2021 IPC® and UPC® Essentials

Based on the 2021 International Plumbing Code® (IPC®) and 2021 Uniform Plumbing Code® (UPC®)

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SIGN IN/OUT

Use this QR Code or URL to Sign In & Sign Out
(Automates CEU/CPE Credits in "myICC" Account)

iccsafe.org/attend

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INSTRUCTOR

Gary Gauthier

Director of PMG Technical Resources for the International Code Council (ICC), where I serve as a subject matter expert for ICC's Plumbing, Mechanical, Fuel Gas, Swimming Pool & Spa, and Private Sewage Disposal Codes (PMG).

ICC PMG
PLUMBING, MECHANICAL, FUEL GAS, AND SWIMMING POOL & SPA

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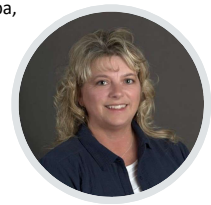
INSTRUCTOR

Lisa Reiheld

- Director of PMG Technical Resources for the International Code Council (ICC), where I serve as a subject matter expert for ICC's Plumbing, Mechanical, Fuel Gas, Swimming Pool & Spa, and Private Sewage Disposal Codes (PMG).

ICC PMG
PLUMBING, MECHANICAL, FUEL GAS, AND SWIMMING POOL & SPA



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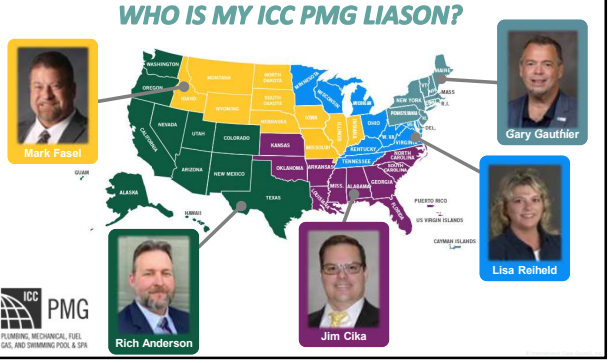
WHO IS MY ICC PMG LIASON?



ICC PMG
PLUMBING, MECHANICAL, FUEL GAS, AND SWIMMING POOL & SPA

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How We Help

The Code Council offers resources, people and ways to get involved in the process.

PMG Resources

Explore more about each code: Plumbing, Mechanical, Fuel Gas, Swimming Pool & Spa and Private Sewage Disposal.

Articles & Podcasts | Fact Sheets
Code Adoptions | Publications
CodeNotes | Partner Resources

Get Involved

Find out how you can become a part of the code development process.

PMG Code Action Committee
PMG Code Development
PMG Membership Council
ICC Call for Committees

https://www.iccsafe.org/products-and-services/i-codes/pmg/

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GOAL & OBJECTIVES

1) 2021 International Plumbing Code® (IPC®) and 2021 Uniform Plumbing Code® (UPC®) continue to emphasize both prescriptive and performance-related provisions.
2) 2021 IPC and UPC encompass the initial design of the plumbing system, the installation and construction of plumbing systemsm and the maintenance of operating systems.
3) All plumbing systems that are provided for utilization by and for the general safety and wellbeing of the occupants of a building are intended to be governed by the code.

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REALITY CHECK

Why Does This Matter?

Prescriptive vs Performance

- ***Prescriptive code provisions*** form a specific set of rules (a recipe) to follow to gain compliance with the code.
- ***Performance code provisions*** require systems or components to function in a certain way to meet the desired level of safety and performance but do not specify the method of construction.

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GOAL & OBJECTIVES

Goal

1) The goal of this seminar is to provide key information on the design, installation and inspection principles based on the 2021 IPC.
   - Correlation between the 2021 IPC and the UPC will also be a part of this training.

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GOAL & OBJECTIVES

Objectives

Upon completion, participants will be better able to:

1) Identify code enforcement issues and key code sections.
2) Determine appropriate code provisions to apply to plumbing.
3) Describe the application of the code to inspection, plan review and code enforcement.
4) Apply the provisions of the IPC to design, installation and inspection phases of construction.

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International Code Council Model Codes (I-Codes)

- Nationally recognized construction regulations that serve as models for local ordinances.
- Revised and updated through an open process that invites participation by experts, stakeholders and all affected parties.
- Updated on three-year cycles to recognize new and developing technology, materials and methods of construction.
- Changes are often in response to natural or human-made disasters involving the loss of lives or the destruction of property.

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International Plumbing Code (IPC)

- Provides regulations for the design, installation, alteration and maintenance of plumbing systems.
- Governs materials, sizing and installation of potable water supply and distribution plumbing fixtures, drain-waste-vent piping(DWV) and storm drainage systems.

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2024 Uniform Plumbing Code®, UPC®

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International Residential Code (IRC)

- Regulates construction of detached 1- and 2-family dwellings and townhouses.

- Combines all regulations for building, energy, mechanical, fuel gas, plumbing and electrical into one document.

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cdpACCESS™

- ICC's cloud-based system for the code development process (cdp).
- Developed to increase participation in the code development process.
- Users can create, collaborate, review, submit and vote (if eligible) on code change proposals and public comments.
- ICC members can view and vote on motions for code changes that receive an assembly motion.
- ICC posts the Online Governmental Consensus Vote.

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I-CODE
Development Cycle

PROPOSED CODE CHANGES SUBMITTED
JAN 8, 2024
PROPOSED CODE CHANGE AGENDA
FEB 26, 2024
COMMITTEE ACTION HEARING (CAH) #1
APR 7-16, 2024, ORLANDO, FL
CAH #1 RESULTS PUBLISHED
MAY 16, 2024
CAH #1 COMMENT PERIOD DEADLINE
JUL 8, 2024
COMMITTEE ACTION HEARING (CAH) #2
OCT 23-31, 2024, LONG BEACH, CA
CAH #2 RESULTS PUBLISHED
DEC 2, 2024
CAH #2 COMMENT PERIOD DEADLINE
MAR 14, 2025
PUBLIC COMMENT PERIOD DEADLINE
JAN 5, 2026
PUBLIC COMMENT AGENDA PUBLISHED
MAR 4, 2026
PUBLIC COMMENT HEARING
APR 19-28, 2026
ONLINE GOVT CONSENSUS VOTE (OGCV)
MAY 12-19, 2026 (ESTIMATE ONLY)

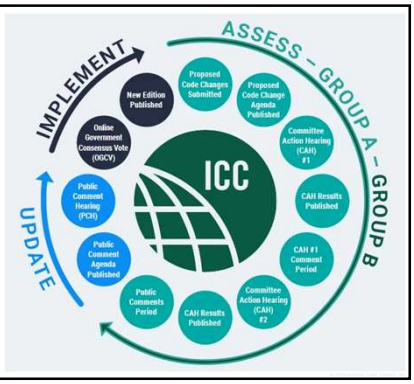

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Table of Contents

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Administration
Part I

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Adoption of the IPC® or UPC®

- Becomes an enforceable regulation through legal proceedings of the governmental jurisdiction.
- Adopting ordinance references IPC edition and title and provides ordinance purpose, scope and effective date.
- Government authority must provide local information for insertion into the code text.

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Amending the IPC or UPC

- Jurisdiction can modify the model code through amendments placed in the adopting ordinance.
- Amendments influenced by:
  - Unique characteristics and conditions, such as geographic location, weather, topography, flooding, soil properties and water tables.
  - Considerations of political influences, local traditions or customs, compatibility issues with other state or local laws, or the existence of unique housing stock, such as in historic districts.

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Local and State Laws

- The IPC or UPC is not meant to nullify any local, state or federal law, and in many cases, such other laws supersede provisions found in the model code.
- Local ordinances may include regulations for storm water management, public and private sewers and private wells.
- State laws may override plumbing codes related to food preparation and food service establishments and accessibility for persons with disabilities.
- State law often determines circumstances under which a licensed engineer or architect is required and sets the licensing regulations for these design professionals.

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Code Official (IPC) or Authority Having Jurisdiction (UPC)

Duties

- Enforce the code.
- Review plans, diagrams and calculations.
- Issue permits.
- Issue notices and orders.
- Conduct inspections.
- Maintain records.

Authorities

- Make interpretations.
- Adopt policies and procedures.
- Approve modifications and alternatives.

