on each side of a door, and the code reference in the IRC is section 311.3. (In the IRC, the number is actually R311.3. We omit the letter “R” at the beginning to save space and include more information on each line.) The line that follows is an exception to the rule, and the code reference is 311.3 Exception. This exception is a new code change, and is explained further on the inside back cover as code change #19.

Tables and Figures are referenced in the code text lines in the following way:

**Example from p.17:**

- Notching & boring per F30 & T14 _________________________ [502.8.1]

This line says that the rules for notching & boring joists are found in section 502.8.1 and illustrated in figure 30, with further explanation in table 14.
The IRC is part of the suite of codes published by the International Code Council. It is limited to one- and two-family dwellings and townhouses not more than 3 stories above grade. It is a prescriptive document containing rules and instructions. Aspects of a building that exceed the scope of the IRC are built to the IBC, a more comprehensive document containing engineering regulations for structural design. It is acceptable to use any of the specific performance-based provisions of the International Codes as an alternative to the prescriptive rules in the IRC.

The American Forest and Paper Association publishes the Wood Frame Construction Manual for One- and Two-Family Dwellings (WFCM), which can be used as an alternate to IRC designs for wood framing.

The American Iron and Steel Institute (AISI) publishes the Standard for Cold-Formed Steel Framing—Prescriptive Method for One- and Two-Family Dwellings (AISI S230), which can be used as an alternative to IRC designs for wood framing.

The American Concrete Institute (ACI) publishes two documents that supplement the prescriptive rules of the IRC. These are ACI 318—Building Codes for Structural Concrete and ACI 530—Building Code Requirements for Masonry Structures.

The Truss Plate Institute (TPI) publishes TPI 1—National Design Standard for Metal Plate Connected Wood Truss Construction, which is mandatory for metal-plate-connected truss design. TPI also contributes to BCSI 1-03—Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses.

This book follows the same basic sequence as the IRC. It begins with the administrative sections in the IRC chapter 1, followed by the planning and nonstructural topics in the IRC chapter 3. The structural sections are arranged “from the ground up,” beginning with foundations (chapter 4), followed by floors (5), wall construction (6), wall coverings (7), roof-ceiling construction (8), roof assemblies (9), and chimneys and fireplaces (10).
Stairs: General

- Min width above handrail 36in except spiral stairways [F11][311.7.1]
- Max handrail projection into stairway 4½in [F11][311.7.1]
- Min headroom 6ft 8in EXC [F11][311.7.2]
  - Floor openings above stair OK to project 4¾in into req’d headroom at the side of a flight of stairs [F11.7.2X][311.7.2]
- Riser height max 7¾in, tread depth min 10in EXC [F12][311.7.4.2&3]
  - Tread depth min 11in if no nosing projection on treads [F12][311.7.4.3]
- Measure rise & run exclusive of carpets, rugs, or runners [F12][311.7.4][311.7.6]
- Tallest riser not >3/8in than shortest riser [F12][311.7.4.1]
- Deepest tread not >3/8in than shortest [F12][311.7.4.2]
- Max 2½ slope on treads & landings [F12][311.7.6]
- Enclosed accessible space below stairs req’s min ½in GB [302.7]

Nosings & Risers

- Nosing req’d for solid risers w/treads <11in deep [F12][311.7.4.3]
- Nosing projection min ¾in, max 1¼in [F12][311.7.4.3]
- Deepest nosing projection not >3/8in than shortest [F12][311.7.4.3]
- Beveling of nosing max ½in, max nosing radius 9⁄16in [F12][311.7.4.3]
- Risers vertical or sloped from tread above max 30° from vertical [F12][311.7.4.3]
- Open riser treads must prevent passage of 4in sphere EXC [F12][311.7.4.3]
  - Opening between adjacent treads not limited if stair rise ≤30in [F11.7.4.3X]
Winding Stairs F13

- Walkline concentric to curvature of stair & measured 12in from first clear area on narrow side of winder walking surface [311.7.3] [22]
- Min tread depth 10in at walkline [311.7.4.2]
- Deepest tread not >3/8in than shortest measured at walkline [311.7.4.2]
- OK for winder treads not to be within 3/8in of depth of rectangular treads in same flight of stairs [311.7.4.2] [23]

![Winding Stairs](image)

**FIG. 13**

Min. 10 in. tread depth at walkline; deepest tread may not exceed shortest by >½ in.

Min. 6 in. depth within shaded area

Uniform depth of rectangular treads in same flight as winders is allowed to be different than uniform depth of winders at walkline.

