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</tr>
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**CODE CHECK® Seventh Edition**

By DOUGLAS HANSEN & REDWOOD KARDON

Illustrations & layout by Paddy Morrissey


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**MODEL CODE ORGANIZATIONS**

- **ICC** = The International Code Council
- **IAPMO** = International Association of Plumbing and Mechanical Officials
- **NFPA** = National Fire Protection Association

The IRC is a prescriptive guide to residential construction. It is intended primarily for wood-frame conventional construction within prescribed height limits and areas of wind and seismic design. When a project has aspects that exceed the prescriptive limits of the IRC, those aspects require an engineered design. Many houses will require design for certain specific portions, while the majority of the construction can be built prescriptively using the IRC. Some projects might be in wind, snow, or seismic areas that require all of the structural aspects be built to the International Building Code (IBC), while the nonstructural aspects are built to the IRC.

The information in this document is believed to be accurate; however, it is provided for informational purposes only and is not intended as a substitute for the full text of the referenced codes. Publication by The Taunton Press, ICC, and the authors should not be considered by the user to be a substitute for the advice of a registered design professional. Contact the local building department to learn what codes apply in your area as well as any local amendments and procedures.

**KEY TO USING CODE CHECK**

Each item with a checkbox refers to a **code rule**, and is followed by **code citations**. In the building section, most sections have only one column of code citations and they reference the numbers from the 2009 & 2012 IRC. Two columns of references are used when the 2009 & 2012 IRC used different numberings. In the plumbing, mechanical, and electrical sections the left citation is from the 2009 IRC, and the right column is from the 2012 IRC, and the right column is from the 2012 UPC, 2012 UMC, or 2011 NEC. Example from p.22:

**Indoor Air as Sole Source**

- **Min volume of space 50 cu.ft./1kBtu/hr. T18, F55____ [2407.5.1] (701.4.1)**

This line says that appliances deriving all their combustion air from indoors must have a space at least 50 cu. ft. for each 1,000 Btu of the appliance rating. The rule is found in section 2407.5.1 of the IRC and 701.4.1 of the UMC. It is also shown in Table 18 and Figure 55.

When the code line text ends in "EXC" an exception follows the main rule, as in this example from p.18

- **Valve ahead of union & ≤ 6 ft. of appliance F41.42 EXC____ [2420.5.1] (1211.5)**

This line says that a gas shutoff valve is required within 6 ft. of each appliance, as shown in figures 41 & 42. The IRC has an exception that allows the valve to be 50 ft. from the appliance at an accessible labeled manifold. The UPC prohibits this practice, so the reference in that column is "(O)."

Code changes from the previous code edition are shown by placing the reference in a different color, and a superscript endnote to the table on p.31, as in this example from p.20

- **Pan not req’d under tankless WHs _____________ [2801.5]11 (n/a)**

The IRC does not intend to require a drain pan under a tankless water heater. The UPC does not have this rule, so it’s reference is “n/a”. This change is explained as change #51 on p.31.

Lumber dimensions, e.g. “2 x 4”, are nominal dimensions unless including a fraction or otherwise stated.
Benjamin Franklin was chosen as the main character in our Code Check illustrations for a number of reasons. The “First American’s” insatiable curiosity, scientific genius, and civic-mindedness drove him to study fire safety, safe exiting, public sanitation, improved heating methods, and of course, electricity. Franklin made major contributions to each of the four main disciplines of building inspection: Building, Plumbing, Mechanical, and Electrical. To find out more, visit: www.codecheck.com/cc/Ben.html

### PLANNING

**Plans, Permits & Inspections**

**09 & 12 IRC**

- Approved plans & permit card on site [106.3.1]
- Permits req’d for all work EXC [105.1]
  - 1-story accessory structures ≤ 200 sq. ft., fences ≤ 7 ft.,[1] retaining walls ≤ 4 ft. from bottom of footing to top of wall, water tanks on grade ≤ 5,000 gallons, sidewalks, driveways, painting, countertops, similar finish work, window awnings projecting ≤ 54 in., decks ≤ 200 sq. ft. & ≤ 30 in. above grade & not serving req’d exit door [105.2][5]
- Inspection & approval prior to covering any work [109.4]

**Design**

- Engineered design per IBC OK as alternative to IRC [301.1.3]
- Determine climatic and geographic design criteria [301.2]
- AHJ to determine wind speed from maps & topography [T301.2]
- Special design (e.g. ASCE-7 or ICC-600) where maps indicate special wind regions or basic wind speed > 110 mph [301.2.1.1][5]
- AHJ to determine seismic design category from IRC maps [301.2.2.1]
- AHJ may allow alternate determination of SDC E if all shear walls extend from foundation to top story & no cantilevers or irregularity [301.2.2.1.2]

### BUILDING LOCATION

**Setbacks F1**

- Verify setbacks – unrated walls min 5 ft. to LL EXC [T302.1] (T302.1(1))
  - 3 ft. if compliant automatic sprinkler system present [n/a] (T302.1(2))
- No openings in walls < 3 ft. to LL EXC [T302.1] (T302.1)
- Openings in walls perpendicular to LL OK [302.1X1] (302.1X1)
- Facing dwellings & accessory structures on same lot [302.1X2] (302.1X2)
- Accessory structures that are exempt from permits [302.1X3] (302.1X3)
- Foundation vents [302.1X5] (302.1X5)
- Openings up to 25% of wall area OK > 3 ft. & ≤ 5 ft. EXC [T302.1] (T302.1)
  - No limit > 3 ft. if automatic sprinkler system present [n/a] (T302.1(2))
- Projections (eaves) min. 5 ft. from LL EXC [T302.1] (T302.1)
  - 2 ft. O K if 1-hr. protected on underside [T302.1] (T302.1(1))
  - 3 ft. O K unrated if automatic sprinkler system present [n/a] (T302.1(2))
  - 4 in. O K in detached garages 2 ft. from LL [302.1X4] (302.1X4)

