



# Code Check<sup>®</sup> Building Third Edition

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## Based on Chapters 1 through 10 of the 2009 International Residential Code<sup>®</sup>

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

**C**ode 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.

### 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]<sup>19</sup>

*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.*

## REFERENCE DOCUMENTS

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 the IRC.

**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*.

## SEQUENCE OF THIS BOOK

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).

## ABBREVIATIONS

<b>AAMA</b> = American Architectural Manufacturers Association	<b>in</b> = inches
<b>ACI</b> = American Concrete Institute	<b>L&amp;L</b> = listed and labeled
<b>AMI</b> = in accordance with manufacturer's instructions	<b>max</b> = maximum
<b>ASTM</b> = American Society for Testing & Materials	<b>min</b> = minimum
<b>BO</b> = building official	<b>mph</b> = miles per hour
<b>BWL</b> = braced wall line	<b>o.c.</b> = on center
<b>BWP</b> = braced wall panel	<b>PL</b> = property line
<b>cfm</b> = cubic feet per minute	<b>PT</b> = pressure treated
<b>CMU</b> = concrete masonry unit	<b>psf</b> = pounds per square foot
<b>EXC</b> = exception to rule will follow in the next line	<b>psi</b> = pounds per square inch
<b>FSD</b> = fire separation distance	<b>req</b> = require
<b>ft</b> = feet	<b>req'd</b> = required
<b>GB</b> = gypsum board	<b>req's</b> = requires, requirements
<b>hr</b> = hour	<b>SDC</b> = Seismic Design Category
<b>IBC</b> = International Building Code	<b>sq.</b> = square, as in sq. ft
<b>ICF</b> = insulating concrete form	<b>w/</b> = with
	<b>w/o</b> = without
	<b>WRB</b> = water-resistive barrier
	<b>WSP</b> = wood structural panel

**Stairs: General**

**09 IRC**

- 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 \_\_\_\_\_ [311.7.2X]<sup>20</sup>
- 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 \_\_\_\_\_ [311.7.4]<sup>21</sup>
- Tallest riser not >¾in than shortest riser **F12** \_\_\_\_\_ [311.7.4.1]
- Deepest tread not >¾in than shortest **F12** \_\_\_\_\_ [311.7.4.2]
- Max 2% slope on treads & landings \_\_\_\_\_ [311.7.6]
- Enclosed accessible space below stairs req's min ½in GB \_\_\_\_\_ [302.7]

**Nosings & Risers**

**09 IRC**

- Nosing req'd for solid risers w/treads <11in deep **F12** \_\_\_\_\_ [311.7.4.3]
- Nosing projection min ¾in, max 1½in **F12** \_\_\_\_\_ [311.7.4.3]
- Deepest nosing projection not >¾in than shortest **F12** \_\_\_\_\_ [311.7.4.3]
- Beveling of nosing max ½in, max nosing radius ½in \_\_\_\_\_ [311.7.4.3]
- Risers vertical or sloped from tread above max 30° from vertical \_\_\_\_\_ [311.7.4.3]
- Open riser treads must prevent passage of 4in sphere EXC \_\_\_\_\_ [311.7.4.3]
  - Opening between adjacent treads not limited if stair rise ≤30in\_ [311.7.4.3X]

**FIG. 11**

**Stair Width & Height**

Min. 1½ in. between wall & handrail, max. 4½ in. projection from wall

Return to wall

Min. 36 in.

Min. 6 ft. 8 in. headroom clearance

Light switch req. at each floor level with 6 or more risers.

**FIG. 12**

**Stair Rise & Run**

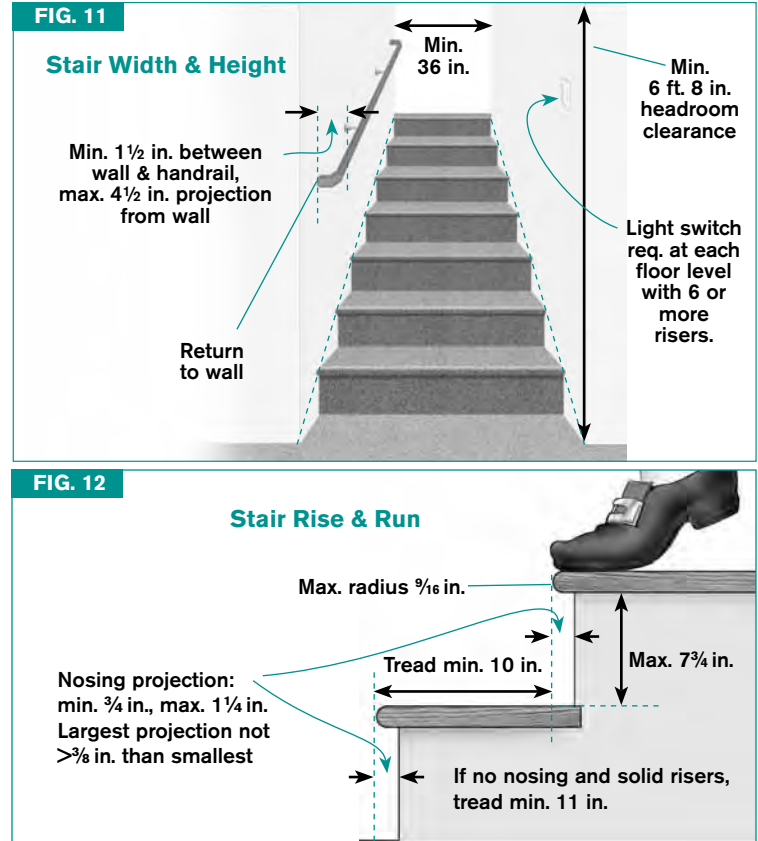
Max. radius ⅝ in.

Nosing projection: min. ¾ in., max. 1½ in. Largest projection not >¾ in. than smallest

Tread min. 10 in.

Max. 7¾ in.

If no nosing and solid risers, tread min. 11 in.



## Winding Stairs F13

09 IRC

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

FIG. 13

### Winding Stairs

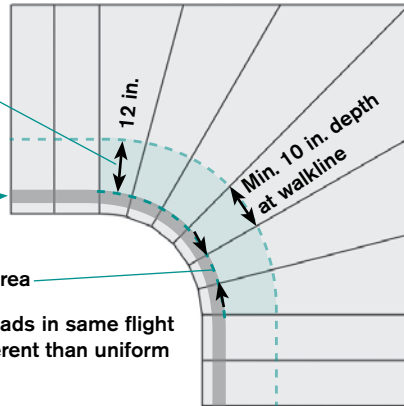
Walkline is concentric to direction of travel & measured 12 in. from point where foot can be placed on narrow side of stairs.

Min. 10 in. tread depth at walkline; deepest tread may not exceed shortest by  $> \frac{3}{8}$  in.

Handrail

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.



