

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 code also references standards, many of which are maintained by the organizations in Table 2 (T2).

Organization	Edition	Code
ASHRAE	2019	ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Residential Buildings
ICC	2021	International Residential Code (IRC)
ICC	2021	IFC—International Fire Code
IPSCO	2021	Uniform Mechanical Code (UMC)
IPSCO	2021	Uniform Plumbing Code (UPC)
NFPA	2020	NFPA 54 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	Standards Organizations Name
ACCA	Air Conditioning Contractors of America
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ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (formerly American Society for Testing & Materials)
CSA	CSA Group (Canadian Standards Association)
IPSCO	International Association of Plumbing & Mechanical Officials
ICC	International Code Council
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NFIB	National Bathroom Foundation
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Large amounts of code information are condensed here by using several "left-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 citations of citations, the first line 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 installed before casting concrete. 21 IRC 105.1.2 21 UMC 105.1
This section is saying that piping must be installed before being covered by concrete. The IRC Code reference is 105.1.2 & the UMC 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 3201.2 1005.1
 Size trap for fixture per T8 3201.7 1003.3
Figure 21 illustrates an example of this trap size, 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. 9:
 Max. 5 WCs on 3-in. horizontal or vertical pipe.
The UMC changed the maximum allowed in the following note that applies to 3-in. horizontal pipe.

An "X" inside a code reference stands for from p. 15:
 Increase 1 pipe size if >1/2 of vent is in this section 504.2 Exception.
When a text line ends with the letters EXC, the next line, as in this example from p. 12:

Fixture tailpiece max. 24-in. vertical dis. • CW standpipes 18–42 in. (UPC) 18
This line says that the maximum height of tailpiece between the fixture outlet and the trap is 24 in. for a clothes washer standpipe. Minor size pipe is not 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 the code.

Section 1005.1.2 shall comply with the most restrictive of the following: (1) 1/2 in. minimum pipe size for all vent pipes, and (2) 3/4 in. minimum pipe size for all vent pipes, and (3) 1/2 in. minimum pipe size for all vent pipes, and (4) 3/4 in. minimum pipe size for all vent pipes.

Section 1005.1.2 shall comply with the most restrictive of the following: (1) 1/2 in. minimum pipe size for all vent pipes, and (2) 3/4 in. minimum pipe size for all vent pipes, and (3) 1/2 in. minimum pipe size for all vent pipes, and (4) 3/4 in. minimum pipe size for all vent pipes.

CODE CHECK: "YOUR KEY TO THE CODES"

For updates, additional information on the codes, standards, and other resources, visit www.CodeCheck.com

ABBREVIATIONS

1A2FD = 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	F = Fahrenheit	NP = not permitted
AC = air conditioning	FAU = forced air unit	NRTL = nationally recognized testing laboratory
ACH = air changes per hour	Pa = pascals (new or static)	o.c. = on center
ACH = air changes per hour	FLR = flood level rim	O.D. = outside diameter
AFF = above finished floor	FL = foot/feet	p. = pages, as in "see p. 5"
AHJ = Authority Having Jurisdiction	FVIR = flame/arrest vapor ignition-resistant	PB = polybutylene (water tubing)
AL = aluminum	ga = gauge	PE = polyethylene (water or gas tubing)
AMI = in accordance with MFR's instructions	gal = gallon(s)	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-releef valve
Btu = British thermal unit(s)	HDPE = high-density polyethylene	psf = pounds per square foot
C = centigrade	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	psib = 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 = cleanout	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 (1kBu = 1,000Btu)	sq. = square, as in sq. ft.
CPVC = chlorinated PVC pipe	KS = kitchen sink	SS = stainless steel
CSST = corrugated stainless-steel (gas) tubing	L&L = listed & labeled	temp = temperature
cu. = cubic, as in cu. ft.	lav = lavatory sink	TPRV = temperature & pressure-relief valve
Cu = copper	lb. = pound(s)	w/ = with
CW = clothes washer	LL = lot line	w/o = without
CW&V = combination waste & vent	LP = liquefied petroleum (LP gas)	WC = water closet (toilet)
DFU = drainage fixture unit	LT = laundry tray	WH = water heater
DW = dishwasher	max. = maximum	WSFU = water supply fixture unit
DWV = drain, waste & vent	MFR = manufacturer	Zi = zinc, galvanized
e.g. = for example (exempli gratia)	min. = minimum	
	MP = medium pressure	

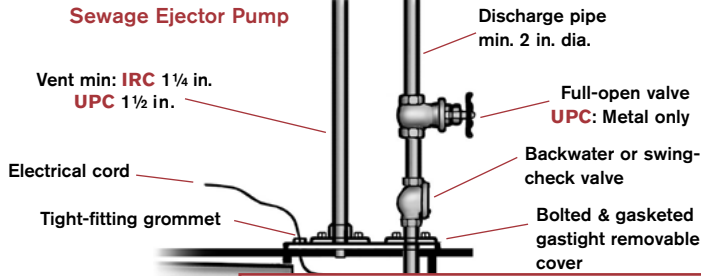
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Sump Pit & Pump

- 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



Max. height of starting level of sump must be ≥ 2 in. below gravity drain inlet.

