

Code Check Plumbing & Mechanical[®] Sixth Edition



By **DOUGLAS HANSEN, SKIP WALKER & REDWOOD KARDON**
 Illustrations by Paddy Morrissey, Kaia Mathewson & Douglas Hansen

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Updated to the 2021 International Residential Code, Uniform Plumbing Code & Uniform Mechanical Code

Code Check Plumbing & Mechanical 6th edition is an illustrated reference guide to code requirements and common violations in residential plumbing and mechanical systems. The main codes referenced in this book are the 2021 International Residential Code, published by the International Code Council, the 2021 Uniform Plumbing Code, and the 2021 Uniform Mechanical Code. For most topics, these codes are in agreement. These are the most widely used codes throughout the United States. NFPA 54, the National Fuel Gas Code, is the basis for the fuel gas provisions of the IRC, UPC, and UMC. Other referenced codes used in the book are listed in Table 1 (T1) below.

Model codes are updated on a 3-year cycle. In most areas, the 2021 code cycle will remain in effect for 3 to 6 years after the cover date. Significant changes from the previous code editions are highlighted in the text so that this book can be used in areas still using older code editions. Minor changes and those that only affected numbering (not substance) are not highlighted.

Energy codes vary greatly from one area to another and may modify or overrule the requirements shown in this book. Before beginning any project, check with your local building department to determine the codes and editions that apply in your area. Some jurisdictions modify the model code standards, many of which are maintained by the organ

KEY TO USING THIS BOOK

Large amounts of code information are condensed here by using several "shorthand" conventions. Many terms are abbreviated, as shown on the following page.

Each rule described in Code Check begins with a checkbox and ends with code citations. Where there are two columns of citations, the first one is from the IRC and the second one from the UPC or UMC, as noted at the top of the columns of code references. See this example from p. 4:

Inspections **21 IRC** **21 UPC**
 All piping below slab tested before casting concrete 109.1.2 105.1
This section is saying that piping must be tested before being covered by concrete. The IRC code reference is 109.1.2 & the UPC reference 105.1.

References to figures and tables are preceded by an **F** or a **T** as in the following examples from p. 13:

Trap seal min. 2 in., max. 4 in. **F21** 3201.2 1005.1
 Size trap for fixture per **T8** 3201.7 1003.3

TABLE 1 CODES USED IN THE BOOK

| Organization | Edition | Code Title |
|--------------|---------|--|
| ASHRAE | 2019 | ASHRAE 62.2 Ventilation for Acceptable Indoor Air Quality in Residential Buildings |
| ICC | 2021 | International Residential Code |
| ICC | 2021 | International Plumbing Code |
| IAPMO | 2021 | Uniform Mechanical Code |
| IAPMO | 2021 | Uniform Plumbing Code |
| NFPA | 2020 | NFPA 31 Standard for the Installation of Oil-Burning Equipment |
| NFPA | 2021 | NFPA 54 National Fuel Gas Code |
| NFPA | 2020 | NFPA 58 Liquefied Petroleum Gas Code |
| NFPA | 2020 | NFPA 70 National Electrical Code |
| NFPA | 2019 | NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances |

TABLE 2 STANDARDS ORGANIZATIONS

| Acronym | Name |
|---------|---|
| ACCA | Air Conditioning Contractors of America |
| ANSI | American National Standards Institute |
| ASHRAE | American Society of Heating, Refrigerating & Air-Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| ASSE | American Society of Sanitary Engineering |
| ASTM | ASTM International (formerly American Society for Testing & Materials) |
| CSA | CSA Group (Canadian Standards Association) |
| IAPMO | International Association of Plumbing & Mechanical Officials |
| ICC | International Code Council |
| NFPA | National Fire Protection Association |
| NSF | National Sanitation Foundation |
| SMACNA | Sheet Metal & Air Conditioning Contractors' National Association |
| UL | UL (formerly Underwriters Laboratories) |

The inside cover lists the codes and standards that are used in the book, along with examples of the shorthand conventions that are used.

the next line, as in this example from p. 13:

Fixture tailpiece max. 24-in. vertical distance EXC **F20** 3201.6 1001.2
 • CW standpipes 18–42 in. (UPC: 18–30 in.) **F74** 2706.1.2 804.1

This line says that the maximum height of a fixture tailpiece (the vertical distance between the fixture outlet and its trap) is 24 inches in both codes, with an exception for a clothes washer standpipe. Notice also that the maximum height of the standpipe is not the same in the two codes, and the UPC size is shown in parentheses.