**Fire Separation Distances & Openings**

<table>
<thead>
<tr>
<th>FIG. 1</th>
<th>Non-sprinklered</th>
<th>Sprinklered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-hour fire rating</td>
<td>No openings</td>
</tr>
<tr>
<td></td>
<td>&lt;3 ft.</td>
<td>&lt;3 ft.</td>
</tr>
<tr>
<td></td>
<td>≥3 ft.</td>
<td>≥3 ft.</td>
</tr>
<tr>
<td></td>
<td>&lt;5 ft.</td>
<td>≤5 ft.</td>
</tr>
<tr>
<td></td>
<td>≥5 ft.</td>
<td>≥5 ft.</td>
</tr>
</tbody>
</table>

- 1-hour fire rating
- No openings
- No fire rating
- No restrictions on openings
WALL FRAMING

Stud Framing

- Size, spacing, notching & boring per tables T4,F10 [602.3.1]
- Studs must fully bear on min 2 in. nominal sole plate [602.3.4]
- Corners req 3 studs min EXC [F602.3(2)]
  - 2 studs OK w/ cleats for attaching interior surfaces [F602.3(2)]
- Single members headers allowed w/ spans per IRC T602.7.1 F11 [602.7.1]*

Top Plates

- Bearing wall intersections & corners must overlap [602.3.2]
- End joints must offset 24 in. min (see T7 for nailing) [602.3.2]
- Joints need not be over studs [602.3.2]
- Min 16 gauge 1½ in. strap w/ min 8 10d nails each side over notches or holes > 50% of plate width F10 EXC [602.6.1]
  - Not req’d when structural panel sheathing covers notches [602.6.1]

Cripple Walls

- Cripple wall < 14 in. sheathed or solidly blocked [602.9]
- Studs ≥ studs above them, walls > 4 ft. sized as additional story [602.9]

Wood Structural Panel Sheathing

- Panels req grade stamp from approved agency [602.3]
- Fasten direct to framing members in accordance w/ T7 [602.3]

<table>
<thead>
<tr>
<th>Stud Size</th>
<th>2x4</th>
<th>3x4</th>
<th>2x6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bearing Walls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(to 10ft. high)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supporting roof &amp; ceiling</td>
<td>24 in. O.C.*</td>
<td>24 in. O.C.</td>
<td>24 in. O.C.</td>
</tr>
<tr>
<td>Roof &amp; ceiling + 1 floor</td>
<td>16 in. O.C.*</td>
<td>24 in. O.C.</td>
<td>24 in. O.C.</td>
</tr>
<tr>
<td>Roof &amp; ceiling + 2 floors</td>
<td>n/a</td>
<td>16 in. O.C.</td>
<td>16 in. O.C.</td>
</tr>
<tr>
<td>Notching F9</td>
<td>7/8 in.</td>
<td>7/8 in.</td>
<td>1 1/8 in.</td>
</tr>
<tr>
<td>Boring F9</td>
<td>1 1/8 in.</td>
<td>1 1/8 in.</td>
<td>2 3/4 in.</td>
</tr>
<tr>
<td>Boring 2 doubled consecutive</td>
<td>2 in.</td>
<td>2 in.</td>
<td>3 3/4 in.</td>
</tr>
<tr>
<td><strong>Nonbearing Walls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notching F9</td>
<td>1 1/8 in.</td>
<td>1 1/8 in.</td>
<td>2 3/4 in.</td>
</tr>
<tr>
<td>Boring F9</td>
<td>2 in.</td>
<td>2 in.</td>
<td>3 3/4 in.</td>
</tr>
</tbody>
</table>

*Limited to roof spans ≤32 ft.

WALL BRACING FOR WOOD FRAME BUILDINGS

Locations

- BWL is straight line in plan view  [09 IRC: 202] [12 IRC: 602.10.1]
- Exterior walls max offset from braced wall line 4 ft. [09 IRC: 602.10.1.4] [12 IRC: 602.10.1.2]
- Max spacing of BWLs 25 ft. SDC D [09 IRC: 602.10.1.5] [12 IRC: 602.10.1.3]
- Max length from end 10 ft. (12.5 combined in 09) [09 IRC: 602.10.1.4] [12 IRC: 602.10.2.2]*
- Max. 20 ft. between braced wall panel ends in same BWL [n/a] [12 IRC: 602.10.2.2]*

Methods

- All buildings req bracing by 1 of following methods:  [602.10] [602.10.10]
  - Intermittent bracing methods [602.10.2] [602.10.4]
  - Continuous sheathing [602.10.4.45] [602.10.4.2]
  - Simplified wall bracing method in SDC A, B & C [n/a] [602.12]*
- Intermittent braced wall panels min 48 in. length EXC [602.10.3] [602.10.5]
  - Alternate braced wall panels [602.10.3.2] [T602.10.5]
  - Portal frame w/ hold-downs [602.10.3.3] [T602.10.5]
  - Garage door openings in SDC A, B, or C [602.10.3.4] [T602.10.5]
SAFETY GLAZING

Safety Glass Identification
09 & 12 IRC

- Tempered glass reqs permanent etched label EXC [308.1]
- Spandrel glass removable paper label OK [308.1X2]
- Only 1 lite req's full label in multipane windows w/ lites ≤ 1 sq. ft., others marked "CPSC 16 CFR 1201" or "ANSI Z97.1" [308.1.1]
- Laminated glass does not req label [308.1X1]