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
- in traps, crown-vented traps, or traps w/ _____ 1004.1&2
- ions EXC **F23** _ 3105.3 & 3201.5 1004.1
- less 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
- uble traps (in series) _____ 3201.6 1004.1
- ps _____ 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
- d 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

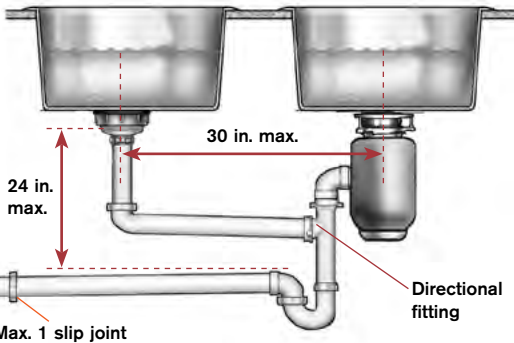
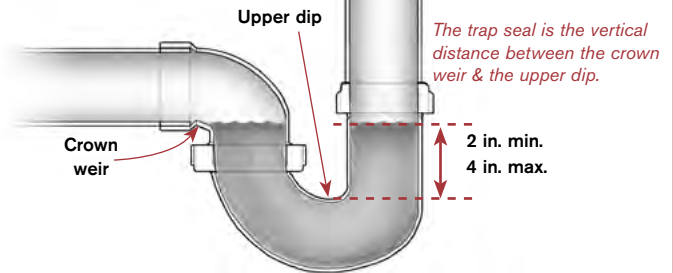


FIG. 21

Trap Seal Depth



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

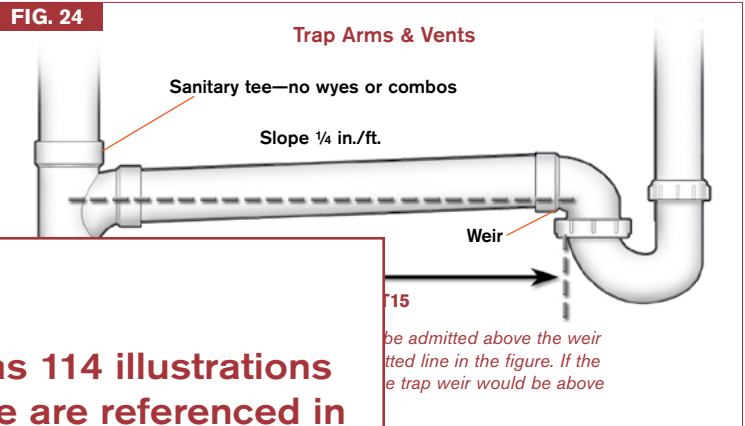


FIG. 22

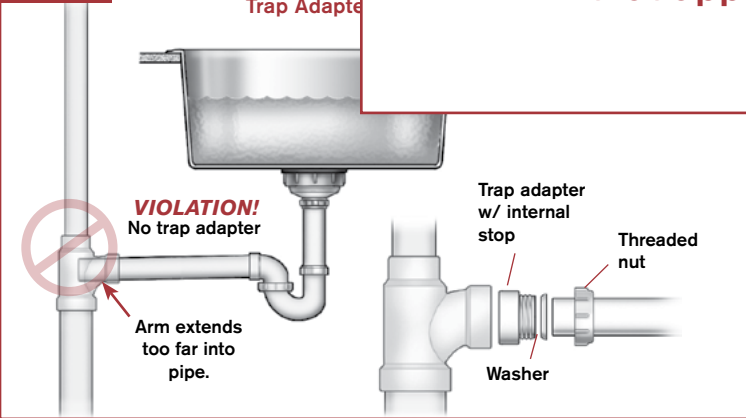
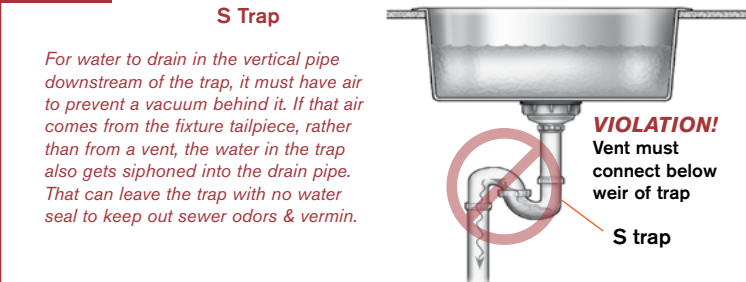


FIG. 23



DISTANCE TO VENT
5.1 & UPC T1002.2

Max. Arm Length	UPC Max. Arm Length		
5 ft. (60 in.)	3 in.	6 ft. (72 in.)	2½ ft. (30 in.)
6 ft. (72 in.)	4 in.	8 ft. (96 in.)	3½ ft. (42 in.)
8 ft. (96 in.)	6 in. ^A	12 ft. (144 in.)	5 ft. (60 in.)
10 ft. (120 in.)	8 in.	16 ft. (192 in.)	6 ft. (72 in.)
12 ft. (144 in.)	10 in. or larger ^A	20 ft. (240 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