The information in this book is provided for informational purposes only and is not a substitute for the full text of the referenced codes. It should not be considered to be a substitute for the enforceable interpretation of the local building department.

Benjamin Franklin was chosen as the main character in our illustrations for several reasons. Franklin'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.

In 1752, he brought the first bathtub to America. After designing a more comfortable model, he took it with him on his travels to Europe.



CODE CHECK: "YOUR KEY TO THE CODES."

For updates, additional information on the codes, seminars, and online resources, visit: www.codecheck.com

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Energy codes vary greatly from one area to another and may modify or override the requirements shown in this book. Before beginning any project, check with your local building department to determine the codes and editions that apply in your area. Some jurisdictions modify the model codes. The codes also reference standards, many of which are mandated by the organizations in Table 2 (T2).

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Large amounts of code information are condensed here by using several "short-hand" conventions. Many terms are abbreviated as shown on the following page.

Each rule described in Code Check begins with a checkbox and ends with code citations. Where there are two columns of citations, the first one is from the IRC and the second one from the UPC or UMC, as noted at the top of the columns of code references. See this example from p. 4:

Inspections
 All piping below slab tested before casting concrete. **21 IRC 109.1.2** **21 UPC 105.1**
 This section is saying that piping must be tested before being covered by concrete. The IRC code reference is 109.1.2 & the UPC reference is 105.1.

References to figures and tables are preceded by an F or a T as in the following examples from p. 12:

Trap seal min. 2 in., max. 4 in. **F21 7201.2** **1005.1**
 Size trap for fixture per **T8 9201.7** **1003.3**

Figure 21 illustrates an example of this code rule, and the size is per Table 8.

Code changes are highlighted by showing the code citation in a different color, and by the superscript character that references a further explanation at the bottom of the page, as in the example from p. 8:

Max. 5 WCs on 3-in. horizontal or vertical.

The UPC changed the maximum allowed to 4 in the following note that applies to the UPC reference in this example:

As an "X" inside a code reference stands for from p. 15:

Increase 1 pipe size if >1/2 of vent is in this line is saying that this rule is not applicable in section 904.2. Exception.

When a text line ends with the letters ETC, the next line, as in this example from p. 12:

Future tailpiece max. 24-in. vertical dis. • CW standpipes 18-42 in. (UPC) 18

This line says that the maximum height of between the fixture outlet and its trap is 24 inches for a clothes washer standpipe, but only pipe of the same in the two codes, and

The information in this book is provided for substitute for the full text of the referenced code to substitute for the enforceable interpretation of

Best practices are shown as the most preferred or recommended for a given situation, but not mandatory. These lines to guide the reader only when writing, public relations, general meeting, and/or other related.

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| ASHRAE | 2019 | ASHRAE 92.2 Ventilation and Acceptable Indoor Air Quality in Residential Buildings |
| ICC | 2021 | International Residential Code (IRC) |
| ICC | 2021 | IFSEC—International Fire Sprinkler Design Code |
| UPMO | 2021 | Uniform Mechanical Code (UMC) |
| UPMO | 2021 | Uniform Plumbing Code (UPC) |
| NFPA | 2020 | NFPA 91 Standard for the Installation of Oil-Burning Equipment |
| NFPA | 2021 | NFPA 54 National Fuel Gas Code |
| NFPA | 2020 | NFPA 56 Liquefied Petroleum Gas Code |
| NFPA | 2020 | NFPA 70 National Electrical Code |
| NFPA | 2019 | NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances |

| Acronym | Name |
|---------|---|
| ACCA | Air Conditioning Contractors of America |
| ANSI | American National Standards Institute |
| ASHRAE | American Society of Heating, Refrigerating & Air-Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| ASSE | American Society of Sanitary Engineering |
| ASTM | ASTM International (formerly American Society for Testing & Materials) |
| CSA | CSA Group (Canadian Standards Association) |
| IFMA | International Association of Plumbing & Mechanical Officials |
| ICC | International Code Council |
| NFPA | National Fire Protection Association |
| NIP | National Inspection Association |
| SMACNA | Sheet Metal & Air Conditioning Contractors' National Association |
| UL | UL Solutions (Underwriters Laboratories) |