Hazardous Locations Requiring Safety Glass
09 IRC 12 IRC

- Glass in swinging, bifold, or sliding doors EXC [308.4-1] [308.4.1]
  - Decorative glazing or lites w/ < 3 in. least dimension [308.4-1X] [308.4.1X]
- Sidelites where glass is < 24 in. arc of door edge & any part of glass
  < 60 in. above floor or walking surface EXC F22 [308.4-2] [308.4.2]
  - Decorative glazing [308.4-2X1] [308.4.2X1]
  - Where separated by wall or intervening barrier [308.4-2X2] [308.4.2X2]
  - Where door only accesses closet < 3 ft. deep [308.4-2X3] [308.4.2X3]
  - Perpendicular to door & on latch side F22 [308.4-2X4] [308.4.2X4]
  - Adjacent to fixed panel of patio doors F22 [308.4-2X5] [308.4.2X5]
- Windows w/ walk-through hazard EXC F22 [308.4-3] [308.4.3]
  - Decorative glass [308.4-3X1] [308.4.3X1]
  - Protection from railing on side w/ walking surface [308.4-3X2] [308.4.3X2]
  - All glazing in railings [308.4-4] [308.4.4]
- Wet areas (walls & enclosures facing walls of hot tubs, spas, whirlpools, bathtubs, showers, pools) where lower edge of glass ≤ 60 in. above standing or walking surface EXC [308.4-5&6] [308.4.5&6]
  - Glazing > 60 in. horizontal from water’s edge [308.4-5X] [308.4.5X]
- Glazing ≤ 3 ft. horizontally from stair or ramp EXC [308.4-7] [308.4.6X2]
  - Intervening rail 34-38 in. high & withstandig 50 psf load w/ O touching glass [308.4-7X1] [308.4.6X1]
  - Guard or handrail > 18 in. horizontal from glass [308.4-7X2] [n/a][308.4.7X2]
  - Solid wall 34 in. to 36 in. below glass [308.4-7X3] [n/a][308.4.7X3]
- Glazing < 60 in. horizontal of bottom stair landing & < 36 in. above landing EXC [308.4-8] [308.4.7X7]
  - Intervening guard min 18 in. from glass [308.4-8X1] [308.4.7X7]
  - Solid wall 34 in. to 36 in. below glass [308.4-8X2] [n/a][308.4.7X7]

SAFETY GLAZING

Performance & Labeling
09 IRC 12 IRC

- Windows & doors installed & flashed AMI [612.1] [612.1]
- Installation instructions req'd for each window & door [612.1] [612.1]
- Must be designed to resist wind loads [612.5] [612.2]
- Anchor glass assemblies AMI for design pressure [612.10.1] [612.7.1]
- 3rd party performance testing & labeling req'd EXC [612.6] [612.3]
  - Decorative glazed openings exempt [612.6X] [612.3X]
- Garage doors to ASTM E 330 ANSI/DASMA 108 [612.7] [612.4]

Coil pressurized systems must be drained of water & enclosures must be flashed AMI.

SAFETY GLAZING

ENERGY EFFICIENCY

Compliance
09 IRC 12 IRC

- Software can be approved to demonstrate compliance [n/a] [1101.5]
- Compliance certificate posted on electrical panel [1101.9] [1101.16]
- Additions & alterations same as new construction EXC [n/a] [1101.3]
  - Replacement fenestration, glass, up to 50% of luminaires, reroofing if sheathing not exposed & energy use not increased [n/a] [1101.3X]

Building Thermal Envelope

- HVAC systems sized per ACCA Manual S & J [1103.6] [1103.6]
- Programmable thermostat req'd for central FAU heat [1103.1] [1103.1]
- Attic ducts min R-6 insulation, others min R-4 [1103.2.1] [1103.2.1]
- Duct leakage test mandatory [1103.2.2] [1103.2.2]
- All recessed luminaires type IC airtight & gasketed trim [1102.4.5] [1102.4.4]
- Min 75% installed lamps high-efficacy (50% in 09) [1104.1] [1104.1]

Building Garages ➤ Fireplaces ➤ Interiors ➤ Safety Glass ➤ Energy
PIPING INSTALLATION & PROTECTION

General
- 12 IRC 12 UPC
- Max support intervals T11
- Min 16 gage steel shield plate if < 1 1/2 in. from edge of framing (18 gage and 1 in. in UPC) F26
- Extend 2 in. above sole plate & below top plates
- Freeze protection req’d for pipes outside building thermal envelope in areas subject to freezing
- Each pipe & fitting must bear manufacturer identification & any markings req’d by applicable standards

Utility Trenches
- PVC: Provide for expansion every 30 ft.
- Cast iron w/ no-hub fittings: IRC: 5 ft. (10 ft. for 10 ft. pipes) IRC: 15 ft.
- ABS & PVC: 4 ft.
- Cast iron w/ no-hub fittings: IRC: 5 ft. (10 ft. for 10 ft. pipes) IRC: 15 ft.
- UPC: Base & each floor & max. 10 ft.

TABLE 11  MAX. SUPPORT INTERVALS [T2605] {T313.1}

<table>
<thead>
<tr>
<th>Pipe or Tube</th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPVC</td>
<td>≤ 1 in. – 3 ft.</td>
<td>IRC: 10 ft. &amp; midstory guides for ≤ 2 in.</td>
</tr>
<tr>
<td>PEX</td>
<td>≤ 1 in. 32 in.</td>
<td>UPC: Base &amp; each floor + midstory guides</td>
</tr>
<tr>
<td>ABS &amp; PVC</td>
<td>≥ 4 ft.</td>
<td>IRC: 15 ft.</td>
</tr>
<tr>
<td>Cast iron w/ no-hub fittings</td>
<td>IRC: 5 ft. (10 ft. for 10 ft. pipes) IRC: 15 ft.</td>
<td></td>
</tr>
<tr>
<td>UPC</td>
<td>&gt; 1 in. – 4 ft.</td>
<td>IRC: 10 ft.</td>
</tr>
<tr>
<td>Cu Tubing</td>
<td>&gt; 1 1/2 in. – 10 ft.</td>
<td>UPC: Each floor &amp; max. 10 ft.</td>
</tr>
</tbody>
</table>

Utility Trenches
- 12 IRC 12 UPC
- Backfill in layers & tamped in place - no backhoe or grader until 12 in. of tamped earth in place F25
- Contact utility re: sharing gas or electric in water trench [utility] (utility)
- Water service min 12 in. deep (12 in. cover UPC) F26
- Water service min 6 in. (12 in. UPC) below frost line
- Water in sewer trench if materials OK in house F25
- If other sewer material, separate trench req’d (5 ft. away IRC) or install water pipe on shelf 12 in. above sewer F25
- Sewer depth per local BO & utility
- Utility or other trench may not undermine footing
- Pipes through foundation req sleeve or arch