Handrails

- Req’d on at least one side of flights of stairs w/ ≥4 risers F11,15 [311.7.7]
- Top 34–38in above line connecting nosings F15 EXC [311.7.7.1]
  - Volute, turnout, or starting easing OK over lowest tread [311.7.7.1X1]
  - Fitting or bending OK to exceed max height at continuous transition between flights, start of flight, or from handrail to guard F15 [311.7.7.1X2] [24]
- Ends must return to wall or post or safety terminal F11,15 [311.7.7.2]
- Min 1½in space between wall and handrail F11 [311.7.7.2]
- Handrail continuous from line above top & bottom nosings EXC [311.7.7.2]
  - May be interrupted by post at landing [311.7.7.2X1]
  - Volute, turnout, or starting easing OK over lowest tread F15 [311.7.7.2X2]
- Round handrails min 1¼in–max 2in diameter F14 [311.7.7.3]
- Non-round Type I handrails perimeter 4in–6⅛in F14 [311.7.7.3]
- If perimeter >6⅛in, finger recess req’d both sides F14 [311.7.7.3]

![Handrail Profiles](image)
**CRIPPLE WALLS**

**Cripple Walls**

- No smaller than size of studding above cripple wall [602.9]
- If <14 in high, solid WSP sheathing or solid blocking req’d [602.9]
- If >4 ft high, size as if additional story [602.9]
- SDC A, B & C bracing length 1.15x req’d length of wall above T21 [602.10.9]
- SDC D₀, D₁ & D₂ length 1.5x req’d length of wall above T22 [602.10.9.1]
- Max spacing of bracing 18 ft [602.10.9]
- Can be redesignated as 1st story for bracing purposes [602.10.9.2]

---

**Manufactured Lumber & Floor Trusses**

- Cuts, notches & holes only where specified by manufacturer or registered design professional F32,34 [502.8.2]
- Point loads & other installation details F34 [502.7.1X]
- Blocking, bridging & other lateral support AMI [502.7.1X]
- Truss drawings to include bracing requirements [502.11.2]
- No truss alterations w/o approval of registered design professional [502.11.3]

---

**UNDERFLOOR FRAMING**

**CRIPPLE WALLS**
**Stucco Soffit**

- Casing bead of vertical surface min. ¼ in. below bead on horizontal surface so as to form a drip edge.
- Casing beads secured at max. 7 in. intervals.

**TABLE 27**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Summary of Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 926</td>
<td></td>
</tr>
<tr>
<td>7.1.5</td>
<td>Install each coat without interruption or cold joints.</td>
</tr>
<tr>
<td>8.1</td>
<td>Continuously hydrate between coats.</td>
</tr>
<tr>
<td>8.1</td>
<td>Time between coats depends on climatic &amp; job conditions.</td>
</tr>
<tr>
<td>12.3.2</td>
<td>Apply when ambient temperature &gt;40°F.</td>
</tr>
<tr>
<td>A2.2.3</td>
<td>Vertical-to-horizontal intersections req casing beads both surfaces, with vertical ¼ in. below horizontal to provide drip edge. Horizontal casing bead held back min. ¼ in. <strong>F46</strong>.</td>
</tr>
<tr>
<td>A2.3.1.2</td>
<td>Control joints to be included in plans &amp; specifications.</td>
</tr>
</tbody>
</table>
Code Check Plumbing 4th Edition is an illustrated guide to common code questions in residential plumbing, heating, ventilation, and air conditioning systems. The book emphasizes the safety principles that are at the heart of the codes for these systems.

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

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

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

Thanks to Hamid Naderi of ICC for his editorial input.

Table 1: CODES & STANDARDS USED IN THIS BOOK

<table>
<thead>
<tr>
<th>Organization</th>
<th>Edition</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC</td>
<td>2009</td>
<td>International Residential Code</td>
</tr>
<tr>
<td>ICC</td>
<td>2009</td>
<td>ISPDC - International Private Sewage Disposal Code</td>
</tr>
<tr>
<td>IAPMO</td>
<td>2009</td>
<td>Uniform Plumbing Code</td>
</tr>
<tr>
<td>IAPMO</td>
<td>2009</td>
<td>Uniform Mechanical Code</td>
</tr>
<tr>
<td>NFPA</td>
<td>2011</td>
<td>NFPA 31 Standard for Installation of Oil-burning Equipment</td>
</tr>
<tr>
<td>NFPA</td>
<td>2009</td>
<td>NFPA 54 National Fuel Gas Code</td>
</tr>
</tbody>
</table>
**GENERAL RULES FOR ALL PIPING**

**Materials**
- Materials must be 3rd party tested or certified [09 IRC 2608.4] (09 UPC 301.1.1)
- All pipes & fittings marked by manufacturer [09 IRC 2608.1] (09 UPC 301.1.2)