CODE CHECK: "YOUR KEY TO THE CODES"

For updates, contact us at the publisher's website: www.tauntonpress.com

ABBREVIATIONS

| | | |
|---|--|--|
| 1-1/2FD = 1- & 2-family dwellings | EGC = equipment grounding conductor | n/a = not applicable |
| AAV = air admittance valve | EKC = exception to rule follows in the next line | NEC = National Electrical Code |
| ABS = acrylonitrile-butadiene-styrene drain (drain plastic pipe) | F = Fahrenheit | NP = not permitted |
| AC = air conditioning | FAM = forced air unit | NRTL = nationally recognized testing laboratory |
| ACH = air changes per hour | Pa = pascals (one in. w.e. = 2.49 Pa) | o.c. = on center |
| ACH50 = air changes per hour @ 50 Pa | FLR = flood level rim | O.D. = outside diameter |
| AFF = above finished floor | fl = floorless | p = pages, as in "see p. 5" |
| AHJ = Authority Having Jurisdiction | FVIR = flame-retardant vapor ignition-resistant | PE = polyethylene (water tubing) |
| AL = aluminum | ga = gauge | PE = polyethylene (water or gas tubing) |
| AMI = in accordance with MFR's instructions | gal = gallon | PE-RT = polyethylene (raised temperature) |
| AMM = alternative materials, design, & methods | GB = gypsum board | PEX = cross-linked polyethylene tubing |
| AVB = atmospheric vacuum breaker | GFCI = ground-fault circuit interrupter | PP = polypropylene plastic tubing |
| BO = building official | GFP = gallons per flush | PRR = pressure-reducing regulator |
| BT = bathtub | gpm = gallons per minute | PRV = pressure-relief valve |
| Btu = British thermal unit(s) | HDPE = high-density polyethylene | psf = pounds per square foot |
| C = category | hr = hour(s) | psi = pounds per square inch |
| Cat = Category (appliance vent category: Cat. I, Cat. II, Cat. III, or Cat. IV) | IBC = International Building Code | psig = pounds per square inch gauge |
| cfm = cubic feet per minute | IFGC = International Fuel Gas Code | PVC = polyvinyl chloride pipe |
| CI = cast iron | IMC = International Mechanical Code | RP = reduced-pressure principle backflow preventer |
| CO = clearout | in. = inch(es) | SDC = Seismic Design Category |
| CPE = chlorinated polyethylene | IPC = International Plumbing Code | SFD = single-family dwelling specification |
| CPSC = Consumer Product Safety Commission | k = 1,000 (1 kBtu = 1,000 Btu) | sq. = square, as in sq. ft. |
| CPVC = chlorinated PVC pipe | KS = kitchen sink | SS = stainless steel |
| CSST = corrugated stainless-steel (gas) tubing | lav = lavatory sink | temp = temperature |
| cu. = cubic, as in cu. ft. | lb. = pound(s) | TPRV = temperature & pressure-relief valve |
| Cu = copper | LL = lot line | w/ = with |
| CW = clothes washer | LP = liquefied petroleum (LP gas) | w/o = without |
| CWV = combination waste & vent | LT = laundry tray | WC = water closet (toilet) |
| DFU = drainage fixture unit | max. = maximum | WH = water heater |
| DW = dishwasher | MFR = manufacturer | WSFU = water supply fixture unit |
| DWV = drain, waste & vent | min. = minimum | Zi = zinc, galvanized |
| e.g. = for example (exempli gratia) | MP = medium pressure | |