EGRESS

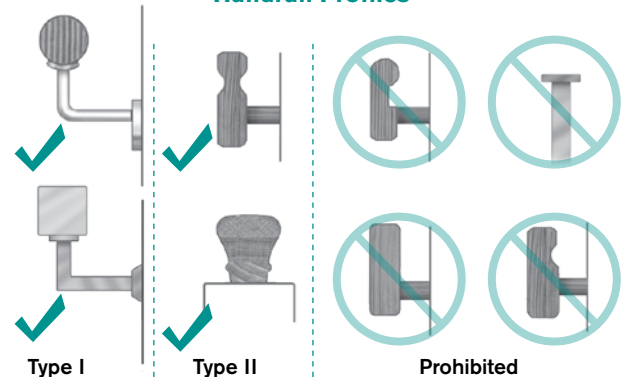
## Handrails

09 IRC

- Req'd on at least one side of flights of stairs w/  $\geq 4$  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]<sup>24</sup>
- Ends must return to wall or post or safety terminal **F11,15** \_\_\_\_\_ [311.7.7.2]
- Min 1 1/2in 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 1 1/4in–max 2in diameter **F14** \_\_\_\_\_ [311.7.7.3]
- Non-round Type I handrails perimeter 4in–6 1/4in **F14** \_\_\_\_\_ [311.7.7.3]
- If perimeter  $> 6 \frac{1}{4}$ in, finger recess req'd both sides **F14** \_\_\_\_\_ [311.7.7.3]

FIG. 14

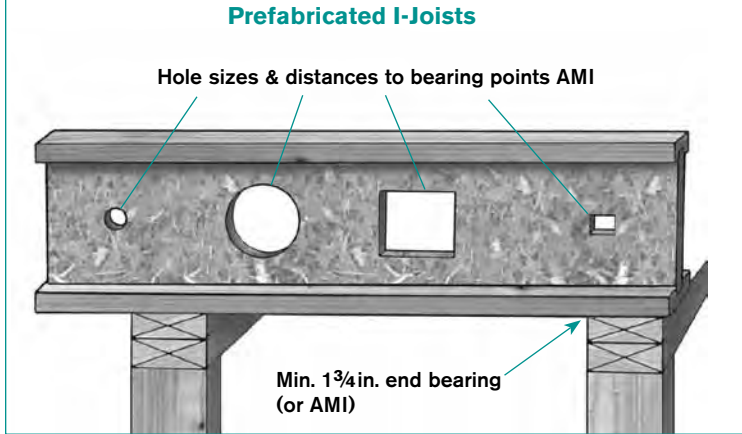
### Handrail Profiles



BUILDING

15

FIG. 32



**Manufactured Lumber & Floor Trusses**

**09 IRC**

- 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]

**CRIPPLE WALLS**

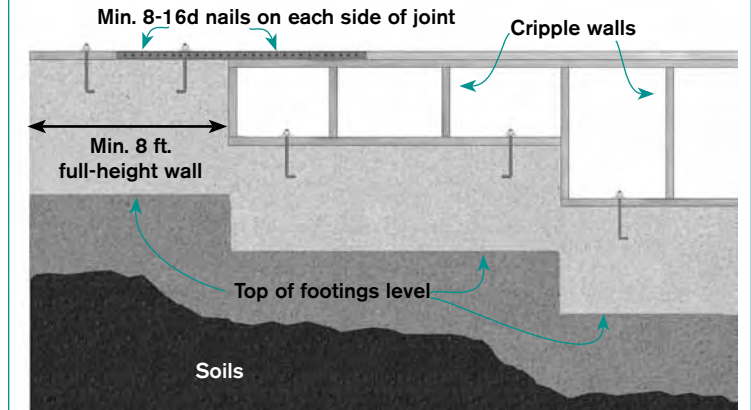
**Cripple Walls**

**09 IRC**

- No smaller than size of studing above cripple wall \_\_\_\_\_ [602.9]
- If <14in high, solid WSP sheathing or solid blocking req'd \_\_\_\_\_ [602.9]
- If >4ft 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 D<sub>0</sub>, D<sub>1</sub> & D<sub>2</sub> length 1.5x req'd length of wall above **T22** \_\_\_\_\_ [602.10.9.1]
- Max spacing of bracing 18ft \_\_\_\_\_ [602.10.9]
- Can be redesignated as 1st story for bracing purposes \_\_\_\_\_ [602.10.9.2]

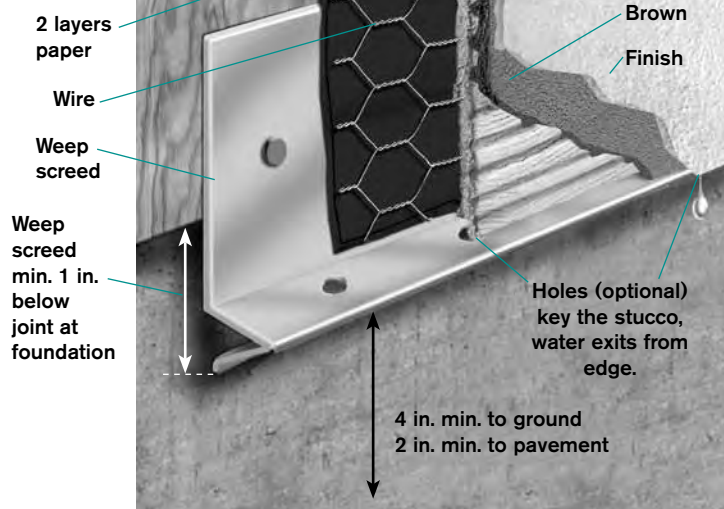
FIG. 33

**Stepped Foundation in SDC D<sub>0</sub>, D<sub>1</sub> & D<sub>2</sub>**



**FIG. 45**

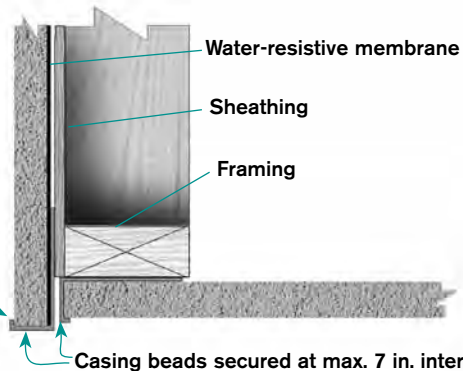
**Weep Screenshot**



**FIG. 46**

**Stucco Soffit**

Casing bead of vertical surface min. ¼ in. below bead on horizontal surface so as to form a drip edge



**TABLE 27**

**SELECTED ASTM C 926 & ASTM C 1063 REQUIREMENTS**

C 926	Summary of Requirement
7.1.5	Install each coat without interruption or cold joints.
8.1	Continuously hydrate between coats.
8.1	Time between coats depends on climatic & job conditions.
12.3.2	Apply when ambient temperature >40°F.
A2.2.3	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. <b>F46</b> .
A2.3.1.2	Control joints to be included in plans & specifications.