**Pipe Support**
- Hangers must prevent distortion & maintain alignment (no wires, no metal straps contacting plastic pipe) [F1] (09 IRC 2605.1) (09 UPC 314.2&4)
- Insulate Zi hangers from contact w/ Cu pipes [F1] (09 IRC 2605.1) (09 UPC 314.4)
- Max support intervals for water pipe T3,4 [09 IRC 2605.1] (09 UPC 314.1)

**TABLE 3 IRC MAX. SUPPORT SPACING OF WATER PIPE**

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS/PVC DWV</td>
<td>4 ft.</td>
<td>10 ft.</td>
</tr>
<tr>
<td>Threaded steel</td>
<td>12 ft.</td>
<td>15 ft.</td>
</tr>
<tr>
<td>Cast-iron hubless</td>
<td>5 ft. (10 ft. OK for 10 ft. lengths of pipe)</td>
<td>15 ft.</td>
</tr>
<tr>
<td>Cu water tubing</td>
<td>6 ft. for 1¼ in. pipe</td>
<td>10 ft.</td>
</tr>
<tr>
<td></td>
<td>10 ft. for 1½ in. pipe</td>
<td></td>
</tr>
<tr>
<td>CPVC</td>
<td>3 ft. for 1 in. pipe</td>
<td>10 ft.</td>
</tr>
<tr>
<td></td>
<td>4 ft. for 1¼ in. pipe</td>
<td></td>
</tr>
<tr>
<td>PEX</td>
<td>32 in.</td>
<td>10 ft.</td>
</tr>
<tr>
<td>PEX-AL-PEX</td>
<td>32 in.</td>
<td>4 ft.</td>
</tr>
</tbody>
</table>

A. Provide mid-story guides for pipes 2 in.

**TABLE 4 UPC MAX. SUPPORT SPACING OF WATER PIPE**

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS/PVC DWV</td>
<td>4 ft.</td>
<td>per AHJ</td>
</tr>
<tr>
<td>Threaded steel</td>
<td>per AHJ</td>
<td>per AHJ</td>
</tr>
<tr>
<td>Cast-iron hubless</td>
<td>Within 18 in. of joints (every other joint if 4 ft.)</td>
<td>Base &amp; each floor 15 ft.</td>
</tr>
<tr>
<td>Cu water tubing</td>
<td>6 ft. for 1½ in. pipe</td>
<td>Each floor 10 ft.</td>
</tr>
<tr>
<td></td>
<td>10 ft. for 2 in. pipe</td>
<td></td>
</tr>
<tr>
<td>CPVC</td>
<td>3 ft. for 1 in. pipe</td>
<td>Base &amp; each floor</td>
</tr>
<tr>
<td></td>
<td>4 ft. for 1¼ in. pipe</td>
<td></td>
</tr>
<tr>
<td>PEX</td>
<td>32 in.</td>
<td>Base &amp; each floor</td>
</tr>
<tr>
<td>PEX-AL-PEX</td>
<td>98 in.</td>
<td>Base &amp; each floor</td>
</tr>
</tbody>
</table>

A. Provide mid-story guides.
B. Includes horizontal branch connections. Hangers are not OK directly on couplings.
C. Some manufacturers require closer support spacing.
IRC Cleanout (CO) Requirements (cont.)

- Req’d for runs with aggregate change of direction >135° **F14** (707.4)
- Trap arm bends <90° do not req CO **(707.14)**
- Takeoff above flow line unless wye branch or end of line **F30** (707.5)
- Pipes 2in req 12in clearance; >2in req’s 18in clearance **(707.10)**
- Underfloor CO must extend above finished floor or outside building if >20ft from access door or if <18in vertical clearance or if passageway to CO <30in wide **(707.9)**

**FIG. 13**

**UPC Cleanouts**

Horizontal Distances

- WC
- LAV
- KS

**CO**

<90°

<90°

5ft.

5ft.

2-way CO if no upper terminal CO

**FIG. 14**

Cleanout Bends & Clearances

- UPC req’s a CO for an aggregate total bend >135°.
- IRC req’s a CO for every change of direction >45° except only one is req’d each 40 ft.

**FIG. 15**

Adding Drain at Cleanout

- COs may not be used for new fixtures.
- If additional drain is added here, new CO is req’d.
Vents prevent atmospheric pressure differences across traps and are essential to maintaining the trap seal. Without vents the water in the seal could be sucked out, leaving the occupants unprotected from contaminants downstream of the trap. The IRC and UPC have very different approaches to venting.