PIPING UNDER OR ENCASED IN CONCRETE SLABS
- 12 IRC 12 UPC
- Pipes through concrete wrapped or sheathed
- Gas underground beneath building req’s conduit
- Cu water tubing underground beneath building min Type L [n/a]

Underground Gas Pipes
- Min depth (min cover UPC) 12 in. EXC
- 8 in. OK for individual lines to lights, grills, etc. [n/a]
- 18 in. cover unless external damage not likely [n/a]
- Provide sleeve or bridge in conduit if < 12 in. cover
- Plastic only OK underground outside building
- Tracer wire min 18 AWG (UPC 14 AWG) adjacent to plastic pipe & brought above ground at riser
- Buried metal factory wrapped EXC
- Field wrapping OK where stripped for threading

ROUGH INSPECTION - TESTING

Required Pre-Concealment Piping Tests
- 12 IRC 12 UPC
- Test all piping before cover or concealment
- DWV water test min. 10 ft. head for 15 minutes OR
- Air test 5psig (10 in. mercury) for 15 minutes
- Water pipe test 15 minutes w/ potable water at working pressure
- TEST all piping before cover or concealment

TABLE 12  DFUS, TRAPS & TRAP ARMS

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Min. Trap Size</th>
<th>DFUs</th>
<th>IRC Length to Vent</th>
<th>UPC Length to Vent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathub</td>
<td>1 1/2 in.</td>
<td>2</td>
<td>6 ft.</td>
<td>3 ft. 6 in.</td>
</tr>
<tr>
<td>Bidet</td>
<td>1 1/4 in.</td>
<td>1</td>
<td>5 ft.</td>
<td>2 ft. 6 in.</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>2 in.</td>
<td>3</td>
<td>8 ft.</td>
<td>5 ft.</td>
</tr>
<tr>
<td>Floor Drain</td>
<td>2 in.</td>
<td>0A</td>
<td>8 ft.</td>
<td>5 ft.</td>
</tr>
<tr>
<td>Kitchen Sink</td>
<td>1 1/2 in.</td>
<td>2</td>
<td>6 ft.</td>
<td>3 ft. 6 in.</td>
</tr>
<tr>
<td>Laundry Tub</td>
<td>1 1/4 in.</td>
<td>1</td>
<td>5 ft.</td>
<td>2 ft. 6 in.</td>
</tr>
<tr>
<td>Lavatory</td>
<td>2 in.</td>
<td>3</td>
<td>8 ft.</td>
<td>5 ft.</td>
</tr>
<tr>
<td>Shower</td>
<td>3 in.</td>
<td>3</td>
<td>no limit</td>
<td>6 ft.</td>
</tr>
</tbody>
</table>

A. If used as a receptor, use the DFUs of the fixture; the UPC counts all floor drains as 2 DFUs.
B. With or without dishwasher or disposer.
C. After the trap arm the UPC min. drain size is 2 in.
D. UPC 1 1/2 in. for sets of 2 or 3 lavatories.
E. IRC shower traps can be 1 1/2 in. for up to 5.7 gpm flow rates.
PLUMBING

WATER SUPPLY & DISTRIBUTION (CONT.)

Piping & Valves 12 IRC 12 UPC
- Accessible fullway main shutoff req’d F33,34 [2409.9.1] (606.2)
- Accessible fullway shutoff req’d at WH F33,34 [2409.9.2] (606.2)
- Brass adapter [or dielectric fittings] between galv & Cu [2905.17.1] (316.2.1)
- Water hammer arrestors req’d if quick-close valves __ [2903.5] (609.10)
- Individual shutoff req’d each fixture except tubs & showers [2903.9.3] (606.5)
- Control valve can be at manifold if identified __ [2903.8.5] (606.5)

Protection of Potable Water Supply 12 IRC 12 UPC
- No connections between private & public water supply __ [2902.1] (602.2)
- Fixture outlet air gaps min 2X diameter of outlet __ [2902.3.1] (603.2.1)
- Backflow protection devices to recognized standards __ [T2902.3] (603.2.2)

GAS PIPING

General 12 IRC 12 UPC
- Locate gas meter in accessible & ventilated space __ (utility) [2410.6.1] (1208.6.1)
- Main shutoff req’d at each meter & building F36 __ [2420.283] (1210.11.2)
- Material: steel (galv or black), type K or L Cu, CSST [2414.485] (1208.5.2.23)
- Cu only OK for low sulfur-content gas __ [2414.5.2] (1208.5.2.3)
- Size pipe per tables T16-17 __ [2413.3] (1217.1)
- Support pipe & smooth-wall tubing per T15 __ [2424.1] (1201.2.4)
- Interior of pipe or tubing must be deburred __ [2414.7] (1208.5.5)
- No gas pipe in duct, clothes chute, or gas vent __ [2415.3] (1210.2.3)
- Outdoor piping min 3½ in. above ground or roof __ [2415.9] (n/a)
- No unions or bushings in concealed locations __ [2415.5] (1210.3)
- Shutoff before each medium-pressure regulator __ [2420.4] (1210.11)

Appliance Shutoffs & Connections 12 IRC 12 UPC
- Valve ahead of union & ≤ 6 ft. of appliance F41,42 EXC [2420.5.1] (1211.5)
  - 50 ft OK if accessible identified valve at manifold __ [2420.5.3] (n/a)
- Max length connector 6 ft. __ [2422.1.2.1] (n/a)
- Flex connectors not through walls, floors, ceilings __ [2422.1.2.3] (1211.4.4)
- Connector not through appliance housing EXC __ [2422.1.2.3] (n/a)
  - Hard pipe, flex connectors protected against damage,
  - & fireplace inserts w/ grommets AAMI __ [2422.1.2.3X] (n/a)
- Sediment trap close as practical to appliance EXC F41,42 [2419.4] (1211.8)
  - Ranges, clothes dryers, fireplaces & gas lights __ [2419.4] (1212.8)

Corrugated Stainless Steel Tubing (CSST) 12 IRC 12 UPC
- Install AAMI (includes training & qualification) __ [2414.5.3] (1208.5.3.4)
- Sizing, support, protection, & connection AAMI __ [2414.5.3] (1208.5.3.4)