# Code Check® Plumbing Fourth Edition

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For more information on the building, electrical and mechanical codes, valuable resources, and why Benjamin Franklin is featured in the Code Check series, visit [www.codecheck.com](http://www.codecheck.com)

**C**ode 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		
Organization	Edition	Code
ICC	2009	International Residential Code
ICC	2009	ISPDC - International Private Sewage Disposal Code
IAPMO	2009	Uniform Plumbing Code
IAPMO	2009	Uniform Mechanical Code
NFPA	2011	NFPA 31 Standard for Installation of Oil-burning Equipment
NFPA	2010	NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA	2009	NFPA 54 National Fuel Gas Code
NFPA	2011	NFPA 58 Liquefied Petroleum Gas Code

## GENERAL RULES FOR ALL PIPING

### Materials

- Materials must be 3rd party tested or certified \_\_\_\_\_ [2608.4] {301.1.1}
- All pipes & fittings marked by manufacturer \_\_\_\_\_ [2608.1] {301.1.2}

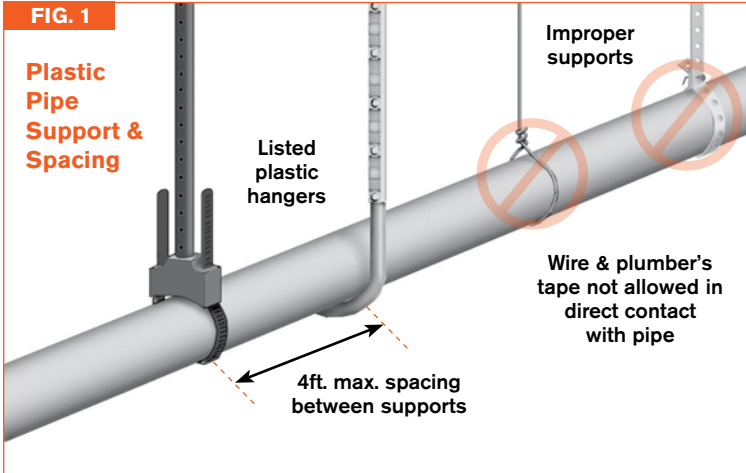
### Pipe Support

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

**09 IRC 09 UPC**

**09 IRC 09 UPC**

FIG. 1



**TABLE 3 IRC MAX. SUPPORT SPACING OF WATER PIPE [T2605.1]**

Pipe Material	Horizontal	Vertical
ABS/PVC DWV	4 ft.	10 ft. <sup>A</sup>
Threaded steel	12 ft.	15 ft.
Cast-iron hubless	5 ft. (10 ft. OK for 10 ft. lengths of pipe)	15 ft.
Cu water tubing	6 ft. for 1 1/4 in. pipe 10 ft. for 1 1/2 in. pipe	10 ft.
CPVC	3 ft. for 1 in. pipe 4 ft. for 1 1/4 in. pipe	10 ft. <sup>A</sup>
PEX	32 in.	10 ft. <sup>A</sup>
PEX-AL-PEX	32 in.	4 ft. <sup>A</sup>

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

**TABLE 4 UPC MAX. SUPPORT SPACING OF WATER PIPE [T3-2]**

Pipe Material	Horizontal	Vertical
ABS/PVC DWV	4 ft.	Base & each floor <sup>A</sup>
Threaded steel	per AHJ	per AHJ
Cast-iron hubless	Within 18 in. of joints <sup>B</sup> (every other joint if 4 ft.)	Base & each floor 15 ft.
Cu water tubing	6 ft. for 1 1/2 in. pipe 10 ft. for 2 in. pipe	Each floor 10 ft.
CPVC	3 ft. for 1 in. pipe 4 ft. for 1 1/4 in. pipe	Base & each floor <sup>A</sup>
PEX	32 in.	Base & each floor <sup>A</sup>
PEX-AL-PEX	98 in. <sup>C</sup>	Base & each floor <sup>A</sup>

A. Provide mid-story guides.

B. Includes horizontal branch connections. Hangers are not OK directly on couplings.

C. Some manufacturers require closer support spacing.



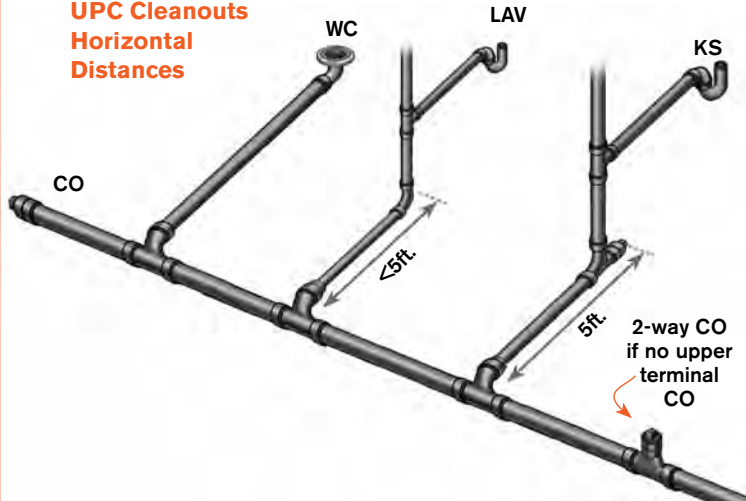
**IRC Cleanout (CO) Requirements (cont.)**

**09 IRC**

- 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}

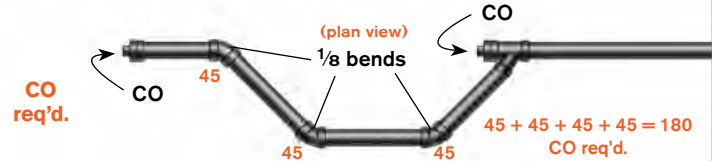
**FIG. 13**

**UPC Cleanouts  
Horizontal  
Distances**



**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.

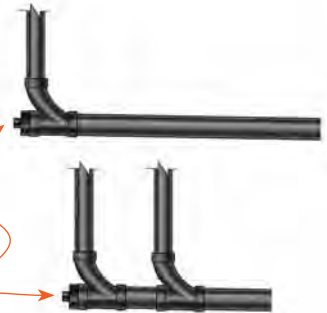


FIG. 25

Directional Fittings

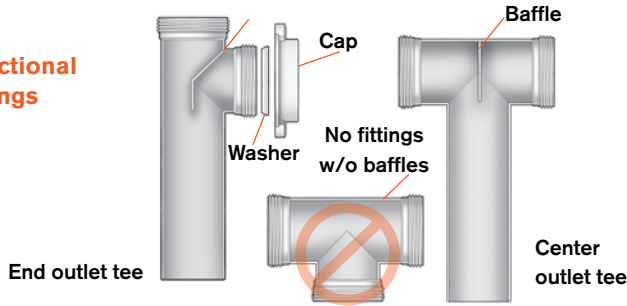


FIG. 27

Crown Venting

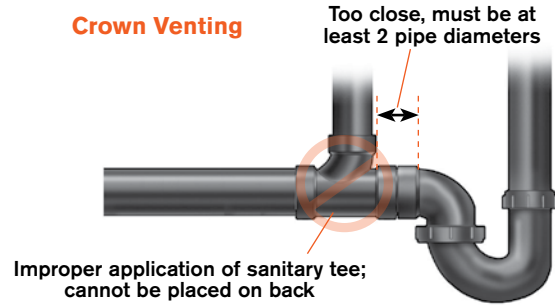
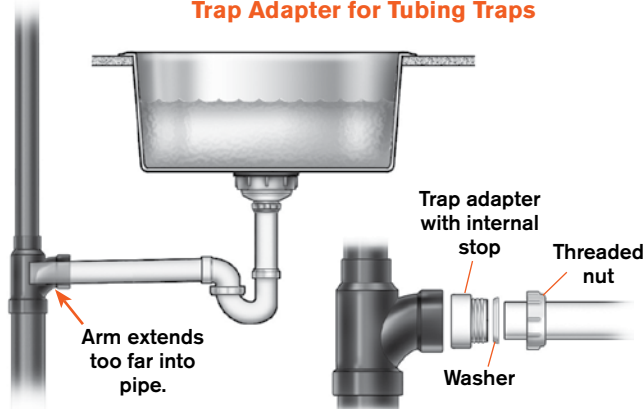