Limits on authority

- Cannot waive code requirements.
- Cannot require more than the code.

Duties

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Prescriptive vs Performance

- ***Prescriptive code provisions*** form a specific set of rules (a recipe) to follow to gain compliance with the code.
- ***Performance code provisions*** require systems or components to function in a certain way to meet the desired level of safety and performance but do not specify the method of construction.

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Alternative Methods/Materials and Evaluation Service Reports

- The code official approves alternative methods and materials that comply with the intent of the code.
- ICC Evaluation Service (ES) Reports are valuable tools for verifying that alternative methods and materials perform satisfactorily and are equivalent to those prescribed by the code.

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Permits

- Any plumbing installation requires a permit before work begins.
- Plumbing work exempt from permit:
  - Stopping of leaks.
  - Clearing of stoppages, including removal and reinstallation of water closets.
- The owner or authorized agent applies for a permit on a form furnished by the department of plumbing inspection.


PLUMBING PERMIT APPLICATION

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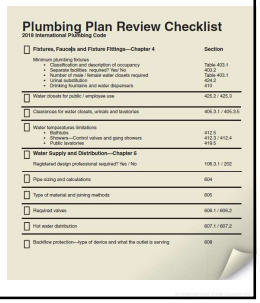
Plans and Specifications

- Design drawings, calculations and other submittal documents must accompany the permit application to verify compliance with the code.


Plumbing Plan Review Checklist

2018 International Plumbing Code

	Section
Fixtures, Faucets and Fixture Fittings—Chapter 4	
Minimum plumbing fixtures • Classification and description of occupancy • Occupant load and gender ratio • Number of male / female water closets required • Urinal substitution • Drinking fountains and water dispensers	Table 403.1 403.1 Table 403.1 424.2 419
Water closets for public / employee use	425.2 / 425.3
Clearances for water closets, urinals and lavatories	406.3.1 / 406.3.5
Water temperatures limitations • Bathtubs • Showers—Control valves and gang showers • Public lavatories	412.5 412.3 / 412.4 419.3
Water Supply and Distribution—Chapter 6	
Registered design professional required? Yes / No	106.3.1 / 202
Pipe sizing and calculations	604
Type of material and joining methods	605
Required valves	606.1 / 606.2
Hot water distribution	607.1 / 607.2
Backflow protection—type of device and what the outlet is serving	608

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Plans and Specifications

- **Construction documents** – All of the written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of the project necessary for obtaining a building permit. The construction drawings shall be drawn to an appropriate scale.
- **Registered design professional –** An individual who is registered or licensed to practice their respective design profession, as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

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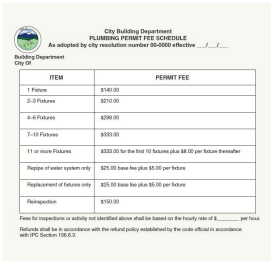
Fees

- The jurisdiction establishes a schedule of fees.
- Permit fees are often based on the number of plumbing fixtures and may also be included as part of the overall building permit.



City Building Department
PLUMBING PERMIT FEE SCHEDULE
As adopted by city resolution number 00-0000 effective ___/___/___

Building Department
City Of

ITEM	PERMIT FEE
1 Fixture	$140.00
2–3 Fixtures	$210.00
4–6 Fixtures	$298.00
7–10 Fixtures	$333.00
11 or more Fixtures	$333.00 for the first 10 fixtures plus $8.00 per fixture thereafter
Repipe of water system only	$25.00 base fee plus $5.00 per fixture
Replacement of fixtures only	$25.00 base fee plus $5.00 per fixture
Reinspection	$150.00

Fees for inspections or activity not identified above shall be based on the hourly rate of $_____ per hour.

Refunds shall be in accordance with the refund policy established by the code official in accordance with IPC Section 106.d.3.

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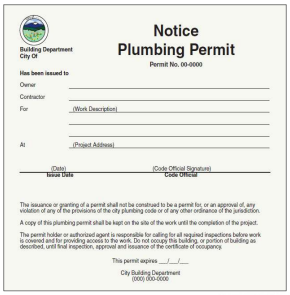
Permit Issuance

- The code official must review the application and construction documents within a reasonable time and, when approved, issue the permit.
- A copy of the permit and the approved construction documents must be kept on the jobsite until completion of the project.



Building Department
City Of

Notice
Plumbing Permit
Permit No. 00-0000

Has been issued to

Owner: _____
Contractor: _____
For: (Work Description) _____
_____
At: (Project Address) _____

(Date) Issue Date — (Code Official Signature) Code Official

The issuance or granting of a permit shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of the city plumbing code or of any other ordinance of the jurisdiction.

A copy of this plumbing permit shall be kept on the site of the work until the completion of the project.

The permit holder or authorized agent is responsible for calling for all required inspections before work is covered and for providing access to the work. Do not occupy this building, or portion of building as described, until final inspection, approval and issuance of the certificate of occupancy.

This permit expires ___/___/___

City Building Department
(000) 000-0000

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Inspections

It is the responsibility of the permit holder or agent to call for the required inspections before work is concealed and to provide access to such work.

Inspection approval tag

Department of Building Safety
Phone (###) 555-4967

INSPECTION APPROVED

☐ Building ☐ Plumbing
☐ Electrical ☐ Mechanical

Description: _____
Comments: _____
_____
_____
Date: _____
Inspector: _____

Jobsite inspection record card

Inspection Record

DO NOT COVER/ USE

DO NOT OCCUPY

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Required Inspections

Inspection	Conducted when	Inspect
Plumbing underground	When underground work is completed	• Materials, fittings and methods • Work properly supported and protected • Pressure testing of piping systems
Plumbing rough-in	Rough-in stage complete prior to rough framing inspection Water service connection	• Materials, fittings and methods • Work properly supported and protected • Pressure testing of piping systems
Plumbing final	After building complete, ready for occupancy Fixtures installed and connected	• Fixtures and appliances properly installed • Sealed at walls, floors and counters • Backflow preventer test completed

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Board of Appeals

- IPC and UPC basis for appeal pertains to code requirements:
  - Appellant claims the code official erred in interpreting the code or wrongly applied a code section.
  - Appellant considers a proposed alternative to be equal to the code requirements.
- Appeals not permitted for seeking a variance or a waiver.
- Board has no authority to waive code requirements.

Building Department
City Of

Department of Building Safety
Application for Appeal
Board of Appeals

Project address ______________
Use of structure ______________
Description of work ______________
Owner's name ______________ Phone ______________
Owner's address ______________

In accordance with the provisions of Section 109 of the *International Plumbing Code* (IPC), I hereby appeal to the Board of Appeals the determination made by the code official relative to the interpretation of Section __________, in order that I might proceed with the design and installation of the plumbing system at the above structure thereof as proposed and shown on the attachments.

Appellant is advised to submit any documentation in support of the appeal. An application for appeal shall be based on a claim that the true intent of the code has been incorrectly interpreted, the provisions of the code do not fully apply, or an equally good or better form of design is proposed. The board has no authority to waive requirements of the code. Appellant and any interested party may appear to present reasons for granting an appeal at the time of the scheduled meeting.

____
Signature of owner or appellant Date

Meeting date ______________
Time ______________
Location ______________

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Part I – Administration

1. T F Only code officials, AHJs, contractors, builders, architects, engineers, industry professionals and other experts can *submit a proposal* to add, revise or delete a code provision.

False
Any member of the public can submit a proposal to add, revise or delete a code provision.

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Part I – Administration

2. T F Only code officials, contractors, builders, architects, engineers, industry professionals and other experts can *vote on an IPC proposal*.

False
Only the ICC Governmental Member Voting Representatives and the ICC Honorary Members are permitted to cast votes.

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Part I – Administration

3. T F Only code officials, contractors, builders, architects, engineers, industry professionals and other experts can *vote on an UPC proposal*.

False
Anyone who is a member of IAPMO is permitted to cast votes.

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Part I – Administration

4. Where do you find the plumbing provisions for the construction of detached one- and two-family dwellings and townhouses?

The International Residential Code® (IRC®)

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Part I – Administration

5. Where do you find the material and installation requirements for water supply and distribution, plumbing fixtures, drain-waste and vent (DWV) piping and storm drainage systems?