Electrical Bonding 12 IRC 12 UPC
- Gas pipe not OK as grounding electrode in earth __ [2410.1] (1210.15.3)
- Electrically bond above-ground metal gas pipes __ [2411.1] (1210.15.1)
- Appliance EGC sufficient to bond non-CSST gas pipe __ [2411.1] (1210.15.1)
- Bond between electrical service & metal pipe between meter & first downstream CSST fitting F36 __ [2411.1.1*] (1210.15.2)
- CSST bonding jumper min 6 AWG Cu F36 __ [2411.1.1] (1210.15.2)

TABLE 15 GAS PIPING & TUBING SUPPORT [T2424.1] (T1210.2.4.1)

<table>
<thead>
<tr>
<th>Nominal Size (in.)</th>
<th>Max. Support (ft.)</th>
<th>Smooth-Wall Tubing</th>
<th>Max. Support (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>½</td>
<td>6</td>
<td>½</td>
<td>4</td>
</tr>
<tr>
<td>¾ or 1</td>
<td>8</td>
<td>⅞ or ⅞ or ⅞</td>
<td>6</td>
</tr>
<tr>
<td>≥ 11/2 (horizontal)</td>
<td>10</td>
<td>≥ ⅞ or 1 (horizontal)</td>
<td>8</td>
</tr>
<tr>
<td>≥ 1 1/4 (vertical)</td>
<td>Every floor level</td>
<td>≥ ⅞ or 1 (vertical)</td>
<td>Every floor level</td>
</tr>
</tbody>
</table>

TABLE 16 SIZE PROCEDURES [2413.4.1&2] & (1216.1.1&2)

1. Determine Btu/cu. ft. gas from local supplier (usually 1100).
2. Divide appl Btu by Btu/cu. ft. to obtain appliance demand.
3a. Longest length method: Measure developed length to most remote outlet.
3b. Branch length method: Measure developed length to each outlet.
4a. Longest length method: Use column from T17 for most remote fixture for all outlets.
4b. Branch length method: Select column from T17 for load on piping to each outlet.
5. Select row for pipe size equaling or exceeding demand each section.

TABLE 17 GAS PIPING (T2413.4(1)) & (T12-8)

<table>
<thead>
<tr>
<th>Pipe</th>
<th>Length (in feet)</th>
<th>Demand Capacity (cu ft/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 in.</td>
<td>172</td>
<td>118</td>
</tr>
<tr>
<td>3/4 in.</td>
<td>360</td>
<td>247</td>
</tr>
<tr>
<td>1 in.</td>
<td>678</td>
<td>466</td>
</tr>
<tr>
<td>1 1/4 in.</td>
<td>1390</td>
<td>957</td>
</tr>
<tr>
<td>1 1/2 in.</td>
<td>2090</td>
<td>1430</td>
</tr>
</tbody>
</table>
WATER HEATERS

General
- Replacements of WH req’s permit [105.1] [502.1]
- Installation & maintenance instructions to be left w/ WH [1307.1] [507.24]
- Full-open valve req’d on cold water supply [F33,34] [2903.9.2] [606.2]
- Unions req’d within 12 in. of tan to service and removal [n/a] [609.5]
- Electrical WH req’s in-sight or lockable disconnect [T4101.5] [NECp.28]

Location
- Fuel-fired WH prohibited in storage closets [2005.2 & 2406.2] (local)
- Fuel-fired WHs in bedroom, bathroom, req separation by weatherstriped
- self-close door & exterior combustion air [EXC] [2406.2] [504.1]
- Direct-vent type [2005.2 & 2406.2] [504.1]
- Watertight pan req’d if leaks would cause damage [F42] [2801.5.1] [507.4]
- Pan not req’d under tankless WHs [2801.5] [507.4]
- Ignition source > 18 in. above garage floor [EXC] [2801.6] [507.13]
- Flammable Vapor Ignition Resistant (FVIR) WH [F42] [2801.6X] [507.13]
- Protection from vehicles req’d in garage [1307.3.1] [507.13.1]
- WH supported on ground req’s 3 in. concrete base [n/a] [507.3]
- Outdoor enclosure req’d unless WH listed for outdoors [2005.1] [507.25]
- Seismic restraint upper & lower 1/3rd of tank in SDC D & townhouses in
  SDC C (all occupancies in SDC C & D in UPC) [F42] [2801.7] [507.2]

Access & Working Space
- Access & working space req’d (IRC min. 30 in. x 30 in.) [2801.3] [507.26]
- Min closet door size 24 in. wide [1305.1.2] (local)
- Attic: solid passage floor max 20 ft., min 24 in. wide [1305.1.3] [508.4]
- Attic equipment req’s light & recep near WH [1305.1.3.1] [508.4.4]

Tankless (On Demand) Water Heaters F42
- Size gas line to max BTU rating [2413.2] [1215.2]
- Install AMI (PRV usually specified) [2005.1] [507.24]
- Type III vent typically req’d [2005.1] [507.24]
- Direct-vent water heater vent clearances [2427.8] [508.8.2]
- Not OK to vent in common w/ other appliances [2427.10.4] [509.10.3.2]
**Venting**

**General (Gravity Gas)**

- Install vents AMI (most appliances ship w/ GAMA venting tables that include limits for size, length & offsets) [2427.6.1] (802.1.1)
- Induced-draft (Category II) can be “gravity vent” T19 [2427.6.1] (802.1.1)
- Vent size ≥ draft hood size & ≤ 7× draft hood size [2427.6.8.1] (802.6.3.1)
- One 60° offset OK, others max 45° EXC [2427.6.8.2] (802.6.1)
- Systems designed using vent sizing tables [2427.6.8.1] (802.6.1)
- Provide proper support AMI [2426.6] (802.6.7)
- Insulation shield to min 2 in. above attic insulation [2426.4] (manu)
- No solid fuel & gas in same chimney flue [2426.5.6.1] (802.5.8)
- Vents < 1½ in. from face of framing req steel plate protection extending 4 in. beyond edge of framing member [2426.7] (manu)