FIG. 26

Trap Adapter for Tubing Traps



VENTS

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

- |  |            |        |          |
|--|------------|--------|----------|
| <input type="checkbox"/> All fixture traps req venting _____                                 | [3101.2.1] | 09 IRC | 09 UPC   |
| <input type="checkbox"/> Vent system not to be used for any other purposes ____              | [3101.3]   |        | {n/a}    |
| <input type="checkbox"/> No flat dry vents (take off above horizontal centerline) <b>F30</b> | [3104.3]   |        | {905.2}  |
| <input type="checkbox"/> Slope vents to drain to soil or waste piping _____                  | [3104.2]   |        | {905.1}  |
| <input type="checkbox"/> Change direction with appropriate fittings <b>F29</b>               | [3104.2]   |        | {903.3}  |
| <input type="checkbox"/> No vent opening below trap weir except toilets <b>F24</b>           | [3105.2]   |        | {905.5}  |
| <input type="checkbox"/> No crown vents: min 2 pipe diameters from trap <b>F27</b>           | [3105.3]   |        | {1002.2} |
| <input type="checkbox"/> Horizontal dry vents min 6in above FLR <b>F28</b>                   | [3104.4]   |        | {905.3}  |
| <input type="checkbox"/> Horizontal branch vents min 6in above FLR <b>F28</b>                | [3104.5]   |        | {905.3}  |
| <input type="checkbox"/> Piping <6in above flood rim req's drainage type fittings            | [3104.2]   |        | {905.3}  |

**FIG. 65**

**Toilet Flanges**



**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]<sup>21</sup> {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 (unlimited IRC) \_\_\_\_\_ [3105.1X] {T10-1}
- Ballcock critical level 1in above overflow pipe \_\_\_\_\_ [2712.4] {603.4.2}

**09 IRC 09 UPC**

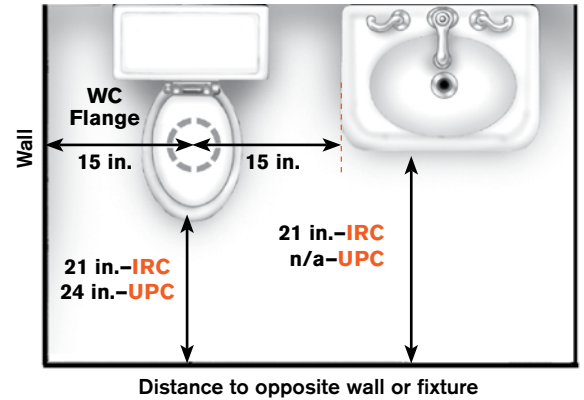
**Tubs**

- Slip joints accessible, min 12in x 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 120°F \_\_\_\_\_ [2713.3] {414.5}

**09 IRC 09 UPC**

**FIG. 66**

**Fixture Layout**

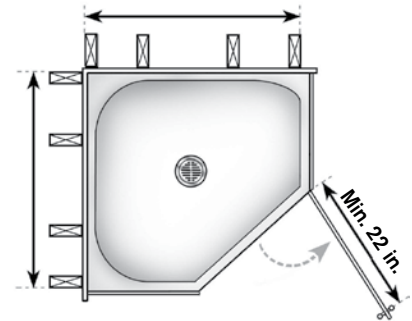


**FIG. 67**

**Shower Pan**

Outside dimensions:

IAPMO listed—39½ in.  
NOT IAPMO listed—37½ in.



## Tubs

- |  |            |                       |
|--|------------|-----------------------|
| <input type="checkbox"/> Slip joints accessible w/ min 12×12in door <b>F25</b> _____ [2704.1]  | <b>IRC</b> | <b>UPC</b>            |
| <input type="checkbox"/> Over-rim bath spout min air gap 2in from flood rim [T2902.3.1]  |            | {404.2}               |
| <input type="checkbox"/> Overflow [req'd] min 1 1/2in dia <b>F25</b> _____ [2713.1]  |            | {T6-3}                |
| <input type="checkbox"/> Tub or whirlpool max water temp 120°F _____ [2713.3] <sup>41</sup>  |            | {404.3}               |
| <input type="checkbox"/> Whirlpool tub access must allow pump removal [min 12×12in], 18in by18in if pump >2ft from access opening _____ [2721.2] <sup>42</sup> |            | {414.5} <sup>41</sup> |
|  |            | {n/a}                 |

## Showers

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

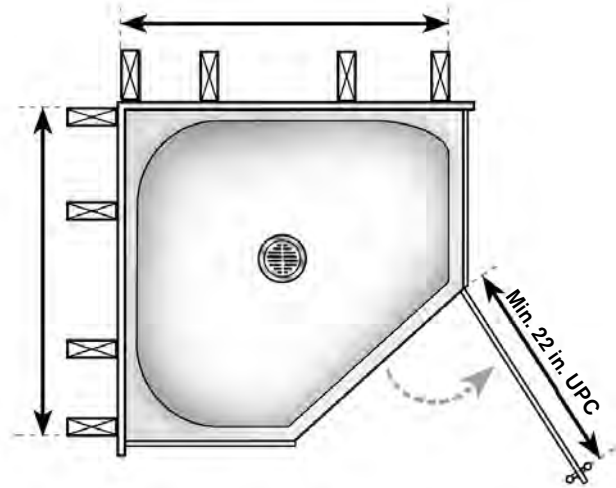
**FIG. 79**

### Shower Pan

Outside dimensions:

IAPMO: Listed - 39 1/2 in.

NOT IAPMO: Listed - 37 1/2 in.





# Code ✓ Check<sup>®</sup> Mechanical Fourth Edition

By DOUGLAS HANSEN & REDWOOD KARDON  
Illustrations and Layout: Paddy Morrissey

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For more information on the building, electrical and mechanical codes, valuable resources, and why Benjamin Franklin is featured in the Code Check series, visit [www.codecheck.com](http://www.codecheck.com)

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

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

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

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

Thanks to Hamid Naderi of ICC for his editorial input.

TABLE 1			CODES & STANDARDS USED IN THIS BOOK
Organization	Edition	Code	
ASHRAE	2010	ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings	
ICC	2009	International Residential Code	
ICC	2009	ISPDC - International Private Sewage Disposal Code	
IAPMO	2009	Uniform Plumbing Code	
IAPMO	2009	Uniform Mechanical Code	
NFPA	2011	NFPA 31 Standard for Installation of Oil-burning Equipment	
NFPA	2010	NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances	
NFPA	2009	NFPA 54 National Fuel Gas Code	
NFPA	2011	NFPA 58 Liquefied Petroleum Gas Code	
NFPA	2011	NFPA 70 National Electrical Code	

### FORCED AIR FURNACES

#### General Rules & Clearances

- |  |               |               |
|--|---------------|---------------|
| <input type="checkbox"/> Prohibited in bedroom, bathroom or their closets EXC__ [2406.2]   | <b>09 IRC</b> | <b>09 UMC</b> |
| <ul style="list-style-type: none"> <li>• Direct-vent type installed AMI _____ [2406.2]</li> <li>• Separated by weather-stripped self-closing door &amp; all combustion air from exterior _____ [2406.2]</li> </ul> |               |               |
| <input type="checkbox"/> Equipment room door large enough to remove appliance [min 24 wide in IRC] _____ [1305.1.2]  |               |               |
| <input type="checkbox"/> Work space min 30in deep & wide in front of appliance_ [1305.1]   |               |               |
| <input type="checkbox"/> FAUs in alcoves or closets must be L&L for alcove__ [2409.3.2]  |               |               |
| <input type="checkbox"/> FAUs clearance AMI EXC _____ [2409.3.2, 2409.4.2]   |               |               |
| <ul style="list-style-type: none"> <li>• Clearance reduction OK if room large in comparison w/size of equipment _____ [2409.3.3, 2409.4.3]</li> </ul>  |               |               |
| <input type="checkbox"/> Install above design flood elevation _____ [1401.5]   |               |               |
| <input type="checkbox"/> Air filter req'd AMI _____ [2442.1]   |               |               |