**General**

- All fixture traps req venting [3101.2.1] [901.0]
- Vent system not to be used for any other purposes [3101.3] (n/a)
- No flat dry vents (take off above horizontal centerline) F30 [3104.3] (905.2)
- Slope vents to drain to soil or waste piping [3104.2] (905.1)
- Change direction with appropriate fittings F29 [3104.2] (903.3)
- No vent opening below trap weir except toilets F24 [3105.2] (905.5)
- No crown vents: min 2 pipe diameters from trap F27 [3105.3] (1002.2)
- Horizontal dry vents min 6in above FLR F28 [3104.4] (905.3)
- Horizontal branch vents min 6in above FLR F28 [3104.5] (905.3)
- Piping <6in above flood rim req’s drainage type fittings [3104.2] (905.3)
Toilets & Bidets

- Floor flanges req’d for floor outlets **F65** [2705.1] [408.3]
- Secure floor flange with corrosion-resistant fasteners **[2705.1]** [408.3]
- WC or bidet req’s min 15in clearance from center to side walls or outer rim of adjacent fixtures or partitions or vanity **F66** [2705.1] [407.5]
- Min 21in (24in UPC) front clearance **F66** [2705.1] [407.5]
- No offset or reducing floor flanges **[3002.3.1]** [408.3]
- Max distance from closet ring to vent 6ft UPC **[3105.1X]** (T10-1)
- Ballcock critical level 1in above overflow pipe **[2712.4]** [603.4.2]

Tubs

- Slip joints accessible, min 12in × 12in door **F23** [2704.1] [404.2]
- Over-rim bath spout–min air gap 2in from flood rim **[T2902.3.1]** [T6-3]
- Overflow min 1½ in diameter **[2713.1]** [404.3]
- Tub or whirlpool max water temp 120ºF **[2713.3]** [414.5]
Tubs
- Slip joints accessible w/ min 12x12 in door F25 [2704.1] 404.2
- Over-rim bath spout min air gap 2 in from flood rim [T2902.3.1] (T6-3)
- Overflow (req’d) min 1\(\frac{1}{2}\) in dia F25 [2713.1] (404.3)
- Tub or whirlpool max water temp 120°F ________ [2713.3]^{41} (414.5)^{41}
- Whirlpool tub access must allow pump removal [min 12x12 in], 18 in by 18 in if pump >2 ft from access opening ____ [2721.2]^{42} (n/a)

Showers
- Min area 900 sq. in (1024 sq. in) min dia 30 in measured from finished wall to center of threshold F80 [2708.1] (411.7)
- Min shower area to be maintained to 70 in above drain [2708.1] (411.7)
- Showerheads, valves, grab bars, & soap dishes: allowed to protrude into req’d min space __________ [2708.1] (411.7)
- Shower walls watertight to min 72 in above drain ______ [307.2] (IS-4)
- Finished threshold height min 1 in below receptor & 2–9 in above top of drain F80 ________ [2709.1] (411.6)
- Door must open outward F79 [2708.1]^{43} (411.6)
- Door min 22 in wide F79 [2708.1.1]^{44} (411.6)
- Finished floor slope 1/4–1/2 in/ft ________ [2709.1] (411.6)
- Secure shower valve, head/riser to permanent structure [2708.2] (411.11)
- Shower head not discharging directly at door ______ [2705.1] (411.10)
- Listed anti-scald/pressure-balance valve req’d 120°F max __________ [2708.3] (418.0)

---

**FIG. 79**

**Shower Pan**

Outside dimensions:

IAPMO: Listed - 39 1/2 in.

NOT IAPMO: Listed - 37 1/2 in.

---

**FIXTURES ♦ BATHROOMS**

---

**PLUMBING**

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## FORCED AIR FURNACES

### General Rules & Clearances

<table>
<thead>
<tr>
<th>09 IRC</th>
<th>09 UMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prohibited in bedroom, bathroom or their closets (904.1)</td>
<td>Prohibited in bedroom, bathroom or their closets (904.1)</td>
</tr>
<tr>
<td>Direct-vent type installed (904.1)</td>
<td>Direct-vent type installed (904.1)</td>
</tr>
<tr>
<td>Separated by weather-stripped self-closing door &amp; all combustion air from exterior (904.1)</td>
<td>Separated by weather-stripped self-closing door &amp; all combustion air from exterior (904.1)</td>
</tr>
<tr>
<td>Equipment room door large enough to remove appliance (904.4)</td>
<td>Equipment room door large enough to remove appliance (904.4)</td>
</tr>
<tr>
<td>Work space min 30in deep &amp; wide in front of appliance (904.4)</td>
<td>Work space min 30in deep &amp; wide in front of appliance (904.4)</td>
</tr>
<tr>
<td>FAUs in alcoves or closets must be L&amp;L for alcove (904.4B)</td>
<td>FAUs in alcoves or closets must be L&amp;L for alcove (904.4B)</td>
</tr>
<tr>
<td>FAUs clearance AMI EXC (904.4B)</td>
<td>FAUs clearance AMI EXC (904.4B)</td>
</tr>
<tr>
<td>Clearance reduction OK if room large in comparison w/size of equipment (904.2A&amp;B)</td>
<td>Clearance reduction OK if room large in comparison w/size of equipment (904.2A&amp;B)</td>
</tr>
<tr>
<td>Install above design flood elevation (904.3)</td>
<td>Install above design flood elevation (904.3)</td>
</tr>
<tr>
<td>Air filter req’d AMI (904.4)</td>
<td>Air filter req’d AMI (904.4)</td>
</tr>
</tbody>
</table>