<table>
<thead>
<tr>
<th>TABLE 19</th>
<th>APPLIANCE VENTING CATEGORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Condensation</td>
</tr>
<tr>
<td>I</td>
<td>No</td>
</tr>
<tr>
<td>II</td>
<td>Yes</td>
</tr>
<tr>
<td>III</td>
<td>No</td>
</tr>
<tr>
<td>IV</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Connectors**

- Connectors short & straight as practical [2427.10.8] (n/a)
- Basic max horizontal length 18 in. per in of diameter [2428.3.2] (803.2.1)
- Single-wall connector max length 75% of vertical vent [2427.10.8] (802.10.7.1)
- Type B connector max length 100% of vertical vent [2427.10.8] (802.10.7.2)
- Max 2× diameter of vent collar or draft hood [2428.2.11] (803.1.14)
- No single wall in attics or excessively cold areas [2427.10.2.2] (802.10.1.2)
- No single-wall connector through interior wall [2427.10.13] (802.10.12)
- Slope min ¼ in./ft. toward appliance F56 [2427.10.7] (802.10.6)
- Connect to appliance vent collar w/ screws or AMI [2427.10.6] (802.10.5)

**Appliances with Common Venting**

- 2 draft-hood equipped appliances: common connector ≥ largest connector + 50% of smaller flue collar outlet size [2427.10.3.4] (802.10.2.3)
- Join smaller connector to common connector at highest level consistent w/ available headroom F56 [2427.10.4] (802.10.3.1)
- Connectors ≤ 45° of vertical OK at same level F56 [2427.10.4.1] (802.10.3)

**Single-Wall Vents**

- Not allowed in dwellings [2427.7.4] (802.7.3)
- Only for runs from appliance space directly to outside [2427.7.6] (802.7.3.2)
- May not originate in attic or pass through inside wall [2427.7.6] (802.7.3.2)
- Min 6 in. clear to combustible for single-wall pipe [2427.7.8] (802.7.3.4)

**B Vents Termination**

- Must extend above roof [2427.6.3] (802.6.2)
- Min 5 ft. vertical height above flue collar F44 [2427.6.4] (802.6.2.1)
- If vertical surface within 8 ft. vent must terminate min. 2ft. higher than any part of building within 10 ft. horizontal F57 [2427.6.4] (802.6.2)
- Min height above roofs T20 [2427.6.3] (802.6.2)

**Forced Vents (Category IV)**

- 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)
- Req’d plastic joint primers must be contrasting color [2427.1.1] (802.4.2)
- No natural & forced-vent to common flue [2427.3.3] (802.3.4.4)
- Terminate min 4 ft. to side or below or 1 ft. above building openings & min 1ft. above ground level EXC [2427.8] (802.8.1.2)
- Termination can be same as direct vent if AMI [2427.8] (802.8.1.2)
- Collect & dispose of condensate from vent (p.24) [2427.9] (802.9)

**Direct Vent Termination**

- Clearances to building openings: 0-10 kBTU/hr min 6 in., 10-50 kBTU/hr min 9 in., > 50 kBTU/hr min 12 in. F58 [2427.8] (802.8.3)
- 12 in. min clearance to finished ground level [2427.8] (802.8.3)

**TABLE 20 **B VENT TERMINATION (F57) [F2427.6.3] (T802.6.2)

<table>
<thead>
<tr>
<th>Roof Slope</th>
<th>Min. Height (ft.)</th>
<th>Roof Slope</th>
<th>Min. Height (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat to 6/12</td>
<td>1</td>
<td>&gt; 11/12 to 12/12</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 6/12 to 7/12</td>
<td>1½</td>
<td>&gt; 12/12 to 14/12</td>
<td>5</td>
</tr>
<tr>
<td>&gt; 7/12 to 8/12</td>
<td>1</td>
<td>&gt; 14/12 to 16/12</td>
<td>6</td>
</tr>
<tr>
<td>&gt; 8/12 to 9/12</td>
<td>2</td>
<td>&gt; 16/12 to 18/12</td>
<td>7</td>
</tr>
<tr>
<td>&gt; 9/12 to 10/12</td>
<td>2½</td>
<td>&gt; 18/12 to 20/12</td>
<td>7½</td>
</tr>
<tr>
<td>&gt; 10/12 to 11/12</td>
<td>3½</td>
<td>&gt; 20/12 to 21/12</td>
<td>8</td>
</tr>
</tbody>
</table>

**FIG. 56**

**FIG. 57**

**FIG. 58**
Grounding Electrode System (GES) FIG. 66

Thel electrodes are bonded together, forming a system. The GEC connects them to the service neutral and equipment grounding conductors at the service equipment.

Grounding Electrode Conductor (GEC)

- GEC must connect to incoming service neutral
- 8 AWG req’s protection in raceway or cable armor
- 6 AWG following building contour OK w/o protection
- Size GEC to T23 EXC
- 6 AWG largest req’d size if dead-ends at rod
- 4 AWG largest req’d size if dead-ends at Ufer

EQUIPMENT GROUNDING CONDUCTOR SIZES

<table>
<thead>
<tr>
<th>Cu Service Wire Avg Size</th>
<th>Al Service Wire Avg Size</th>
<th>Max Service Rating</th>
<th>Size of Cu GEC</th>
<th>Breaker Rating</th>
<th>AWG Size of Cu GEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1/0</td>
<td>≤ 1/0</td>
<td>125</td>
<td>8</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>1 or 3/0</td>
<td>2/0 or 3/0</td>
<td>150/175</td>
<td>6</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>2/0 or 3/0</td>
<td>4/0 or 250 kcmil</td>
<td>200/225</td>
<td>4</td>
<td>30/60</td>
<td>10</td>
</tr>
<tr>
<td>&gt; 3/0 to 350 kcmil</td>
<td>&gt; 250kcmil to 500 kcmil</td>
<td>250/300</td>
<td>2</td>
<td>70/100</td>
<td>8</td>
</tr>
<tr>
<td>&gt; 350 kcmil to 600 kcmil</td>
<td>&gt; 500 kcmil to 900 kcmil</td>
<td>400</td>
<td>1/0</td>
<td>110/200</td>
<td>6</td>
</tr>
</tbody>
</table>

A. Use Code Check Electrical for Al GEC sizes.

B. Al EGCS 1 size larger than Cu.

Grounding & Bonding FIG. 65

- Do not bond neutral in subpanel.
- Bond neutral in service enclosure.
- 2 circuits to common yoke & multiwire circuits req handle tie or single-handle 2-pole breaker.