#### Electrical Requirements

- |  |               |               |
|--|---------------|---------------|
| <input type="checkbox"/> Receptacle within 25ft of appliance __ [1305.1.3.1 & 1305.1.4.3]                                | <b>09 IRC</b> | <b>11 NEC</b> |
| <input type="checkbox"/> Crawlspace furnace req's light w/switch at access__ [1305.1.4.3]                                |               |               |
| <input type="checkbox"/> Attic furnace req's light w/switch at access _____ [1305.1.3.1]                                 |               |               |
| <input type="checkbox"/> Individual circuit req'd for central heating _____ [3703.1]                                     |               |               |
| <input type="checkbox"/> No other equipment on central heating circuit EXC _____ [3703.1]                                |               |               |
| <ul style="list-style-type: none"> <li>• Associated pumps, humidifiers, air cleaners, &amp; AC _____ [3703.1]</li> </ul> |               |               |

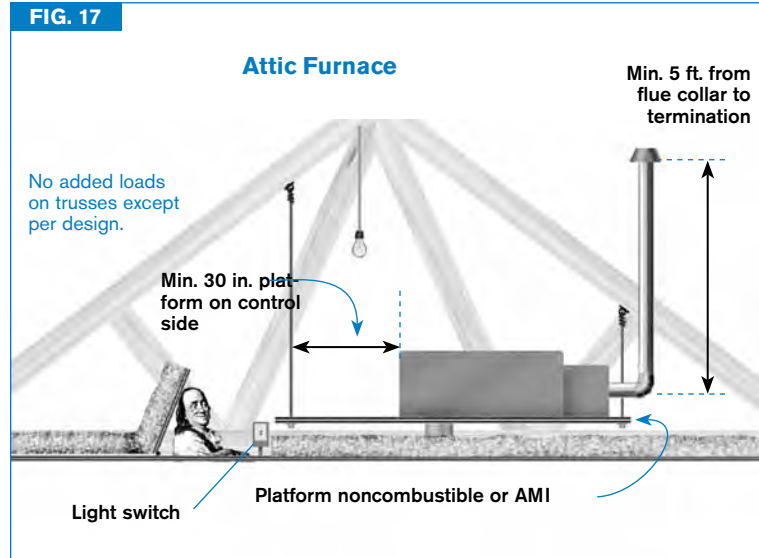
#### Underfloor

- |  |               |               |
|--|---------------|---------------|
| <input type="checkbox"/> Equipment support on grade req's min 3in pad _____ [2408.4] <sup>5</sup>                        | <b>09 IRC</b> | <b>09 UMC</b> |
| <input type="checkbox"/> Suspended equipment min 6in above grade _____ [2408.4]  |               |               |
| <input type="checkbox"/> Passageway min 22in wide×30in high _____ [1305.1.4]   |               |               |
| <input type="checkbox"/> Passageway max distance 20ft to equipment EXC__ [1305.1.4]                                      |               |               |
| <ul style="list-style-type: none"> <li>• Unlimited length if passageway 6ft high &amp; 22in wide [1305.1.4X2]</li> </ul> |               |               |

#### Attic

- |   |               |               |
|---|---------------|---------------|
| <input type="checkbox"/> Opening min 20in wide {22in UMC} & >appliance size [1305.1.3]                                | <b>09 IRC</b> | <b>09 UMC</b> |
| <input type="checkbox"/> Passageway min 22in wide×30in high _____ [1305.1.3]  |               |               |
| <input type="checkbox"/> Max distance from opening 20ft EXC _____ [1305.1.3]  |               |               |
| <ul style="list-style-type: none"> <li>• [50 if ≥6ft high in IRC] {Unlimited if ≥6ft in UMC} _ [1305.1.3X]</li> </ul> |               |               |
| <input type="checkbox"/> Solid floor min. 24in wide to equipment _____ [1305.1.3]                                     |               |               |
| <input type="checkbox"/> Min 30×30in platform in front of firebox EXC <b>F17</b> ____ [1305.1.3]                      |               |               |
| <ul style="list-style-type: none"> <li>• Not req'd if equipment can be serviced from opening [1305.1.3X1]</li> </ul>  |               |               |

FIG. 17



## BOILERS & HYDRONICS

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

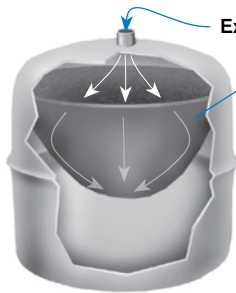
**09 IRC 09 UMC**

- Install AMI \_\_\_\_\_ [2001.1] {303.1}
- Installer to supply control diagram & operating manual \_\_\_\_\_ [2001.1] {1020.0}
- Hot water boilers req pressure & temperature gauges **F20** [2002.2] {1004.3}
- Steam boilers req sight-glass & pressure gauge \_\_\_\_\_ [2002.3] {1004.3}
- Pressure regulator req'd on water feed **F20** \_\_\_\_\_ [manu] {manu}
- Shutoff valves req'd in supply & return piping EXC **F20** \_\_\_\_\_ [2001.3] {1011.0}
  - Single low-pressure steam boiler \_\_\_\_\_ [2001.3X] {1011.0}
- Low-water cutoff control req'd \_\_\_\_\_ [2002.5] {1011.0}
- Hydronic boilers req expansion tanks **F19** \_\_\_\_\_ [2003.1] {1005.1}
- Tank support designed for twice waterlogged weight \_\_\_\_\_ [2003.1] {1005.1}
- Tank capacity based on system volume **T4** \_\_\_\_\_ [2003.2] {1005.4}
- PRV req'd **F20** \_\_\_\_\_ [2002.4] {1011.0}
- PRV drain piped to within 18in 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.



Expanded water

Diaphragm

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.

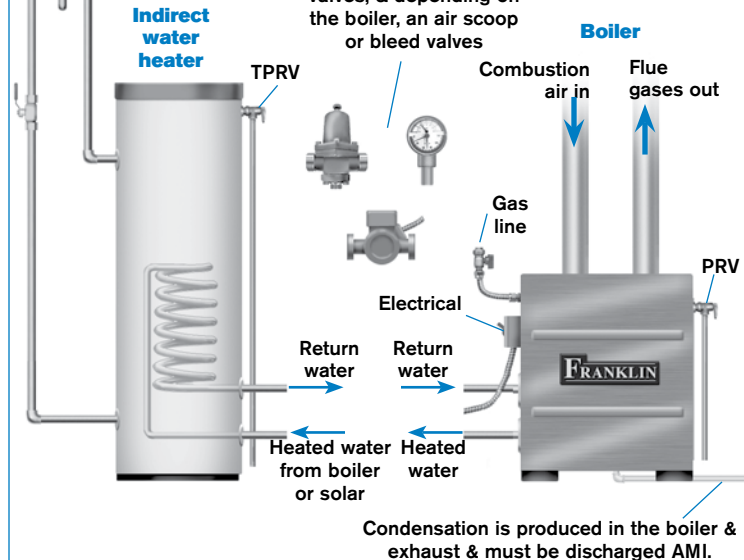
**FIG. 20**

### Boiler & Indirect 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.*



Condensation is produced in the boiler & exhaust & must be discharged AMI.