International Plumbing Code® (IPC®) or Uniform Plumbing Code® (UPC®)

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Part I – Administration

6. T F The IPC or UPC overrides any local, state or federal law.

False
The IPC or UPC is not meant to nullify any local, state or federal law, and in many cases, such other laws supersede provisions found in the model code.

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Part I – Administration

7. Who applies for a permit?

A. Code Official
B. Owner/Authorized Agent
C. Authority Having Jurisdiction

B
The owner or authorized agent applies for a permit

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Part I – Administration

8. Who issues the permit?

A. Code Official
B. Owner/Authorized Agent
C. Jurisdiction
D. Authority Having Jurisdiction

A (IPC) D (UPC)
The code official or Authority Having Jurisdiction must review the application and construction documents and, when approved, issue the permit as soon as is practicable.

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Part I – Administration

9. Who establishes a schedule of fees?

A. Code Official
B. Owner/Authorized Agent
C. Jurisdiction

C
The jurisdiction establishes a schedule of fees.

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Part I – Administration

10. Who is responsible to call for the required inspections?

A. Code Official
B. Permit Holder/Authorized Agent
C. Authority Having Jurisdiction

B
The permit holder or agent must call for the required inspections before the work is concealed and to provide access to such work.

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Part I – Administration

11. T F The Board of Appeals has no authority to waive code requirements.

True

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Part I – Administration

Discuss the following questions:

- Why is it important for I-Codes and U-codes to be updated on three-year cycles?
- What are the duties and authorities of the code official?
- How does prescriptive and performance code provisions help a code official to determine compliance?

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Layout and Planning

Part II

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Water and Sewer Required

- The *International Private Sewage Disposal Code* or the *IAPMO/UPC/Appendix H-2021, Private Sewage Disposal Systems*, contain provisions for on-site sewage disposal systems.
- Both *International Plumbing Code* and *Uniform Plumbing Code* contain provisions on graywater discharge to subsurface irrigation use. Always verify local regulations that may apply.
- The code official/AHJ should work with the local authority overseeing public sewers and onsite sewage disposal systems, such as a public utility or a health department when it comes to identifying discharges that may be detrimental to the disposal systems. Such agencies may also control hazardous waste disposal operations.

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Materials and Standards

- IPC and UPC list the various product standards for plumbing materials.
- A manufactured product listing provides confirmation that the product or material has been evaluated by a third-party certification agency.
- Where there are conflicts between the code, manufacturer's installation instructions, referenced standards or other regulations, the minimum provisions of the code apply.

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Materials and Standards - Definitions

- **Third-party certification agency –** An approved agency operating a product or material certification system that incorporates initial product testing, assessment and surveillance of a manufacturer's quality control system.
- **Third-party certified –** Certification obtained by the manufacturer indicating that the function and performance characteristics of a product or material have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification is in the form of identification in accordance with the requirements of the third-party certification agency.

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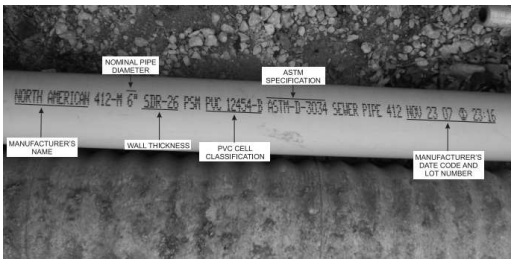
Sample of Markings of PVC Pipe



IPC Commentary Figure 303.1(2) Marking of PVC Gravity Sewer Pipe

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Part II — Layout and Planning

- Consider temperature-actuated, flow reduction (TARF) devices that conform to the ASSE 1062 product standard (an approved standard recognized by the IPC). Such devices can effectively reduce the possibility of injury due to exposure to hot water discharge in excess of 120°F.
- However, the IPC clearly states that such valves are not to be used alone as a substitute for balanced-pressure, thermostatic or combination shower valves.
- **Which prevails: the manufacturer's installation instructions or the code?**

In this case, the code prevails.

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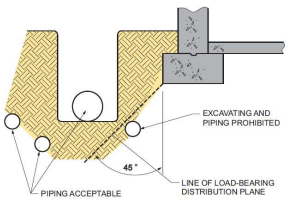
Protection of the Plumbing System and Structure

- Piping placed underground near the structural foundation can undermine the foundation.
- Trenches parallel and next to the foundation cannot extend below the 45° bearing plane of the footing wall.

(IPC 307.5) (UPC 314.4)



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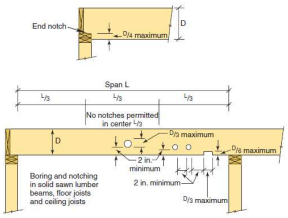
Protection of the Plumbing System and Structure

- **IPC Appendix C** details the location and maximum allowances for cutting, notching, and boring of wood framing members as required in the IBC and IRC.
- **UPC Sections 312.2 and 312.11** refer to the building code for cutting and notching.
- Boring, cutting or notching of trusses and other engineered wood products is prohibited except as specifically permitted by the manufacturer.



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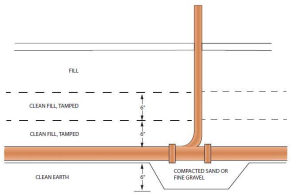
Protection of the Plumbing System and Structure

- When installing a piping installation in a trench, the entire length of the piping must be supported, including the fittings, to:
  - Maintain proper slope of the piping.
  - Protect the joints of the pipe and fittings from sagging.

(IPC 306.2) (UPC 313.5)



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Protection of the Plumbing System and Structure

- Support is necessary for piping installed above grade (both horizontal and vertical piping installations).
  - Type and weight of the piping material.
  - Weight and velocity of the contents within the piping.

IPC Table 308.5 Hanger Spacing

Piping material	Maximum horizontal spacing (feet)	Maximum vertical Spacing (feet)
ABS pipe	4	10[a]
Cast-iron pipe	5[b]	15[b]
Copper tubing (1¼" or smaller)	6[a]	10
Copper tubing (1¼" or smaller)	10	10
PEX	2.67 (32 inches)	10[b]
PVC	4	10[b]

[a] The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.

[b] For sizes 2 inches and smaller, a guide shall be installed midway between required vertical supports. Such guides shall prevent pipe movement in a direction perpendicular to the axis of the pipe.

See also,
UPC Table 313.3 Hangers and Supports

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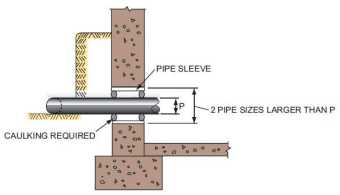
Protection of the Plumbing System and Structure

- Primary way to protect the pipe is to install a pipe sleeve in the foundation through which the pipe can pass.
- Pipe sleeve is to be two-pipe sizes larger than the pipe passing through. (IPC 305.3)
- Opening must be sealed to prevent water and moisture intrusion.

(IPC 306.2) **(UPC 312.8)**



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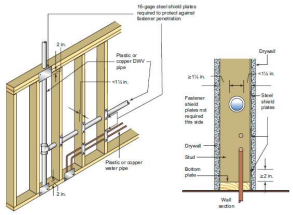
Protection of the Plumbing System and Structure

- Plastic and copper material are extremely vulnerable to damage due to sheetrock nails and screws.
- Must be protected by means of steel shield plates, typically known as nail plates, having a minimum thickness of **No. 16 gage** or **No. 18 gage**.

(IPC 305.6) **(UPC 312.9)**



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Interceptors and Separators

- **Interceptor -** A device that separates and retains for removal, by automatic or manual means, harmful, hazardous or undesirable matter from normal wastes, while permitting normal sewage or wastes to discharge into the drainage system by gravity.
- *Interceptors* are also referred to as "*separators.*"

(IPC Chapter 10) **(UPC Chapter 10)**

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Interceptors and Separators

Grease-laden Waste - Discharge produced from food processing, food preparation or other sources where grease, fats and oils enter automatic dishwater pre-rinse stations, sinks or other appurtenances.