### Electrical Requirements

<table>
<thead>
<tr>
<th>09 IRC</th>
<th>11 NEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptacle within 25ft of appliance (210.63)</td>
<td>Receptacle within 25ft of appliance (210.63)</td>
</tr>
<tr>
<td>Crawlspace furnace req’s light w/switch at access (210.70A3)</td>
<td>Crawlspace furnace req’s light w/switch at access (210.70A3)</td>
</tr>
<tr>
<td>Attic furnace req’s light w/switch at access (210.70A3)</td>
<td>Attic furnace req’s light w/switch at access (210.70A3)</td>
</tr>
<tr>
<td>Individual circuit req’d for central heating (422.12X)</td>
<td>Individual circuit req’d for central heating (422.12X)</td>
</tr>
<tr>
<td>No other equipment on central heating circuit EXC</td>
<td>No other equipment on central heating circuit EXC</td>
</tr>
<tr>
<td>Associated pumps, humidifiers, air cleaners, &amp; AC</td>
<td>Associated pumps, humidifiers, air cleaners, &amp; AC</td>
</tr>
</tbody>
</table>

### Underfloor

<table>
<thead>
<tr>
<th>09 IRC</th>
<th>09 UMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment support on grade req’s min 3in pad (904.3.1)</td>
<td>Equipment support on grade req’s min 3in pad (904.3.1)</td>
</tr>
<tr>
<td>Suspended equipment min 6in above grade (904.3.2)</td>
<td>Suspended equipment min 6in above grade (904.3.2)</td>
</tr>
<tr>
<td>Passageway min 22in wide×30in high (904.1.1)</td>
<td>Passageway min 22in wide×30in high (904.1.1)</td>
</tr>
<tr>
<td>Passageway max distance 20ft to equipment (904.1.1)</td>
<td>Passageway max distance 20ft to equipment (904.1.1)</td>
</tr>
<tr>
<td>Unlimited length if passageway 6ft high &amp; 22in wide (904.1.1)</td>
<td>Unlimited length if passageway 6ft high &amp; 22in wide (904.1.1)</td>
</tr>
</tbody>
</table>

---

#### FIG. 17

**Attic Furnace**

- No added loads on trusses except per design.
- Min. 5 ft. from flue collar to termination.
- Min. 30 in. platform on control side.
- Platform noncombustible or AMI.
- Light switch.
Modern high-efficiency boilers are often used with indirect water heaters as well as for hydronic heating systems. Heat can be distributed through radiators, baseboard convectors, radiant slab-encased tubing, or through duct heaters.

### Steam & Hot-Water Boilers

- **09 IRC**
  - Install AMI [2001.1] (303.1)
  - Installer to supply control diagram & operating manual [2001.1] (1020.0)
- **09 UMC**
  - Steam boilers req sight-glass & pressure gauge [2002.3] (1004.3)
  - Pressure regulator req’d on water feed [2001.3] (manu)
  - Shutoff valves req’d in supply & return piping EXC [2001.3] (1011.0)
  - Low-water cutoff control req’d [2002.5] (1011.0)
  - Hydronic boilers req expansion tanks [2003.1] (1005.1)
  - Tank support designed for twice waterlogged weight [2003.1] (1005.1)
  - Tank capacity based on system volume [2003.2] (1005.4)
  - PRV req’d [2002.4] (1011.0)
  - PRV drain piped to within 18in of floor or receptor [2002.4] (1006.0)

### 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.

### Boiler & Indirect Water Heater

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 & provide the energy source for an indirect-fired water heater. A single high-efficiency boiler can be the energy plant for the whole house.