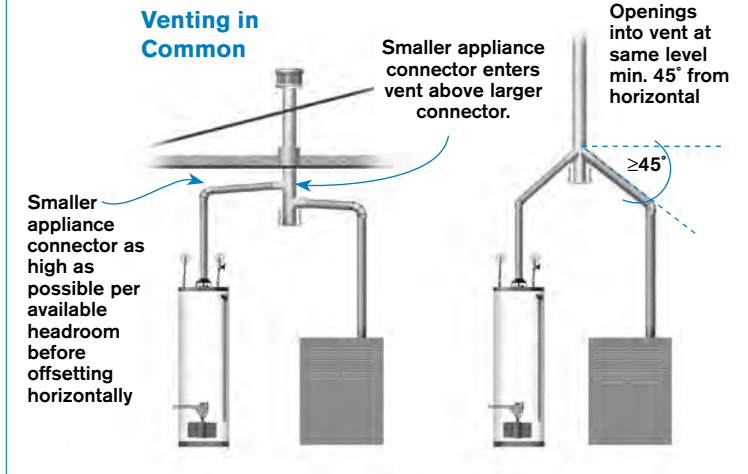
## Vent Size Using Manufacturer's Tables 09 IRC 09 UMC

- Tables can be used for all Category I appliances \_\_\_\_\_ [2427.6.8.1] {802.6.3.1}
- Req'd to be used if appliance is induced draft \_\_\_\_\_ [2427.10.3.1] {802.10.3.1}
- Connector not >2 sizes larger than flue collar \_\_\_\_\_ [2428.2.11] {803.1.10}
- When vertical vent > than connector, use vertical diameter to determine table min & connector diameter for table max \_\_\_\_\_ [2428.2.8] {803.1.7}
- Use double-wall vent tables only for vents not exposed to outdoors below the roof line (B vent in invented chase insulated to R-8 or in unused masonry chimney flue not considered outdoors) \_\_\_\_\_ [2428.2.9] {803.1.8.1}
- Zero lateral values only if straight vertical vent connects directly to top outlet draft hood or flue collar \_\_\_\_\_ [2428.2.4] {803.1.3}
- No elbows if using "zero lateral length" part of table \_\_\_\_\_ [2428.2.3] {803.1.2}
- Vent tables w/ lateral length allow for 2-90° elbows \_\_\_\_\_ [2428.2.3] {803.1.2}
- Reduce table capacity 5% each elbow up to 45° & 10% each elbow >45° up to 90° \_\_\_\_\_ [2428.2.3] {803.1.2}
- Reductions for elbows in common vents as above \_\_\_\_\_ [2428.3.6] {803.2.6}
- Reductions for common vent connectors as above \_\_\_\_\_ [2428.3.7] {803.2.7}

## Multiple Appliances Vented in Common 09 IRC 09 UMC

- Tables req'd to be used if induced draft included \_\_\_\_\_ [2427.10.3.1] {802.10.3.1}
- Join multiple connectors as high as possible per available headroom & clearance **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 7ft above ground where adjacent to public walkways \_\_\_\_\_ [2427.3.3] {802.3.4.6}
- Terminate 3ft above forced air inlets within 10ft \_\_\_\_\_ [2427.8] {802.8.1}
- Terminate min 4ft to side or below or 1ft above building openings, min 1 ft above ground level EXC \_\_\_\_\_ [2427.8] {802.8.2}
  - Termination can be same as direct vent (**p.35**) if AMI \_\_\_\_\_ [2427.8] {802.8.1&2}
- Collect & dispose of condensate from vent (see **p.29**) \_\_\_\_\_ [2427.9] {802.9}



## 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 w/ 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]

## 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 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 <12in EXC \_\_\_\_ [1306.2.1]
  - Appliances listed for <12in & 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 1in & 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

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 w/T9.*

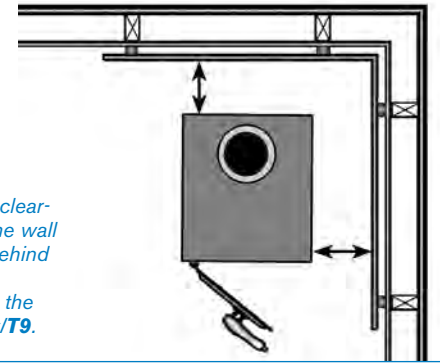
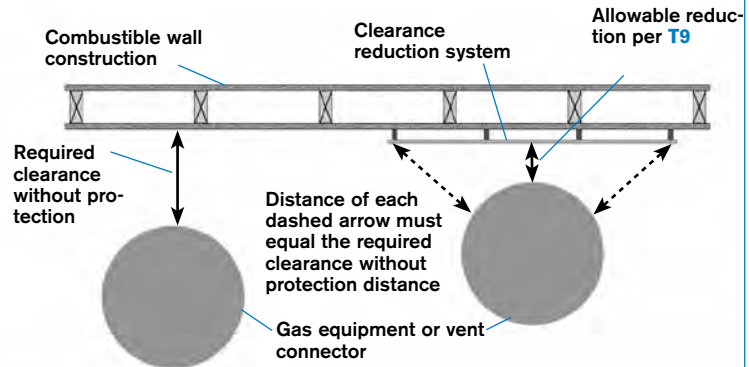


FIG. 39

### Clearance Reduction for Gas Equipment or Gas Vent Connectors



## KITCHENS

### Freestanding Ranges

- |  |               |               |          |
|--|---------------|---------------|----------|
| <input type="checkbox"/> Must be listed as household type – not commercial ____ [2447.3] | <b>09 IRC</b> | <b>09 UMC</b> | {n/a}    |
| <input type="checkbox"/> 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} |
| <input type="checkbox"/> Side clearance to combustibles AMI EXC ____ [1901.2]            |               |               | {916.1A} |
| • 6in min sides & rear for unlisted appliances ____ [Ø]                                  |               |               | {916.1A} |

### Built-in Ranges

- |   |               |               |            |
|---|---------------|---------------|------------|
| <input type="checkbox"/> Install AMI ____ [1901.2 & 2447.1]                                       | <b>09 IRC</b> | <b>09 UMC</b> | {916.2A&C} |
| <input type="checkbox"/> Vertical clearance to combustibles min 30in EXC <b>F45</b> ____ [1901.1] |               |               | {916.2B}   |
| • Lesser clearances AMI <b>F45</b> ____ [1901.1]  |               |               | {916.2B}   |
| • 24in OK w/ 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]   | <b>09 IRC</b> | <b>09 UMC</b> | {920.3} |
| <input type="checkbox"/> Min ¼in clearance to combustibles ____ [1505.1]                  |               |               | {920.3} |
| <input type="checkbox"/> Min 24in 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} |