(IPC Chapter 2 Definitions)

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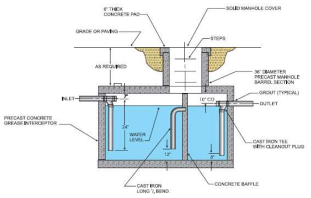
Interceptors and Separators

Gravity-type Grease Interceptor -

Plumbing appurtenances of not less than 500 gallons (1893 L) capacity that are installed in the sanitary drainage system to intercept free-floating fats, oils and grease from wastewater discharge. Separation is accomplished by gravity during a retention time of not less than 30 minutes.

(IPC Chapter 2) (UPC Chapter 2)



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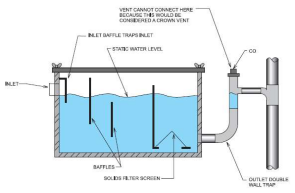
Interceptors and Separators

Hydromechanical Grease Interceptor -

Plumbing appurtenances installed in the sanitary drainage system to intercept free-floating fats, oils and grease from wastewater discharge. Continuous separation is accomplished by air entrainment, buoyancy and interior baffling.

(IPC Chapter 2) (UPC Chapter 2)



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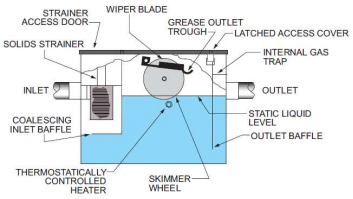
Interceptors and Separators

Automatic Grease Removal Device (GRD)-

Plumbing appurtenance installed in the sanitary drainage system to intercept free-floating fats, oils and grease from wastewater discharge. Operating on a time- or event- controlled basis, it removes free-floating fats, oils and grease automatically without intervention from the user except for maintenance.

(IPC Chapter 2) **(UPC Chapter 2)**



64

Interceptors and Separators

- All grease interceptors must be designed, sized and installed in accordance with the code and manufacturer's instructions.
- IPC Table 1003.3.5.1 is used for sizing gravity-type grease interceptors. It identifies the grease retention capacity in pounds corresponding with the total flow-through rating of the interceptor.

IPC Table 1003.3.5.1 Grease Interceptor Capacity

Total flow-through rating (gpm)	Grease retention capacity (pounds)
4	8
6	12
9	18
15	30
25	50
75	150
100	200

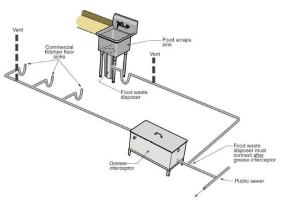
For total flow-through ratings greater than 100 (gpm), double the flow-through rating to determine the grease retention capacity (pounds)

See also, **UPC Table 1014.2.1 Interceptor Sizing Using Gravity Flow Rates**

65

Interceptors and Separators

- Interceptor performance additives may be used, but only where allowed by the interceptor manufacturer's instructions and the performance additive system conforms to ASME A112.14.6. (IPC 1003.3.3)
- Emulsifiers, chemicals or enzymes are prohibited. (IPC 1003.3.3)
- Food waste disposers shall not discharge to a grease interceptor. (IPC 1003.3.2)
- No food waste disposer or dishwasher shall be connected to or discharge into a grease interceptor with exception of grease interceptors designed to receive the discharge of food waste. **(UPC 1003.3.2)**



66

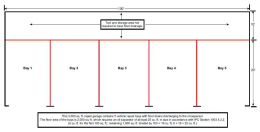
Interceptors and Separators

Oil Separators

Required in vehicle service and repair garages where floor or trench drains are provided, as well as car washing facilities.

- Designed with a minimum depth of 2 feet below the invert of the discharge drain.
- Must provide a minimum 18-inch water seal.

(IPC 1003.4) **(UPC 1017.2)**



67

Chemical Wastes

- Acids or other corrosive liquids that must be diluted prior to discharging to the sanitary drainage system.
- An approved dilution or neutralizing device that automatically supplies sufficient amounts of water for this purpose may be necessary.
- Since the wastes can be corrosive, attention must be given to the type of materials to be used for the drainage system that are resistant to the corrosive action.
- The chemical waste vent system must be independent of the sanitary vent system and shall terminate through the roof to the outdoors, or to an air admittance valve. (IPC)

(IPC 803) **(UPC 811)**

68

Part II – Layout and Planning

1. Which device automatically intercepts free-floating fats, oils and grease from waste water discharge without user intervention?
   A. Automatic Grease Removal Device (GRD)
   B. Hydromechanical Grease Interceptor
   C. Gravity-type Grease Interceptor

A
Automatic Grease Removal Device (GRD)

69

Part II – Layout and Planning

2. Which device intercepts free-floating fats, oils and grease from wastewater discharge by gravity?
   A. Automatic Grease Removal Device (GRD)
   B. Hydromechanical Grease Interceptor
   C. Gravity-type Grease Interceptor

C
Gravity-type Grease Interceptor

70

Part II – Layout and Planning

3. Which device intercepts free-floating fats, oils and grease from wastewater discharge by air entrainment, buoyancy and interior baffling?
   A. Automatic Grease Removal Device (GRD)
   B. Hydromechanical Grease Interceptor
   C. Gravity-type Grease Interceptor

B
Hydromechanical Grease Interceptor

71

Part II – Layout and Planning

4. T F An oil separator is required in car washing facilities.

True
Areas within garages used only for storage of vehicles are not required to drain to the separator.

72

Minimum Plumbing Fixtures

- The minimum fixture requirements of IPC Section 403 are included in of the IBC Chapter 29 for use by the designer of the structure. Also included in UPC Section 422.
- A detached single-family home as well as individual dwelling units in multifamily structures such as townhouses, apartments and condominiums will require at least one water closet, one lavatory, either a bathtub or shower, and a kitchen sink.

73

Minimum Plumbing Fixtures- Definitions

- **Dwelling unit** – A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.
- **Private** – In the classification of plumbing fixtures, "private" applies to fixtures in residences and apartments, and to fixtures in nonpublic toilet rooms of hotels and motels and similar installations in buildings where the plumbing fixtures are intended for utilization by a family or an individual.
- **Public or public utilization** – In the classification of plumbing fixtures, "public" applies to fixtures in general toilet rooms of schools, gymnasiums, hotels, airports, bus and railroad stations, public buildings, bars, public comfort stations, office buildings, stadiums, stores, restaurants and other installations where a number of fixtures are installed so that their utilization is similarly unrestricted.

74

Minimum Plumbing Fixtures

IPC Table 403.1 and UPC Table 422.1 provide the minimum number of required plumbing fixtures for different types of occupancies or uses based on:

1. The classification of the structure or use.
2. The specific description within the classification.
3. The occupant load of the space or structure.

IPC Table 403.1
MINIMUM NUMBER OF REQUIRED PLUMBING FIXTURES

Classification	Description	Water closets	Lavatories
Assembly Group A-3	Church	Male: 1 per 150 Female: 1 per 75	Male: 1 per 200 Female: 1 per 200
Assembly Group A-1	Movie Theater	Male: 1 per 125 Female: 1 per 65	Male: 1 per 200 Female: 1 per 200
Assembly Group A-2	Restaurant	Male: 1 per 150 Female: 1 per 75	Male: 1 per 200 Female: 1 per 200
Mercantile Group M	Retail Store	Male: 1 per 500 Female: 1 per 500	Male: 1 per 750 Female: 1 per 750

75

Minimum Plumbing Fixtures

IPC 403.1.1, exception 2, now allows Multiple-user facilities to be designed to serve all genders. In such cases, minimum fixture count must be calculated at 100 percent, based on total occupant load. In such multiple-user facilities, each fixture type shall be in accordance with ICC A117.1 (Standard for Accessible and Usable Buildings and Facilities), and each urinal provided must be in a stall.

76

Minimum Plumbing Fixtures

Per IPC Table 403.1, How many water closets are required for a church with an occupant load of 500 (250 male, 250 female), with separate facilities for male and female?

NO.	CLASSIFICATION	DESCRIPTION	WATER CLOSETS (URINALS: SEE SECTION 424.2)		LAVATORIES		BATHTUBS/ SHOWERS	DRINKING FOUNTAIN (SEE SECTION 410)	OTHER
			MALE	FEMALE	MALE	FEMALE			
1	Assembly	exhibition halls, museums, lecture halls, libraries, arcades and gymnasiums[a]	1 per 125	1 per 65	1 per 200	—	1 per 500	1 service sink	
		Passenger terminals and transportation facilities[a]	1 per 500	1 per 500	1 per 750	—	1 per 1,000	1 service sink	
		Places of worship and other religious services[a]	1 per 150	1 per 75	1 per 200	—	1 per 1,000	1 service sink	

Men=250/150=1.7 = 2
Women=250/75=3.3 = 4

2 water closets for men and 4 water closets for women, a greater ratio for females is included in table since restroom use is concentrated before, during an intermission, or after services.