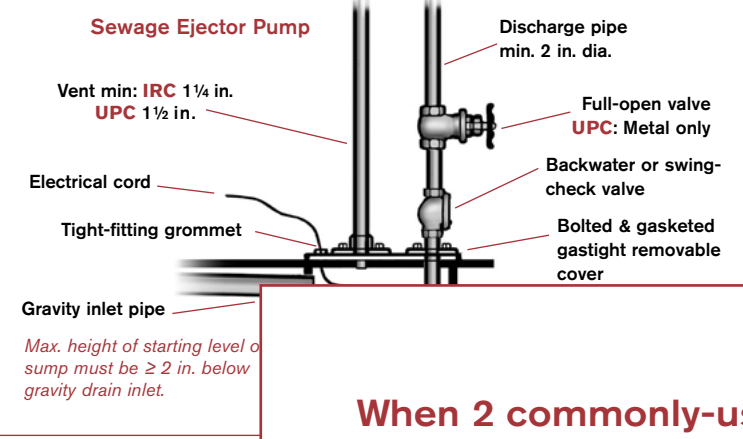
| | | | |
|-------------------------------------|----|-----------------------------------|----|
| INTRODUCTION • ABBREVIATIONS | 1 | TABLE OF CONTENTS | 3 |
| PERMITS • MATERIALS • PROTECTION | 5 | PIPE SUPPORT • TRENCHES | 7 |
| DRAINAGE • MATERIALS • SIZE | 9 | FITTINGS • CLEANOUTS | 11 |
| BACKWATER VALVES • SUMPS • TRAPS | 13 | TRAP ARMS • PLUMBING VENTS | 15 |
| WET VENTS • SPECIAL VENTS | 17 | VENT TERMINALS • SEPTIC • SUPPLY | 19 |
| PEX • WATER SUPPLY SIZE | 21 | NONPOTABLE • BACKFLOW • PRESSURE | 23 |
| GAS PIPE • VALVES • CONNECTORS | 25 | GAS • CSST • PIPE SIZES | 27 |
| PROPANE • WATER HEATERS | 29 | TANKLESS • TPRV • BOILERS | 31 |
| FIXTURES • KITCHEN • BATHS | 33 | LAUNDRY • VENTILATION • EXHAUST | 35 |
| RANGES & HOODS • DUCTS | 37 | AIR CONDITIONING • CONDENSATE | 39 |
| APPLIANCE LOCATION • COMBUSTION AIR | 41 | GAS CHIMNEYS • VENTS • CONNECTORS | 43 |
| VENT TERMINATIONS • GAS FIREPLACES | 45 | CLEARANCE • WALL & FLOOR FURNACES | 47 |

The tabs at the bottom of every page allow quick access to each topic

Sump Pit & Pump

- Sewer ejector pumps must operate automatically _____ 3007.4 21 IRC 710.9
- Sump min. 18 in. diameter 24 in. deep **F19** _____ 3007.3.2 21 UPC n/a
- Sump concrete, metal, or other approved materials (IRC: Also tile or plastic; UPC: Metal requires corrosion protection) _ 3007.3.2 710.8
- Min. pump capacity 21 gpm (UPC: 20 gpm) _____ 3007.6 710.3 #1

FIG. 19



When 2 commonly-used codes are referenced, the IRC code number is in the left column, and the UPC or UMC code number is on the right

TABLE 14 IRC MINI

| Discharge Pipe Diameter |
|-------------------------|
| 2 in. |
| 2 1/2 in. |
| 3 in. |

TRAPS, FIXTURE TAILPIECES & TRAP ARMS

Traps provide an air barrier between the contaminated atmosphere of the sewer and the indoor air we breathe. Without a proper trap seal, sewer gases, airborne bacteria, vermin, and other contaminants can enter the living area. If the seal is too shallow, the seal could be lost due to evaporation. If too deep, drainage could be blocked with sludge. Trap arms (fixture drains) must be vented, otherwise the negative pressure created by water moving down the pipe will cause water to be sucked out of the trap and the seal to be lost. Maintaining a proper trap seal is the underlying principle behind the code rules for drainage, traps, and venting.