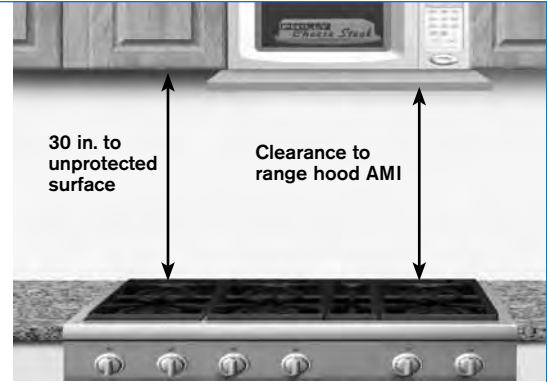
### Range Hoods

- |   |               |               |          |
|---|---------------|---------------|----------|
| <input type="checkbox"/> Must go outdoors (min 3ft from openings UMC) EXC ____ [1503.1] | <b>09 IRC</b> | <b>09 UMC</b> | {504.5}  |
| • Ductless (recirculating) range hoods OK ____ [1503.1X]                                |               |               | {303.1}  |
| <input type="checkbox"/> Exterior openings screened w/ ¼in to ½in 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.*



## INSPECTIONS

### General

- |   |               |               |             |
|---|---------------|---------------|-------------|
| <input type="checkbox"/> Nothing concealed until inspected and approved ____ [2503.2] | <b>09 IRC</b> | <b>09 UPC</b> | {103.5.1}   |
| <input type="checkbox"/> Testing to be conducted in presence of AHJ ____ [2503.1]     |               |               | {105.5.3.1} |

### Water Supply 09 IRC 09 UPC

- |  |  |  |             |
|--|--|--|-------------|
| <input type="checkbox"/> Test all piping before cover or concealment ____ [2503.2]         |  |  | {103.5.1.1} |
| <input type="checkbox"/> 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}     |
| <input type="checkbox"/> Water for testing must be from potable water source ____ [2503.7] |  |  | {609.4}     |
| <input type="checkbox"/> RPPBP devices tested at installation & annually ____ [2503.8.2]   |  |  | {603.3.3}   |
| <input type="checkbox"/> 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<sup>®</sup> Electrical<sup>®</sup> 6th Edition

Based on the 2011 NEC<sup>®</sup> and the 2009 IRC<sup>®</sup>

BY REDWOOD KARDON & DOUGLAS HANSEN

Illustrations & Layout: Paddy Morrissey

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**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.*

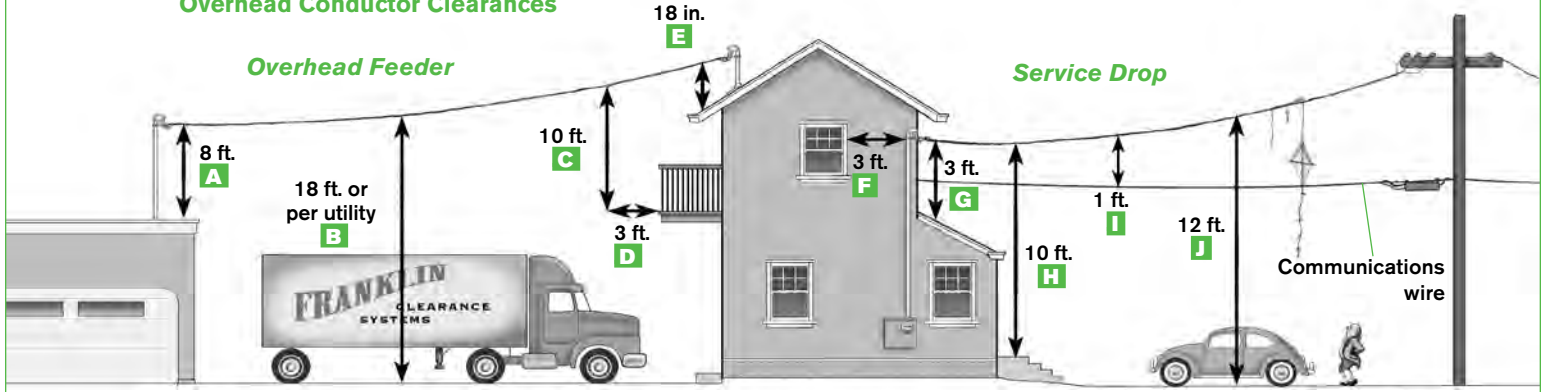
An “n/a” in a code line means the rule is not applicable to that particular code. An “EXC” at the end of a line means that an exception—or exceptions—to the rule will follow in the next line, for example (from p. 12):

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.*

FIG. 2

Overhead Conductor Clearances



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** **09 IRC** **11 NEC**
- <4-in-12 slope: min 8ft **A** EXC \_\_\_\_\_ [3604.2.1] {230.24A}
    - 3ft OK if roof area guarded or isolated \_\_\_\_\_ [n/a] {230.24AX5}'
  - ≥4-in-12 slope: min 3ft **G** EXC \_\_\_\_\_ [3604.2.1X2] {230.24AX2}
    - 18in OK for ≤4ft over eave **E** \_\_\_\_\_ [3604.2.1X3] {230.24AX3}
  - Maintain req'd distance above roof for 3ft past edge EXC \_\_\_\_\_ [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 F2** **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.*

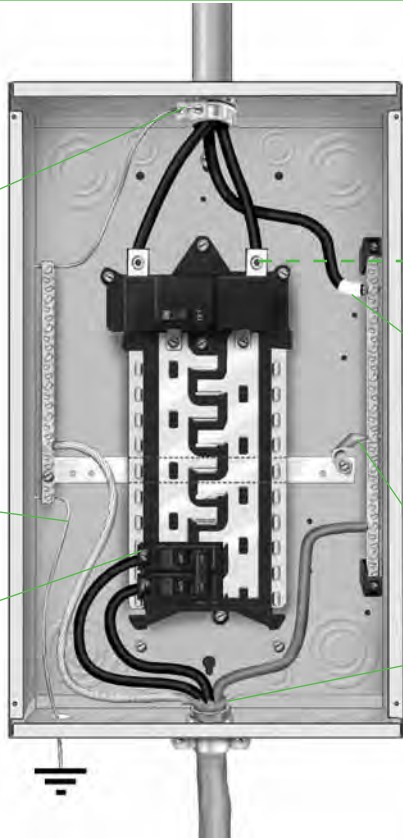
FIG. 15

### Service Panel

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

GEC

Breaker protects panel & subpanel



LINE SIDE  
LOAD SIDE

Neutral conductor identified (white tape encircling end of conductor)

Bond neutral in service enclosure

4-conductor feeder

FIG. 16

### Subpanel

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

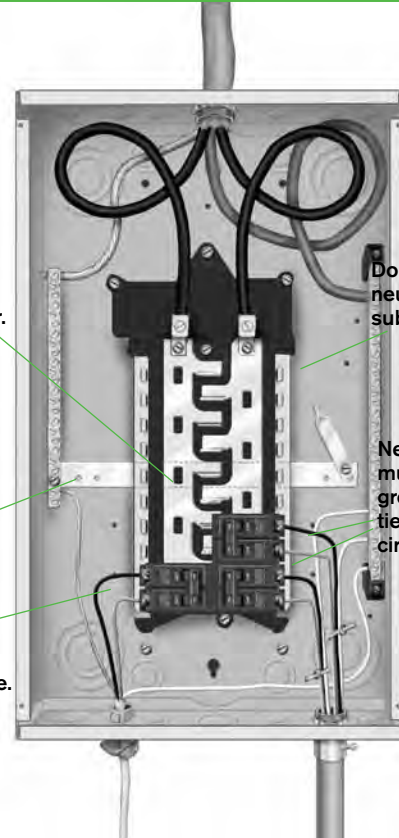


EGC

No wire tie needed for multiwire circuit in cable.