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**FIG. 20**

**Boiler & Indirect Water Heater**

- **Boiler**
  - Combustion air in
  - Flue gases out
  - Gas line
  - PRV

- **Indirect water heater**
  - TPRV
  - Return water
  - Heated water from boiler or solar
  - Condensation is produced in the boiler & exhaust & must be discharged AMI.
Vent Size Using Manufacturer’s Tables  

☐ Tables can be used for all Category I appliances  
☐ Req’d to be used if appliance is induced draft  
☐ Connector not >2 sizes larger than flue collar  
☐ When vertical vent > than connector, use vertical diameter to determine table min & connector diameter for table max  
☐ Use double-wall vent tables only for vents not exposed to outdoors below the roof line (B vent in unvented chase insulated to R-8 or in unused masonry chimney flue not considered outdoors)  
☐ Zero lateral values only if straight vertical vent connects directly to top outlet draft hood or flue collar  
☐ No elbows if using “zero lateral length” part of table  
☐ Vent tables w/ lateral length allow for 2-90° elbows  
☐ Reduce table capacity 5% each elbow up to 45° & 10% each elbow >45° up to 90°  
☐ Reductions for elbows in common vents as above  
☐ Reductions for common vent connectors as above

Multiple Appliances Vented in Common  

☐ Tables req’d to be used if induced draft included  
☐ Join multiple connectors as high as possible per available headroom & clearance  
☐ Connect smaller above larger EXC  
☐ If both appliances have draft hoods, OK to size vent for 100% of larger + 50% of smaller  
☐ Reduce connector table capacity 5% each elbow up to 45° & 10% each elbow >45° up to 90°

Forced Vents (Category IV)

☐ All mechanical draft systems L&L & installed AMI  
☐ Forced draft system must be gas tight  
☐ No natural & forced-vent to common flue  
☐ Terminate min 7ft above ground where adjacent to public walkways  
☐ Terminate 3ft above forced air inlets within 10ft  
☐ Terminate min 4ft to side or below or 1ft above building openings, min 1 ft above ground level EXC  
☐ Termination can be same as direct vent EXC if AMI  
☐ Collect & dispose of condensate from vent (see p.29)
Connection to Masonry Fireplace (Stoves & Fireplace Inserts) NFPA 211

- The connector must extend to the flue liner—not just to the firebox.[12.4.5.1]
- If the connector enters direct through the chimney wall above the smoke chamber, a noncombustible seal is required below the entry.[12.4.5.1]
- There should be no dilution of combustion products in the flue with habitable space air.[12.4.5.1]
- The flue must not be less than the size of the appliance collar.[12.4.5.1]
- The flue diameter should be at least 2x the appliance collar if the chimney walls are exposed to the exterior below the roof.[12.4.5.1]
- The flue diameter should be at least 3x the appliance collar if no part of the chimney walls is exposed to the exterior below the roof.[12.4.5.1]
- Installation must allow for chimney inspection & cleaning.[12.4.5.1]

CLEARANCE REDUCTION SYSTEMS

Clearance reduction systems are used with solid-fuel, oil-burning, and gas-burning appliances. They provide a practical means of installing appliances in spaces where they otherwise might not fit or would take up too much space in a room. They may not be used with appliances in closets (alcoves); those appliances require 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 require 36 inches clearance. The UMC uses T9 as table 5.3, and in NFPA 54 it is table 10.2.3(b).

Clearance Reduction Systems

- 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.[1306.2.1]
  • Appliances listed for <12 in & installed AMI.[1306.2.1]
- No spacers directly behind appliance or connector.[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]
KITCHENS

Freestanding Ranges 09 IRC 09 UMC
☐ Must be listed as household type – not commercial [2447.3] (n/a)
☐ Vertical clearance to combustibles min 30in EXC [1901.1] (916.1B)
  • Lesser clearances AMI [1901.1] (916.1B)
  • 24in OK w/ metal hood or metal over millboard [n/a] (916.1B)
☐ Side clearance to combustibles AMI EXC [1901.2] (916.1A)
  • 6in min sides & rear for unlisted appliances [Ø] (916.1A)

Built-in Ranges 09 IRC 09 UMC
☐ Install AMI [1901.2 & 2447.1] (916.2A&C)
☐ Vertical clearance to combustibles min 30in EXC F45 [1901.1] (916.2B)
  • Lesser clearances AMI F45 [1901.1] (916.2B)
  • 24in OK w/ metal hood or metal over millboard [n/a] (916.2B)
☐ Must be level [n/a] (916.2D)

Hood for Open-top Broilers 09 IRC 09 UMC
☐ Hood req’d & must extend as wide as broiler unit [1505.1] (920.3)
☐ Min ¼in clearance to combustibles [1505.1] (920.3)
☐ Min 24in from cooking surface to combustible materials [1505.1] (920.3)
☐ Must be ducted to outdoors & have backdraft damper [1505.1] (504.1)