Traps & Fixture Tailpieces

- Each fixture requires separate trap EXC _____ 3201.6 21 IRC 1001.2 21 UPC 1001.2
 - Fixtures w/ integral traps (toilets) _____ 3201.6X1 1001.2
 - 2 or 3 like fixtures (sinks, laundry tubs, or lavs) in same room allowed on single trap at center fixture if fixture outlets ≤30 in. apart **F20** _____ 3201.6X2 1001.2
 - Laundry tray (sink) may drain to CW standpipe **F75** 3201.6X3 n/a
- Trap seal min. 2 in., max. 4 in. **F21** _____ 3201.2 1005.1
- Set traps level & protect from freezing _____ 3201.3 1005.1
 - above trap weir **F24** _____ 3201.3 1002.4
- _____ traps, crown-vented traps, or traps w/ _____ EXC **F23** _ 3105.3 & 3201.5 1004.1&2
- _____ unless partitions _____ 3201.5(2) 1004.1
- _____ for special conditions _____ 104.11 1004.1
- _____ 3201.7 1003.3
- UPC: max. one size larger) _ 3201.7 1003.3
- _____ double traps (in series) _____ 3201.6 1004.1
- _____ traps _____ 3201.1 1003.1
- _____ vertical distance EXC **F20** _ 3201.6 1001.2
- (UPC: 18–30 in.) **F74** _ 2706.1.2 804.1
- _____ total developed length except _____ n/a 1001.2
- _____ by continuous waste **F20** _ n/a 1001.2
- _____ or continuous wastes from disposer _____ n/a 1001.2
- (i.e., wyes, combos, or tees w/baffles) **F20** _____ 2707.1 419.2
- Building traps prohibited (UPC: unless required by AHJ) 3201.4 1008.1

FIG. 20

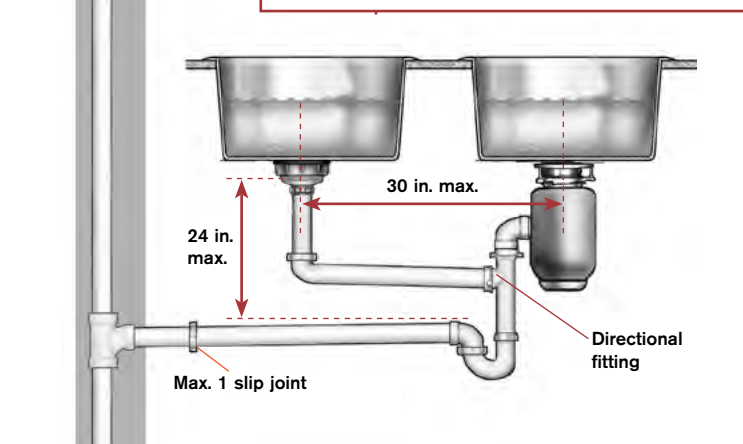
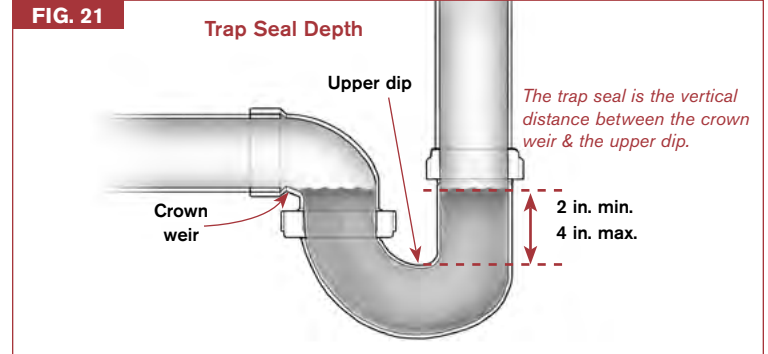


FIG. 21



Trap Arms

21 IRC

21 UPC

- Trap same size as trap arm _____ 3201.7 1003.3
- No crown venting—min. length 2× trap arm diameter **F25** 3105.3 1002.2
- Length & slope per table EXC **T15** _____ 3105.1 1002.2
 - Trap arm length from WC unlimited (UPC: 6 ft.) _____ 3105.1X T1002.2
- Min. slope ¼ in./ft. (IRC ⅛ in./ft. OK for ≥3-in. pipe) ___ T3105.1 T1002.2
- Total fall of trap arm max. 1 pipe diameter **F24,T15** ___ 3105.2 n/a
- Vent connection not below weir of trap (except WCs) ___ 3105.2 1002.4
- Only 1 trap permitted on trap arm EXC _____ n/a 1001.2
 - 2 trap arms on same level allowed
 - double-wye fitting to common vent
- Tubing traps require trap adapter **F2**
- Max. 1 slip joint allowed on outlet side
- Horizontal direction changes in trap
- CO required if direction change > 45°
- Slip-joint connections required to be accessible
- Access openings min. 12 in. × 12 in. **F**

The print edition has 114 illustrations and 52 tables. These are referenced in the text along with the code number that applies to them.