Do not bond neutral in subpanel.

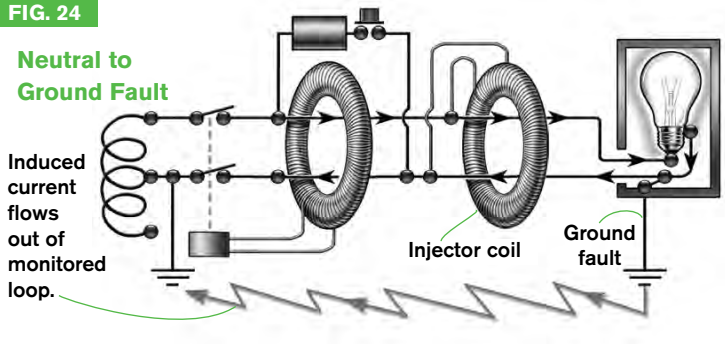
Neutrals of multiwire circuits grouped by wire ties to associated circuit conductors



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.

FIG. 24

### Neutral to Ground Fault

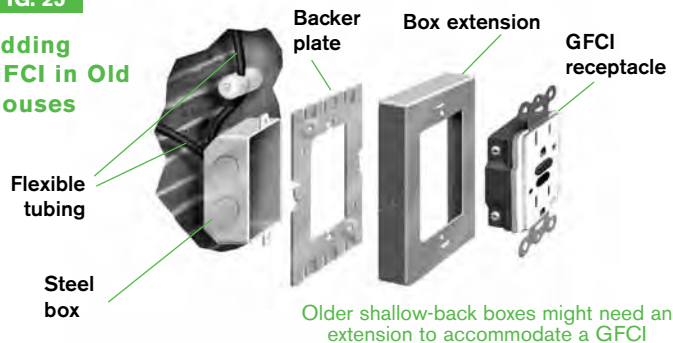


GFCIs take more space inside a box than a conventional receptacle. When adding GFCIs to old houses with shallow boxes, it might be necessary to first add an extension box, as in **F25**.

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.

FIG. 25

### Adding GFCI in Old Houses



A GFCI receptacle can provide protection for other receptacles downstream on the circuit. GFCI protection can be provided by GFCI breakers or GFCI receptacles **F26**.

FIG. 26

### GFCIs



FIG. 30

## Kitchen Receptacles

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

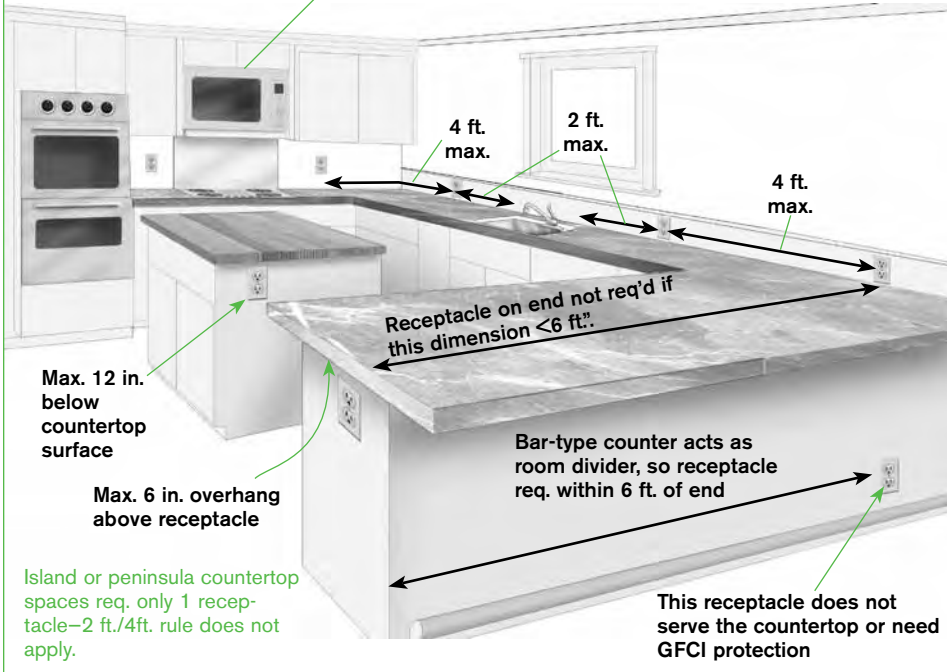
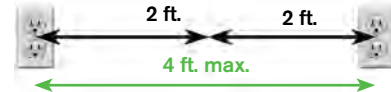


FIG. 31

## 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) F48 09 IRC 11 NEC**

- OK in dry locations only \_\_\_\_\_ [3801.4] {334.12B4}
- Protect exposed cable from damage where necessary [3802.3.2] {334.15B}
- Listed grommets for holes through metal framing \_\_\_\_\_ [3802.1] {300.4B1}
- OCPD selection based on 60° column **T11** \_\_\_\_\_ [3705.4.4] {334.80}
- Derating & temp correction based on 90° rating \_\_\_\_\_ [3705.4.4] {334.80}
- Derate >2 NM cables in same caulked (fireblocked) hole \_\_\_\_\_ [3705.4.4] {334.80}
- Derate >2 NM cables installed w/o spacing in contact w/ thermal insulation \_\_\_\_\_ [3705.4.4]<sup>40</sup> {334.80}
- Secure to box w/ approved NM clamp EXC **F49** \_\_\_\_\_ [3905.3.2] {314.17B&C}
  - Single gang (2 1/4x4in) plastic box stapled within 8in \_\_\_\_\_ [3905.3.2] {314.17CX}
- Min 1/4in sheathing into plastic boxes \_\_\_\_\_ [3905.3.1] {314.17C}
- Secure within 12in of box & max 4 1/2ft intervals \_\_\_\_\_ [3802.1] {334.30}
- Do not overdrive staples or staple flat cable on edge \_\_\_\_\_ [3802.1] {334.30}
- Bends gradual (min 5x cable diameter) \_\_\_\_\_ [3802.5] {334.24}
- Running board for small cable under joists **F47** \_\_\_\_\_ [3802.4] {334.15C}

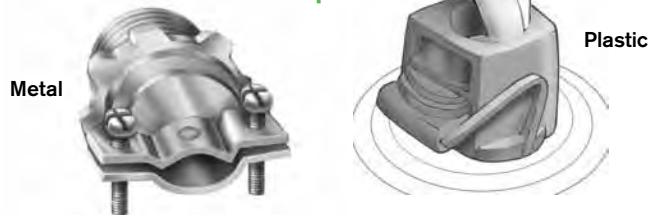
**FIG. 48**

**NM – Nonmetallic Sheathed Cable**



**FIG. 49**

**NM Clamps**



**AC – Armored Cable (BX™) F50 09 IRC 11 NEC**

- Dry locations only \_\_\_\_\_ [3801.4] {320.10}
- Secure within 12in of box & max 4 1/2ft intervals EXC 2ft where flexibility needed (motors) \_\_\_\_\_ [3802.1] {320.30B} [3802.1] {320.30D}
- Insulated (anti-short) bushing at terminations **F50** \_\_\_\_\_ [3802.1] {320.40}
- Armor is EGC—don't bring bond wire into box **F50** \_\_\_\_\_ [3908.8] {250.118}
- Underside of joists—secure at each joist \_\_\_\_\_ [n/a] {320.15}

**FIG. 50**

**AC (BX™) – Armored Cable**