77

Minimum Plumbing Fixtures

Per IPC Table 403.1, How many water closets are required for a restaurant with the same occupant load occupant load of 500 (250 male, 250 female) with separate facilities for male and female?

NO.	CLASSIFICATION	DESCRIPTION	WATER CLOSETS (URINALS: SEE SECTION 424.2)		LAVATORIES		BATHTUBS/ SHOWERS	DRINKING FOUNTAIN (SEE SECTION 410)	OTHER
			MALE	FEMALE	MALE	FEMALE			
		Theaters and other buildings for the performing arts and motion pictures[a]	1 per 125	1 per 65	1 per 200	—	1 per 500	1 service sink	
		Nightclubs, bars, taverns, dance halls and buildings for similar purposes[a]	1 per 40	1 per 40	1 per 75	—	1 per 500	1 service sink	
		Restaurants, banquet halls and food courts[a]	1 per 75	1 per 75	1 per 200	—	1 per 500	1 service sink	

Men=250/75=3.3= 4
Women=250/75=3.3 = 4

4 water closets for each sex due to intermittent use.

78

Minimum Plumbing Fixtures

- Drinking fountains are required where the occupant load exceeds 15. (IPC 410.2)
- Drinking fountains are required where the occupant load exceeds 30. **(UPC 415.2)**
- Two drinking fountains are to be installed:
  - One at a level for people who use a wheelchair.
  - One for standing persons.

(IPC 410.3.1)

- Plumbing fixtures and fixture fittings for persons with disabilities shall be in accordance with ICC A117.1 and the applicable standards in Chapter 4. **(UPC 403.2)**

79

Hot Water Requirements and Temperature Limiting

Hot water [>= 110°F (43°C)] (IPC Chapter 2)

Hot water [>= 120°F (49°C)] **(UPC Chapter 2)**

(IPC 412.3, 412.4, 412.5, 419.5) **(UPC 601.2.1)** Provided to fixtures and equipment used for bathing, washing, culinary purposes, cleansing, laundry or building maintenance in all occupancies, with the following exceptions:

1. In nonresidential occupancies, fixtures and equipment used for bathing or washing may be served by either hot or tempered water.
2. Tempered water [85°F (29°C) to 110°F (43°C)] is required for lavatories and group wash fixtures in public toilet facilities provided to customers, patrons and visitors. (IPC 419.5)

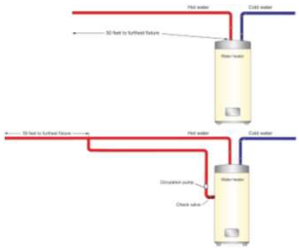
- Tepid Water [85°F (29°C) to 110°F (43°C)] **(UPC Appendix N)**
- Tempered Hot Water [120°F (49°C) to 130°F (54°C)] **(UPC Appendix N)**

80

Hot Water Requirements and Temperature Limiting

- Hot or tempered water piping cannot exceed 50 feet from the heating source to the fixture.
- Circulation systems or heat trace systems used in larger occupancies are considered the heat source. So, the 50-feet length can be measured from the branch connection to the circulation system or heat trace system.

(IPC 607.2)

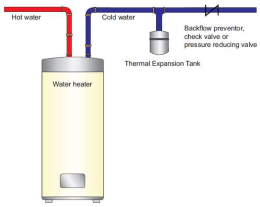


81

Hot Water Requirements and Temperature Limiting

- A means for controlling thermal expansion is required for water distribution systems served by a storage type water heater that is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer.
- A thermal expansion tank is commonly used for controlling thermal expansion.

(IPC 607.3) **(UPC 608.3)**



82

Hot Water Requirements and Temperature Limiting

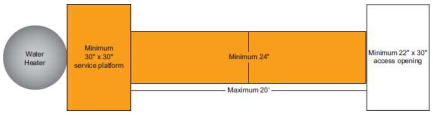
- Faucets shall be connected to the water distribution system such that the flow of hot or tempered water corresponds to the left-hand side, and the flow of cold water corresponds to the right-hand side.
- The exception is for individual balanced-pressure, thermostatic or combination balanced-pressure/thermostatic shower control valves where the flow of hot or cold water corresponds to the markings on the device.

(IPC 607.4) **(UPC 417.5)**

83

Water Heaters – Installation

- Water heaters must be installed so that they can be observed, accessed, removed and replaced when necessary without removing permanent construction. (IPC 502.3) **(UPC 507.26)**
- Where a water heater is located in an attic, indicated by the requirements in the figure below. (IPC 502.5)



- For attic installation, the passageway and servicing area adjacent to the appliance shall be floored. **(UPC 507.26)**

84

Water Heaters – Installation

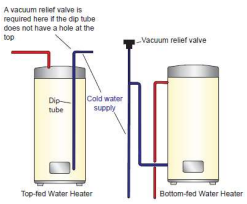
- Support of the water heater is very important. Where subject to seismic activity, it needs to be secured and in most cases, a manufactured water heater seismic bracing kit will be sufficient. (IPC 502.4) **(UPC 507.2)**
- It is also important to protect the water heater from damage, (e.g., out of the path of the vehicle when located in a garage). (IPC 502.1.1)

85

Water Heaters – Safety Devices

- A vacuum relief valve is required for water heaters that do not include a "dip" tube with a hole at the top.
- The "dip" tube is common with most water heaters having the cold water supply connected at the top of the tank.
- Bottom-fed water heaters do not have the "dip" tube, so they require the vacuum relief valve.

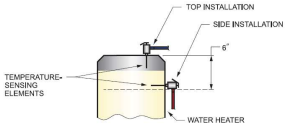
(IPC 504.2) **(UPC 504.6, 608.7)**



86

Water Heaters – Safety Devices

Storage water heaters require the installation of a self-closing relief valve that will open to relieve the pressure if necessary. Most common are combination temperature and pressure relief valves that are set to open at a temperature of 210°F or at a pressure of 150 psi. (IPC 504.4) **(UPC 504.4, 504.5, 608.4)**

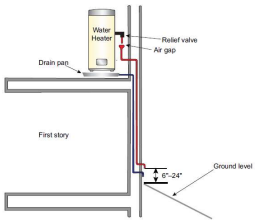


87

Water Heaters – Relief Valve Discharge

The discharge piping serving a pressure relief valve, temperature relief valve or combination thereof shall:

1. Not be directly connected to the drainage system.
2. Discharge through an *air gap* located in the same room as the water heater.
3. Not be smaller than the diameter of the outlet of the valve served and shall discharge full size to the *air gap*.
4. Serve a single relief device and shall not connect to piping serving any other relief device or equipment.
5. Discharge to the floor, to the pan serving the water heater or storage tank, to a waste receptor or to the outdoors.
6. Discharge in a manner that does not cause personal injury or structural damage.
7. Discharge to a termination point that is readily observable by the building occupants.

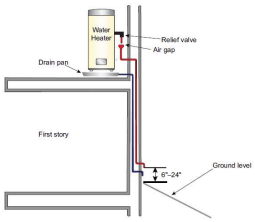


(IPC 504.6) (UPC 608.5)

88

Water Heaters – Relief Valve Discharge Cont'd

8. Not be trapped.
9. Be installed so as to flow by gravity.
10. Terminate not more than 6 inches (152 mm) above and not less than two times the discharge pipe diameter above the floor or *flood level rim* of the waste receptor.
11. Not have a threaded connection at the end of such piping.
12. Not have valves or tee fittings.
13. Be constructed of those materials listed in Section 605.4 or materials tested, rated and *approved* for such use in accordance with ASME A112.4.1.
14. Be one nominal size larger than the size of the relief valve outlet, where the relief valve discharge piping is installed with insert fittings. The outlet end of such tubing shall be fastened in place.