FIG. 24

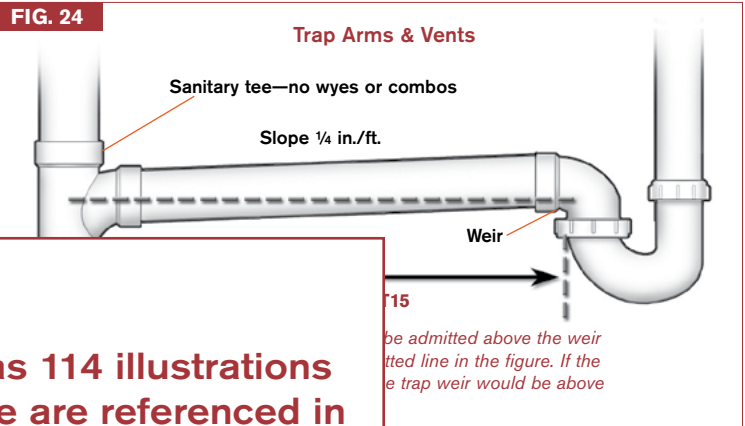


FIG. 22

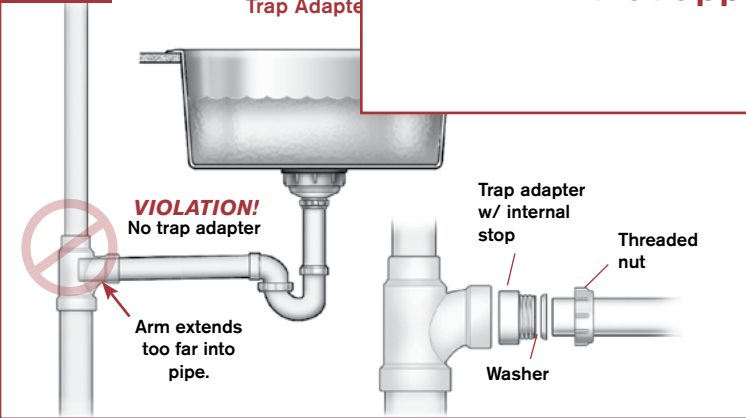
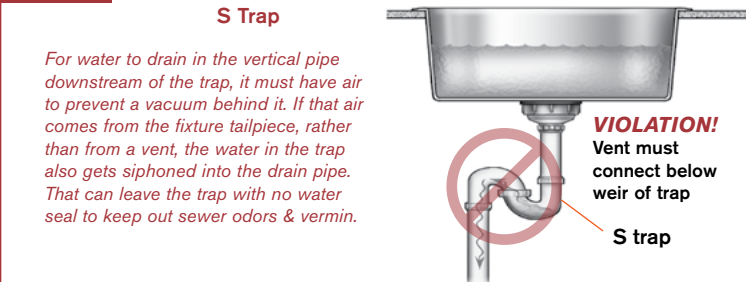


FIG. 23



DISTANCE TO VENT
5.1 & UPC T1002.2

| Max. Arm Length | UPC Max. Arm Length | | |
|------------------------------|---------------------|------------------|-------------------------------|
| 5 ft. (60 in.) | 2 ½ ft. (30 in.) | | |
| 1 ½ in. | 3 in. | 6 ft. (72 in.) | 3 ½ ft. (42 in.) |
| 2 in. | 4 in. | 8 ft. (96 in.) | 5 ft. (60 in.) |
| 3 in. ^A | 6 in. | 12 ft. (144 in.) | 6 ft. (72 in.) |
| 4 in. or larger ^A | 8 in. | 16 ft. (192 in.) | 10 ft. (120 in.) ^B |

A. In the IRC, these arms can have ⅛-in./ft. slope. In the UPC, all arms must slope ¼ in./ft.
B. Max. developed length from a water closet to the vent is 6 ft. in the UPC & unlimited in the IRC.

FIG. 25