Equipment Bonding & Grounding FIG. 66

- Wire EGCS sized per
- EGC must provide effective ground-fault current path
- Earth is not an effective ground-fault current path
- RMCE, IMC, EMT, AC cable armor, electrically continuous raceways & surface metal raceways OK as EGC
- Remove paint from contact surfaces of ground bars

Bonding FIG. 65

- Bond all available electrodes (water piping, rod, Ufer)
- Bond metal raceways enclosing GEC
- Bond service raceway fittings w/ bonding jumpers if knockouts remain or reducing washers used
- Use bonding locknuts if no remaining concentrics remain
- Bond metal piping, hot, cold & gas
- EGC of equipment may be used to bond gas

Intersystem Bonding FIG. 65

- Provide accessible external terminal bar w/ min terminals to bond phone & CATV
- Bar not to interfere w/ opening service enclosure

General FIG. 64

- Working space 30 in. wide x 3 ft. deep min
- Working space to floor & min 6 ft. 6 in. height
- No grounding of neutral after service
- Existing separate structure w/ no parallel metal path
- No bonding subpanel neutral to enclosure
- Only 1 wire per breaker unless L&L for 2
- Each neutral req’s individual terminal
- Overcurrent protection req’d per
- All terminals torqued per labeling
- Breaker brand and models L&L for panel
- Use metal underground water pipe if in damp or wet location
- 1/4 in. air space req’d behind surface-mounted metal panel
- Not to be located over steps of a stairway
- No panels in clothes closet or bathroom
- Max height of center of breaker handle 6 ft. 7 in.
- Unused openings closed equivalent to original
- Multiwire circuits req handle tie or single handle
- e.g., room color or occupant’s name
- Circuit description not dependent on temporary conditions, e.g., room color or occupant’s name
- Multiwire circuits req handle tie or single handle
- Unused openings closed equivalent to original
- Max height of center of breaker handle 6 ft. 7 in.
- No panels in clothes closet or bathroom
- Not to be located over steps of a stairway
- 1/4 in. air space req’d behind surface-mounted metal panel in damp or wet location
- Circuit description not dependent on temporary conditions, e.g., room color or occupant’s name

Grounding & Bonding FIG. 65

- Use metal underground water pipe if ≥ 10 ft. in earth
- Connect GEC to pipe not > 5 ft. inside building
- Bond around removable equipment (meters, etc.)
- Water pipe cannot be only grounding electrode
- Bond service raceway fittings w/ bonding jumpers if knockouts remain or reducing washers used
- Use bonding locknuts if no remaining concentrics remain
- Bond metal piping, hot, cold & gas
- EGC of equipment may be used to bond gas

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- Remove paint from contact surfaces of ground bars

B. Al EGCS 1 size larger than Cu.

Grounding Electrode System (GES) FIG. 66

Thel electrodes are bonded together, forming a system. The GEC connects them to the service neutral and equipment grounding conductors at the service equipment.

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- GEC must connect to incoming service neutral
- 8 AWG req’s protection in raceway or cable armor
- 6 AWG following building contour OK w/o protection
- Size GEC to T23 EXC
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- 4 AWG largest req’d size if dead-ends at Ufer

EQUIPMENT GROUNDING CONDUCTOR SIZES

<table>
<thead>
<tr>
<th>Cu Service Wire Avg Size</th>
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<th>Max Service Rating</th>
<th>Size of Cu GEC</th>
<th>Breaker Rating</th>
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</tr>
</thead>
<tbody>
<tr>
<td>≤ 1/0</td>
<td>≤ 1/0</td>
<td>125</td>
<td>8</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>1 or 3/0</td>
<td>2/0 or 3/0</td>
<td>150/175</td>
<td>6</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>2/0 or 3/0</td>
<td>4/0 or 250 kcmil</td>
<td>200/225</td>
<td>4</td>
<td>30/60</td>
<td>10</td>
</tr>
<tr>
<td>&gt; 3/0 to 350 kcmil</td>
<td>&gt; 250kcmil to 500 kcmil</td>
<td>250/300</td>
<td>2</td>
<td>70/100</td>
<td>8</td>
</tr>
<tr>
<td>&gt; 350 kcmil to 600 kcmil</td>
<td>&gt; 500 kcmil to 900 kcmil</td>
<td>400</td>
<td>1/0</td>
<td>110/200</td>
<td>6</td>
</tr>
</tbody>
</table>

A. Use Code Check Electrical for Al GEC sizes.

B. Al EGCS 1 size larger than Cu.

Grounding & Bonding FIG. 65

- Use metal underground water pipe if ≥ 10 ft. in earth
- Connect GEC to pipe not > 5 ft. inside building
- Bond around removable equipment (meters, etc.)
- Water pipe cannot be only grounding electrode
- “Ufer” = 20 ft. #4 rebar or 4 AWG Cu wire in concrete footing, foundation, or pier in contact w/ earth EXC
- Ufer req’d in existing buildings where steel not accessible w/o removal of concrete
- Ground rod min 8 ft.
- Ground rod min 8 ft. deep & driven flush
- If resistance > 25 ohms, 2nd rod req’d ≥ 6 ft. from 1st
- Each structure w/ > 1 branch circuit req’s GES

B. Al EGCS 1 size larger than Cu.
**APPLIANCES**

**Required Disconnecting Means**

<table>
<thead>
<tr>
<th>12 IRC</th>
<th>11 NEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>[T4101.5]</td>
<td>(422.31A)</td>
</tr>
<tr>
<td>[T4101.5]</td>
<td>(422.3A)</td>
</tr>
<tr>
<td>[T4101.5]</td>
<td>(422.34)</td>
</tr>
<tr>
<td>[T4101.5]</td>
<td>(422.31B)</td>
</tr>
</tbody>
</table>