Range Hoods 09 IRC 09 UMC
☐ Must go outdoors (min 3ft from openings UMC) EXC [1503.1] (504.5)
  • Ductless (recirculating) range hoods OK [1503.1X] (303.1)
☐ Exterior openings screened w/ ¼in to ½in mesh [1503.1] (n/a)
☐ Min 100 cfm intermittent or 25 cfm continuous [1503.3] (n/a)
☐ PVC OK for downdraft duct under slab [1503.2X] (504.2X)

INSPECTIONS

General 09 IRC 09 UPC
☐ Nothing concealed until inspected and approved [2503.2] (103.5.1)
☐ Testing to be conducted in presence of AHJ [2503.1] (105.5.3.1)

Water Supply 09 IRC 09 UPC
☐ Test all piping before cover or concealment [2503.2] (103.5.1.1)
☐ Water pipe test under working pressure 15 minutes EXC (2503.7) (609.4)
  • 50 PSI air for other than plastic pipe [2503.7] (609.4)
☐ Water for testing must be from potable water source [2503.7] (609.4)
☐ RPPBP devices tested at installation & annually [2503.8.2] (603.3.3)
☐ Test gauges req’d to have increments of: [2503.8] (319.1-3)
  • 0.1 psi up to 10 psi test pressure
  • 1 psi up to 100 psi test pressure
  • 2 psi up if over 100 psi test pressure
Code Check Electrical is a field guide to common code issues in residential electrical installations. It is based on the 2011 National Electrical Code—the most widely used electrical code in the United States—and the 2009 International Residential Code. Before beginning any electrical project, check with your local building department. In addition to a model code, energy codes and special rules from utility companies could also apply.

Each code line in Code Check Electrical references the two codes named above. Many building jurisdictions use older versions of the codes. If you are in an area that still uses the 2008 NEC, look in the “09 IRC” column of code references to see if the item applies in your area, and use the table on the inside back cover to see changes that were made in the 2008 NEC, 2009 IRC, and 2011 NEC.

In places where the IRC does not reference a particular rule, the NEC rule might still apply, even where the IRC code is adopted. The IRC states that items not specifically mentioned in that code should comply with the NEC. This applies to issues such as old wiring, outside feeders, and photovoltaics, which are not covered in the IRC.

For information on electrical fundamentals and theory, visit: http://www.codecheck.com/cc/OhmsLaw.html

HOW TO USE CODE CHECK ELECTRICAL

Each text line ends with two code citations. The code numbers on the left, with straight brackets, refer to the 2009 IRC. The code numbers on the right, in braces, refer to the 2011 NEC. For example (from p. 4):

☐ Max 6 disconnects to shut off power_________________ [3601.7]  {230.71}

This line states that there can be no more than 6 disconnects to shut off power, and the rule is found in 3601.7 of the IRC and 230.71 of the NEC.

An “n/a” in a code line means the rule is not applicable to that particular code. An “EXC” at the end of a line means that an exception—or exceptions—to the rule will follow in the next line, for example (from p. 12):

☐ Backfed breakers secured in place EXC____________ [3706.5]  (408.36D)

• Output circuits from utility interactive PV inverter ______ [n/a]  (705.12D6)

Backfed breakers must be secured in place per IRC 3606.5 & NEC 408.36, except that the NEC has an exception for photovoltaic circuits from an inverter. The “n/a” in the IRC column tells us this rule does not apply to that code. The list of abbreviations (to the right on this page) tells us that PV = photovoltaic.
OVERHEAD SERVICE DROP CLEARANCES

Service drop conductors typically have no outer jacket for physical protection and no overload protection at their source. They are protected by isolation and proper clearances. The codes specify minimum clearances, and the serving utility may have different rules that override the code. Check with your local jurisdiction to determine any variations from the standard clearances below.

**Vertical above Roof**

- **F2**
  - **<4-in-12 slope:**
    - min 8ft OK [3604.2.1] (230.24A)
    - 3ft OK if roof area guarded or isolated [n/a] (230.24AX1)
  - **≥4-in-12 slope:**
    - min 3ft OK [3604.2.1X2] (230.24AX2)
    - 18in OK for ≤4ft over eave [3604.2.1X3] (230.24AX3)
  - Maintain req’d distance above roof for 3ft past edge [3604.2.1] (230.24A)
    - Edge clearance above roof is not req’d when attached to side of building [3604.2.1X4] (230.24AX4)

**Vertical above Grade**

- **F2**
  - 09 IRC 11 NEC
    - 10ft above final grade to lowest point of drip loop [3604.2.2] (230.24B1)
    - Area accessible only to pedestrians: 10ft [H] [3604.2.2] (230.24B1)
    - General above grade & driveways: 12ft [J] [3604.2.2] (230.24B2)
    - Above roads or parking areas subject to truck traffic: 18ft [B] [3604.2.2] (230.24B4)
    - Any direction from swimming pool water: 22½ft [4103.5] (680.8A)