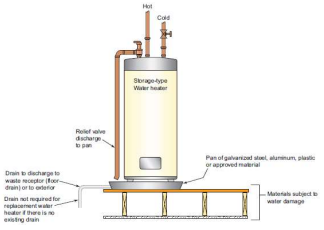
(IPC 504.6) (UPC 608.5)

89

Water Heaters – Drain Pan

- Storage type water heaters shall be installed in a drain pan where leakage from the tank can cause damage.
- The pan must be of approved materials, usually plastic, galvanized steel or aluminum. However, a plastic drain pan shall not be installed beneath a gas-fired water heater.
- The drain pan must be of sufficient size and shape to capture leaking water or condensation from the tank.

(IPC 504.7) (UPC 507.5)

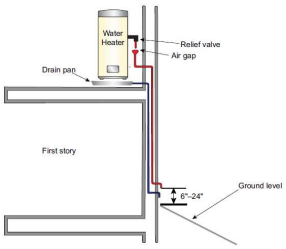


90

Water Heaters – Drain Pan

- The minimum depth of the drain pan is $1^1/_2$ inches and must have a minimum $^3/_4$-inch drain and indirect waste piping terminating to a waste receptor, a floor drain or the exterior of the structure.
- Where the drain extends to the exterior, it must terminate at least 6 inches, but not more than 24 inches, above the adjacent ground.

(IPC 504.7.1, 504.7.2) **(UPC 507.5 , 608.5)**



91

Water Heaters – Relief Valve Discharge

Can a relief discharge terminate to a garage floor that is sloped toward the exterior at the garage door?

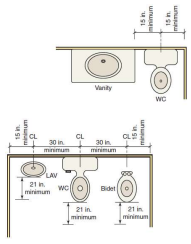
The code official must determine whether termination to a sloped garage floor is acceptable, provided that no structural damage will occur.

92

Fixture Clearances

- Minimum fixture clearance for water closets, urinals, lavatories and bidets:
  - 15 inches from center to any side wall, partition or cabinet
  - **21 inches in front of the fixture (IPC)**
  - **24 inches in front of the fixture (UPC)**
  - 30 inches center-to-center for side-by-side fixtures without partitions between them

(IPC 405.3.1) **(UPC 402.5)**

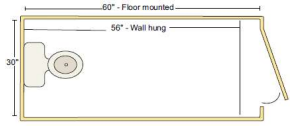


93

Fixture Clearances-Water Closet Compartment

- *Floor-mounted* water closet compartment: space must be minimum 30 inches by 60 inches.
- *Wall-hung* water closet compartment: space must be minimum 30 inches by 56 inches.

(IPC 405.3.1)



94

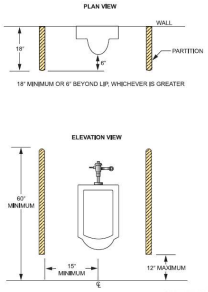
Fixture Clearances-Urinals

- Public or employee restrooms containing multiple urinals shall include partitions between urinals.
  - Must extend at least 6 inches beyond the front lip of the urinal, but not less than 18 inches overall.
  - Shall be not less than 12 inches above the floor at its lowest point to a height not less than 60 inches.

(IPC 405.3.5)

- Urinals
  - Must be 12 inches or more from center to wall or partition.
  - Shall be not less than 24 inches center to center.

(UPC 402.5)



95

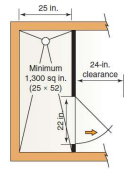
Fixture Clearances

- Minimum shower dimensions are 30 inches by 30 inches (900 square inches), or a minimum width of 25 inches, provided that the interior cross-sectional area is not less than 1,300 square inches.

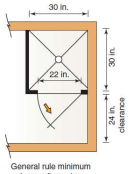
(IPC 421.4)

- Minimum shower finished interior of 1024 square inches and encompass a 30 inch circle
- Minimum required area and dimensions not required when overall dimensions are 30 inches by 60 inches

(UPC 408.6)



Alternate minimum shower dimensions (approximate finish dimensions of bathtub)



General rule minimum shower dimensions

96

General Fixture Provisions – Approved Fixtures

- IPC Chapter 15 and UPC Chapter 17 provide product standards for various types of fixtures and appliances.
- Faucets shall conform to the ASME A112.18.1/CSA B125.1 product standard, and where used for the supply of drinking water for human ingestion, they must also conform to NSF 61, Section 9.

(IPC 412.1) (UPC 417.1)

97

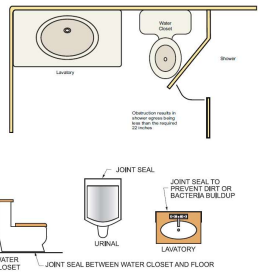
General Fixture Provisions – Installation

- Fixtures and faucets must be installed in accordance with the manufacturer's installation instructions and shall not be installed in a way that interferes with the operation of doors and windows.

(IPC 405.3.3) (UPC 308.1)

- Where fixtures come in contact with floor, wall or counter surfaces, such joints are to be sealed watertight to prevent water intrusion during use or when cleaning.

(IPC 405.6) (UPC 402.2)

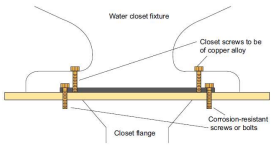


98

General Fixture Provisions – Floor Flange

- Floor-mount type water closets are secured to a floor flange fitting (drainage fitting).
- Flange must be connected to the drainage piping and secured to the floor.
- The joint between the fixture and the floor must be sealed watertight.

(IPC 405.4) (UPC 402.6)

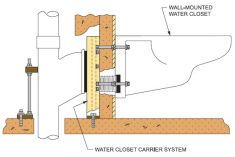


99

General Fixture Provisions – Wall Hung Water Closets

- Wall-hung type water closets connections require an approved metal carrier that is connected to the drainage system and secured to the building structural members.
- The joint between the fixture and the wall must be sealed watertight.

(IPC 405.4.3) (UPC 402.4)



100

General Fixture Provisions – Water Closet Seats

- Water closets for public or employee use shall be of the elongated bowl type with open-front seats.
- This is not required for private use where the fixture is intended to be used by an individual or a family, such as in a residence or private hotel rooms.

(IPC 425.3) (UPC 411.3)

101

General Fixture Provisions – Water Closets and Urinals

- Water closets and urinals are designed to be self-siphoning and must be provided with flushing devices that will:
  - Provide a sufficient volume and flow of water to flush and rinse the bowl
  - Replenish enough water within the bowl to maintain a trap seal when the flushing process is completed.

(IPC 415.1) (UPC 413.1)

102

General Fixture Provisions – Water Closets, Urinals, Lavatories, Bidets

- Proper securing of urinals, lavatories and bidets is equally important, as is the proper installation of the valves.
- An approved carrier is required for wall-hung urinals and lavatories.

(IPC 405.4.3) (UPC 402.4)

103

General Fixture Provisions – Water Temperature

- Water temperature to a bidet must be a maximum temperature of 110°F.
- Hot water is required for lavatories (hand wash sinks or group wash fixtures).
- Tempered water is required for lavatories and group wash fixtures in public toilet facilities.

(IPC Chapter 4) (UPC Chapter 4)

Type of Fixture	Maximum Temperature	Required Device
Shower	120°F	Individual shower control valve conforming to ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A119.18.1/CSA B125.1
Multiple (gang) showers	120°F	Thermostatic mixing valve conforming to ASSE 1069 or CSA B125.3
Bathtub or whirlpool bathtub filler	120°F	Thermostatic mixing valve conforming to ASSE 1070/ASME A112.1070/CSA B125.70 or CSA B125.3
Bidet	110°F	Thermostatic mixing valve conforming to ASSE 1070/ASME A112.1070/CSA B125.70 or CSA B125.3
Head shampoo sink	120°F	Thermostatic mixing valve conforming to ASSE 1070/ASME A112.1070/CSA B125.70 or CSA B125.3
Footbath/Pedicure bath	120°F	Thermostatic mixing valve conforming to ASSE 1070/ASME A112.1070/CSA B125.70 or CSA B125.3

104

General Fixture Provisions – Bathtubs and Showers

- Bathtubs must:
  - Have a minimum drain outlet, fixture drain and trap of not less than 1½ inches.
  - Be equipped with a watertight stopper.
- Hot water temperature to the valve must be limited to not more than 120°F by means of a temperature-limiting device.
- New in 2021 IPC- overflows are optional.