**Central Furnace**

- Central furnace must be on individual circuit EXC [3703.1] (422.12) [T4101.5]
- Auxiliary equipment (ex: filter) OK on furnace circuit [3703.1] (422.12X) [T4101.5]
- Disconnect within sight of furnace [T4101.5] (422.31B) [T4101.5]
- Cord & plug connection not OK [410.13] (422.16A) [T4101.5]
- Lighting outlet switched at entry to equipment space [3903.4] (210.70A3) [T4101.5]
- 120V recap req’d within 25 ft. & on same elevation [3901.12] (210.63) [T4101.5]

**Water Heaters & Space heating**

- Circuit min 125% of nameplate rating [3702.10] (422.13) [T4101.5]
- In-sight or lockable breaker or switch req’d [F70] (422.31B) [T4101.5]
- No electric baseboard heaters under recep outlets [3901.1] (424.9) [T4101.5]
- Receps in baseboard heaters not on heater circuit [3901.1] (424.9) [T4101.5]

**Paddle Fans**

- Not to be supported by standard electrical boxes [3905.9] (422.18) [T4101.5]
- Boxes & box systems listed for fan support OK to 70lbs [3905.8] (314.27C) [T4101.5]
- If listed for > 35 lbs, max weight must be marked [3905.8] (314.27C) [T4101.5]
- Fans over 70 lbs req independent support [3905.8] (314.27C) [T4101.5]
- Sparately switched conductors to ceiling boxes only OK if box listed for paddle fan support [3905.8] (314.27C) [T4101.5]

**Window/Wall Air Conditioners**

- Cord/plug disconnect OK if controls ≤ 6 ft. of floor [3905.8] (440.63) [T4101.5]
- Max cord length 120V = 10 ft., 240V = 6 ft. [3905.8] (440.64) [T4101.5]
- Cord/plug units req AFCI or LCDI (leakage current detection interrupter) in cord or plug cap [3905.8] (440.65) [T4101.5]

**Central Air Conditioning**

- Central AC wire & breaker/fuse size per nameplate [3702.11] (440.4B) [T4101.5]
- Disconnect in sight of condenser [F71] (440.14) [T4101.5]
- Working space req’d in front of disconnect [F63,71] [3405.2] (110.26A) [T4101.5]

**Closet Light Cclearances**

- Surface fluorescent or LED, or recessed incandescent

**GFCI & AFCI PROTECTION**

**Required GFCI Protection**

<table>
<thead>
<tr>
<th>12 IRC</th>
<th>11 NEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>[3902.1]</td>
<td>(210.8A1)</td>
</tr>
<tr>
<td>[3902.2]</td>
<td>(210.8A2)</td>
</tr>
<tr>
<td>[3902.3]</td>
<td>(210.8A3)</td>
</tr>
<tr>
<td>[3902.3X]</td>
<td>(210.8AX3)</td>
</tr>
<tr>
<td>[3902.4]</td>
<td>(210.8A4)</td>
</tr>
<tr>
<td>[3902.5]</td>
<td>(210.8AX5)</td>
</tr>
<tr>
<td>[3902.6]</td>
<td>(210.8A6)</td>
</tr>
<tr>
<td>[3902.7]</td>
<td>(210.8A7)</td>
</tr>
</tbody>
</table>

**AFCI Protection**

- Req’d for all branch circuits w/ outlets in family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas [3902.12] (210.12A) [T4101.5]
- Req’d for extensions or modifications of existing circuits serving above locations (can be outlet type at 1st recep) [3902.13] (210.12B) [T4101.5]
- “Outlet” = receptacle, lighting, or smoke alarm outlet [3501] (100) [T4101.5]
- Must be UL listed “combination type” [3902.12] (210.12A) [T4101.5]

**LIGHTING OUTLETS**

**Required Locations**

- All habitable rooms & bathrooms [3903.2] (210.70A1) [T4101.5]
- Switched recep OK in lieu of lighting outlet except in kitchens & bathrooms [3903.2X1] (210.70A1X) [T4101.5]
- Hallways, stairways & garages [3903.3] (210.70A2) [T4101.5]
- Outside each exterior door w/ grade-level access [3903.3] (210.70A2) [T4101.5]
- Not req’d at garage vehicle door [3903.3] (210.70A2) [T4101.5]

**Switching**

- All switching in ungrounded (hot) conductors [4001.8] (404.2A&B) [T4101.5]
- Req’d at each access to interior stairs if ≥ 6 risers [3903.3] (210.70A2) [T4101.5]
- No dimmers controlling switched receps [4001.12] (404.14E) [T4101.5]
- Neutral req’d at switch box [4001.15] (404.2C) [T4101.5]

**Bath**

- No pendant, track, or suspended lights or paddle fans < 8 ft. above & 3 ft. to side of top of tub or shower threshold [4003.11] (410.10D) [T4101.5]
- Luminaires < 8 ft. above footprint of tub/shower L&L for damp or wet locations if subject to shower spray [4003.11] (410.10D) [T4101.5]

**Recessed Lights**

- Type IC OK in contact w/ insulation & combustibles [4004.8&B] (410.116A2) [T4101.5]
- Recessed light (non-IC rated) ≥ 1/2 in. from combustibles [4004.8] (410.116A1) [T4101.5]
- Recessed light (non-IC rated) ≥ 3 in. from insulation [4004.9] (410.116B) [T4101.5]

**Clothes Closet F72**

- No open incandescent bulb fixtures [4003.12] (410.16B) [T4101.5]
- Storage area = 12 in. or shelf width & to ceiling [4003.12] (410.2) [T4101.5]
- Enclosed surface incandescent: 12 in. clearance [4003.12] (410.16C) [T4101.5]
- LED, fluorescent, or recessed incandescent: 6 in. clearance [4003.12] (410.16C) [T4101.5]