**Openings & Communication Wires**

- 09 IRC 11 NEC
  - Vertical above decks & balconies: 10ft [C] [n/a] (230.9B)
  - From side of area above decks & balconies: 3ft [D] [3604.1] (230.9A)
  - Below or to sides of openable window: 3ft [F] [3604.1] (230.9A)
  - Communications wire ≥12in to parallel power wires [I] [n/a] (800.44A4)

The clearances from windows and doors apply to open conductors and not to conductors contained inside a raceway or a cable with an overall outer jacket. The codes do not have a requirement for minimum clearance of open conductors above a window. Check to see if your local utility has a requirement.
FIG. 15

Service Panel

Bonding bushing F12 req'd for service conductors entering through concentric knockouts.

GEC

Breaker protects panel & subpanel

Neutral conductor identified (white tape encircling end of conductor)

Bond neutral in service enclosure

4-conductor feeder

LINE SIDE
LOAD SIDE

FIG. 16

Subpanel

All multiwire circuits req. handle ties or single-handle 2-pole breaker.

Do not bond neutral in subpanel.

Neutrals of multiwire circuits grouped by wire ties to associated circuit conductors

EGC

No wire tie needed for multiwire circuit in cable.
A GFCI also detects improper connections of the neutral (grounded conductor) to ground. A second “injector” coil F24 surrounds the monitored circuit and induces a small current. Should the neutral have a downstream connection to ground, current will escape outside the circuit, and the sensor coil circuit will be activated as described above.

GFCIs take more space inside a box than a conventional receptacle. When adding GFCIs to old houses with shallow boxes, it might be necessary to first add an extension box, as in F25.

A GFCI will operate properly without an equipment ground. The receptacle should be labeled “no equipment ground” & any downstream protected receptacles should also have that label as well as a label stating that they are GFCI protected. Labels are not required for properly grounded GFCI-protected receptacles.
Kitchen Receptacles

Cord-plug connected range-hood allowed if supplied by individual branch circuit

- Receptacle on end not req’d if this dimension < 6 ft.
- Max. 12 in. below countertop surface
- Max. 6 in. overhang above receptacle
- Bar-type counter acts as room divider, so receptacle req. within 6 ft. of end
- Island or peninsula countertop spaces req. only 1 receptacle–2 ft./4 ft. rule does not apply.
- This receptacle does not serve the countertop or need GFCI protection

2 ft./4 ft. Rule

Wall countertop receptacles serve the spaces for 2 ft. on each side of the receptacle. Therefore, the maximum spacing between receptacles on the same countertop space is 4 ft.
**NM – Nonmetallic Sheathed Cable (NM)**

- OK in dry locations only [IRC 3801.4] (NEC 334.12B4)
- Protect exposed cable from damage where necessary [IRC 3802.3.2] (NEC 334.15B)
- Listed grommets for holes through metal framing [IRC 3802.1] (NEC 300.4B1)
- OCPD selection based on 60° column T11 [IRC 3705.4.4] (NEC 334.80)
- Derating & temp correction based on 90° rating [IRC 3705.4.4] (NEC 334.80)
- Derate >2 NM cables in same caulked (fireblocked) hole [IRC 3705.4.4] (NEC 334.80)
- Derate >2 NM cables installed w/o spacing in contact w/ thermal insulation [IRC 3705.4.4] (NEC 334.80)
- Secure to box w/ approved NM clamp EXC [IRC 3905.3.2] (NEC 314.17B&C)
- Single gang (2 1/4 x 4 in) plastic box stapled within 8 in [IRC 3905.3.2] (NEC 314.17CX)
- Min 1/4 in sheathing into plastic boxes [IRC 3905.3.1] (NEC 314.17C)
- Secure within 12 in of box & max 41/2 ft intervals [IRC 3802.1] (NEC 334.30)
- Do not overdrive staples or staple flat cable on edge [IRC 3802.1] (NEC 334.30)
- Bends gradual (min 5 x cable diameter) [IRC 3802.5] (NEC 334.24)
- Running board for small cable under joists [IRC 3802.4] (NEC 334.15C)

**AC – Armored Cable (BX™)**

- Dry locations only [IRC 3801.4] (NEC 320.10)
- Secure within 12 in of box & max 4 1/2 ft intervals EXC [IRC 3802.1] (NEC 320.30B)
- 2 ft where flexibility needed (motors) [IRC 3802.1] (NEC 320.30D)
- Insulated (anti-short) bushing at terminations [IRC 3802.1] (NEC 320.40)
- Armor is EGC—don’t bring bond wire into box [IRC 3908.8] (NEC 250.118)
- Underside of joists—secure at each joist [IRC 3908.8] (NEC 320.15)