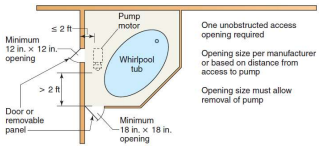
(IPC 407.2) (UPC 409.2, 409.3)

105

General Fixture Provisions – Bathtubs and Showers

- Whirlpool bathtub circulation pumps must be accessible for servicing.
  - Opening must be large enough to permit unobstructed access to the circulation pump for service or removal and replacement.
  - A door or panel is permitted to close the opening.

(IPC 426.5) **(UPC 409.6)**



106

General Fixture Provisions – Bathtubs and Showers

- Showers must have a drain outlet, fixture drain and trap of not less than 1½ inches (IPC) or 2 inches **(UPC)**.
- Shower control valve must be:
  - A balanced-pressure, thermostatic or combination valve due to injury risk.
  - Equipped with a means to limit the maximum setting of the valve to 120°F.

(IPC 421.3, 412.3) **(UPC 408.4, 408.3)**

107

General Fixture Provisions – Bathtubs and Showers

- Where multiple shower risers are provided from a single control valve, the temperature must be not more than 120°F by means of an approved automatic temperature control mixing valve.

(IPC 412.4) **(UPC 408.3)**

108

General Fixture Provisions – Kitchen Sinks

- Residential-use kitchen sinks require a minimum 1½-inch drain outlet, fixture drain and trap, even though they may contain more than one compartment.
- It is common to have a hand-held spray attachment on a kitchen sink faucet.

(IPC 422.2, 412.2) **(UPC 420.4, 417.3)**

109

General Fixture Provisions – Food Waste Disposers

- Food waste disposers require a minimum 1½-inch drain and must be supplied with cold water.
  - Domestic food waste disposer can be connected to a sink compartment.
  - Commercial food waste disposers must be connected and trapped separately from fixtures or sink compartments, and cannot discharge to a grease Interceptor.

(IPC 416.2, 416.3, 416.4, 1003.3.2)

(UPC 419.3, 1014.1.3)

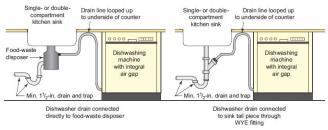
110

General Fixture Provisions – Dishwashers

- Domestic dishwasher requires a minimum 1½-inch fixture drain and trap. Drain may connect to a wye fitting in the sink tailpiece or to a domestic food waste disposer.
- Commercial dishwasher may require a larger fixture drain and trap. Must discharge indirectly to a waste receptor, thus providing an air break at a minimum.

(IPC 409.4, 802.1.6)

(UPC 414.3)

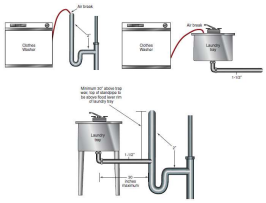


111

General Fixture Provisions – Clothes Washers & Laundry Trays

- Residential clothes washers require a minimum 2-inch fixture drain, trap and standpipe.
- Commercial clothes washers require a minimum 3-inch fixture drain and trap.

(IPC 406.2) (UPC Table 702.1)



112

General Fixture Provisions – Shampoo Sinks and Footbaths

- Head shampoo sinks, footbaths and pedicure baths must have the hot water temperature to the valve limited to not more than 120°F by means of a temperature-limiting device.

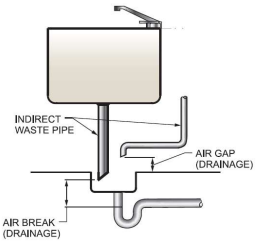
(IPC 412.10, 423.3)

113

Food Preparation and Storage – Protection from Contamination

- Fixtures, appliances and equipment used in food preparation, storage of food or ice and for the washing of dishes, pots, pans and utensils* cannot connect directly to the drainage system.
- They must be discharged by way of an indirect waste pipe through an air gap or air break.

(IPC 802.1.1) (UPC 801.5)



114

Food Preparation and Storage – Protection from Contamination - Definitions

- **Air break (drainage system)** – A piping arrangement in which a drain from a fixture, appliance or device discharges indirectly into another fixture, receptacle or interceptor at a point below the flood level rim and above the trap seal.
- **Air gap (drainage system)** – The unobstructed vertical distance through the free atmosphere between the outlet of the waste pipe and the flood level rim of the receptacle into which the waste pipe is discharging.
- **Indirect waste pipe** – A waste pipe that does not connect directly with the drainage system, but that discharges into the drainage system through an air break or air gap into a trap, fixture, receptor or interceptor.

115

Food Preparation and Storage – Protection from Contamination

New in **2021 IPC**

- Sinks used for the washing of dishes, pots, pans and utensils may now connect directly to the drainage system if connected to a hydro-mechanical grease interceptor, if the branch drain serving the interceptor is provided with an emergency floor drain downstream of the interceptor connection, and the branch serves only the emergency floor drain and the interceptor.

802.1.7 Food utensils, dishes, pots and pans sinks.

Sinks, in other than dwelling units, used for the washing, rinsing or sanitizing of utensils, dishes, pots, pans or service ware used in the preparation, serving or eating of food shall discharge indirectly through an *air gap* or an *air break* to the drainage system.

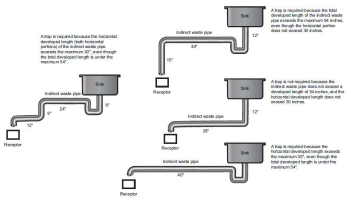
116

Food Preparation and Storage – Indirect Waste Piping

Fixtures that discharge through indirect waste pipes to a receptor are not required to be trapped, except where:

- The indirect waste pipe exceeds 30 inches of horizontal piping, or
- A total developed length of both horizontal and vertical piping of 54 inches.
- Indirect waste piping receiving only clear-water waste does not require a trap regardless of the developed length, such as an indirect drain from an ice maker.

(IPC 802.3)



117

Part II – Layout and Planning

5. From IPC, how many water closets are required for a movie theater with an occupant load of 250 (125 male, 125 female), with separate facilities for male and female?

Classification	Description	Water closets	Lavatories
Assembly Group A-3	Church	Male: 1 per 150 Female: 1 per 75	Male: 1 per 200 Female: 1 per 200
Assembly Group A-1	Movie Theater	Male: 1 per 125 Female: 1 per 65	Male: 1 per 200 Female: 1 per 200
Assembly Group A-2	Restaurant	Male: 1 per 150 Female: 1 per 75	Male: 1 per 200 Female: 1 per 200
Mercantile		Male: 1 per 500	Male: 1 per 750

1 water closet for men and 2 water closets for women.

118

Part II – Layout and Planning

6. From IPC, how many water closets are required for a retail store with an occupant load of 1000 (500 male, 500 female), with separate facilities for male and female?

Classification	Description	Water closets	Lavatories
Assembly Group A-3	Church	Male: 1 per 150 Female: 1 per 75	Male: 1 per 200 Female: 1 per 200
Assembly Group A-1	Movie Theater	Male: 1 per 125 Female: 1 per 65	Male: 1 per 200 Female: 1 per 200
Assembly Group A-2	Restaurant	Male: 1 per 150 Female: 1 per 75	Male: 1 per 200 Female: 1 per 200
Mercantile Group M	Retail Store	Male: 1 per 500 Female: 1 per 500	Male: 1 per 750 Female: 1 per 750

1 water closet for each sex due to intermittent use.

119

Part II – Layout and Planning

7. From the IPC, _____water has a temperature range between 85°F (29°C) and 110°F (43°C).

Tempered water

120

Part II – Layout and Planning

8. From the UPC, _____water has a temperature range between 85°F (29°C) and 110°F (43°C).

Tepid water

121

Part II – Layout and Planning

9. What piping arrangement does a drain from a fixture discharge indirectly into another fixture below the flood level rim and above the trap seal?
   A. air break (drainage system)
   B. air gap (drainage system)
   C. indirect waste pipe

A
air break (drainage system)

122

Part II – Layout and Planning

Discuss the following questions:

- What is the significance of third-party certified product standards and materials listed in the IPC and UPC?
- What are some considerations for protecting both the plumbing system and the structure?
- Why does a shower control valve present a greater risk of injury to users than a bathtub with a hand-held shower wand?

123

Drain, Waste and Vent

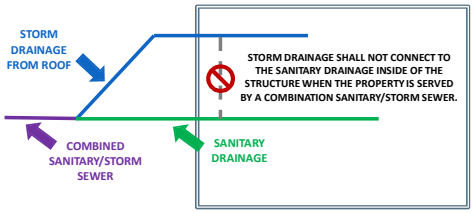
Part III

124

Sanitary Drainage – Connection to Sewer

- Ensure sanitary drainage goes to the sanitary sewer, and roof and storm drainage goes to the storm sewer.

(IPC 703.6) **(UPC 1101.16.2)**



125

Sanitary Drainage – Materials

- Typical ABS/DWV and PVC/DWV is acceptable for above and below ground installation, as is cast iron.
- Stainless steel type 304 can only be installed above ground, where type 316L is approved for both above and below ground.

IPC TABLES 702.1, 702.2, **UPC TABLE 701.2**

Material	Above ground	Below ground
ABS	X	X
PVC	X	X
PE		X
Cast Iron	X	X
Stainless Steel 304	X	
Stainless Steel 316L	X	X

126

Sanitary Drainage – Testing

- All portions of the drain, waste and vents (DWV) system must be tested for leaks prior to cover.
  - Standing water test
  - Minimum 5 psi air test *
- IPC prohibits testing plastic pipe, tubing and fittings with air pressure due to the risk of injury due to pipe bursting and shattering. Manufacturers of plastic materials specifically prohibit such testing.

(IPC Section 312) (UPC 712.1)

127

Sanitary Drainage – Definitions

- **Horizontal pipe** – Any pipe or fitting that makes an angle of less than 45 degrees (0.79 rad) with a horizontal plane.
- **Vertical pipe** – Any pipe or fitting that makes an angle of 45 degrees (0.79 rad) or more with the horizontal.
- **Stack** – A general term for any vertical line of soil, waste, vent or inside conductor piping that extends through not fewer than one story with or without offsets.
- **Branch interval –** A vertical measurement of distance, 8 feet (2438 mm) or more in developed length, between the connections of horizontal branches to a drainage stack. Measurements are taken down the stack from the highest horizontal branch connection.

128

Sanitary Drainage – Installation

- Important to maintain a uniform slope to the drain pipe.
  - Most common for horizontal drains of all sizes in a structure to be sloped at ¼" per foot.
  - **IPC:** 3" and larger piping may be run at a slope less than ¼ inch per foot.
  - **UPC:** 4" and larger piping may be run at a slope less than ¼ inch per foot.
  - Horizontal drains discharging to a grease interceptor shall not be installed with less than ¼ inch/foot slope.

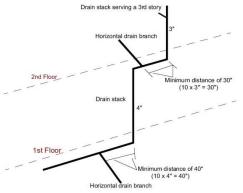
(IPC 704.1) (UPC 708.1)

Size (inches)	Minimum Slope (inch per foot)
$2^1/_2$ or less	$^1/_4$
3 to 6	$^1/_8$
8 or larger	$^1/_{16}$

129

Sanitary Drainage – Installation

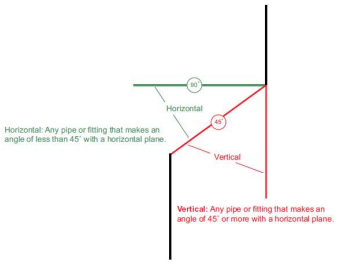
Horizontal branches must connect downstream of the base of a stack a minimum of 10 pipe diameters due to *hydraulic jump*, a rise or wave of liquid waste in the horizontal pipe due to the vertical downward gravity flow in the stack as it hits the horizontal pipe.



130

Sanitary Drainage – Offsets in Drainage Stacks

- Offsets in drainage stacks will create pressure fluctuations in the stack due to turbulence.
- Need to provide sufficient air into the stack to avoid affecting the trap seal of fixtures discharging to the stack.
- How to provide sufficient air depends on whether it is a vertical offset or a horizontal offset.



131

Sanitary Drainage – Offsets in Drainage Stacks

- Horizontal stack offsets must be vented in accordance with IPC Section 907 where there are more than four branch intervals below the top of the stack. The following applies also:
  1. The portion of the stack above the offset must be sized for a vertical stack based on the drainage fixture unit load above the offset;
  2. The offset must be sized as a building drain; and
  3. The portion of the stack below the offset must be the same size as the offset or based on the total number of drainage fixture units on the entire stack, whichever is larger. The venting of a horizontal stack offset may be omitted where the stack and its offset are oversized in accordance with IPC Section 711.2.1.
- Horizontal stack offsets below the lowest horizontal branch connecting to the stack must be sized as a building drain, and the continuation of the stack downstream of the offset shall not be decreased. No such increase in size is required for vertical stack offsets that are located below the lowest horizontal branch connecting to the stack.

Diameter of pipe (inches)	Maximum number of drainage fixture units connected to any portion of the building drain or the building sewer, including branches of the building drain[a] Slope per foot			
	1/16	1/8	1/4	1/2
1 1/4	—	—	1	1
1 1/2	—	—	3	3
2	—	—	21	26
2 1/2	—	—	24	31
3	—	36	42	50
4	—	180	216	250
5	—	390	480	575
6	—	700	840	1,000

Diameter of pipe (inches)	Maximum number of drainage fixture units (dfu) Stacks[a]			
	Total for horizontal branch	Total discharge into one branch interval	Total for stack of three branch intervals or less	Total for stack greater than three branch intervals
1 1/4	3	2	4	8
2	6	6	10	24
2 1/2	12	9	20	42
3	20	20	48	72
4	160	90	240	500
5	360	200	540	1,100
6	620	350	960	1,900

132

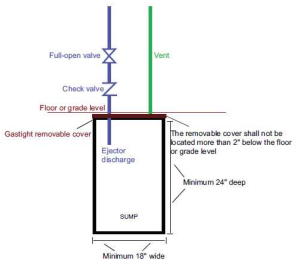
Sanitary Drainage – Definitions

- **Building drain –** That part of the lowest piping of a drainage system that receives the discharge from soil, waste and other drainage pipes inside and that extends 30 inches (762 mm) in developed length of pipe beyond the exterior walls of the building and conveys the drainage to the building sewer.
- **Building subdrain –** That portion of a drainage system that does not drain by gravity into the building sewer.
- **Bathroom group –** A group of fixtures consisting of a water closet, lavatory, bathtub or shower, including or excluding a bidet, an emergency floor drain or both. Such fixtures are located together on the same floor level.

133

Sanitary Drainage – Drainage below the Sewer Level

- Building subdrains that cannot be drained by gravity to the sewer shall be discharged to a sump that is gastight and vented. A pump can then be used to lift the contents to the gravity drain.
- Drains that can discharge by gravity shall not discharge to the sump.



134

Sanitary Drainage – Drainage below the Sewer Level

- The minimum diameter of the discharge piping from sewage pumps and ejectors is based on the gallons per minute (gpm) capacity of the pump.

IPC TABLE 712.4.2

Diameter of the Discharge Pipe (inches)	Capacity of Pump or ejector (gpm)
2	21
2½	30
3	46

- Grinder pumps and ejectors can be discharged through a minimum 1¼-inch diameter pipe.
- Macerating toilet assemblies serving a single water closet can be discharged through a minimum ¾-inch diameter pipe.

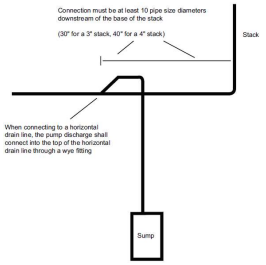
(IPC 712.4.2) **(UPC 710.12, 710.13)**

135

Sanitary Drainage – Drainage below the Sewer Level

- The pump discharge pipe must be equipped with a check valve along with a full-open valve on the discharge side of the check valve to facilitate maintenance of the pump, sump and check valve.
- The pump discharge pipe can then tie into the gravity drainage system.
- When connecting the discharge pipe to a horizontal drain, the point of connection shall be into the top of the horizontal drain pipe through a wye fitting and downstream of the base of a stack at least **10 pipe diameters** as required for any horizontal branch connection downstream of the base of a stack.

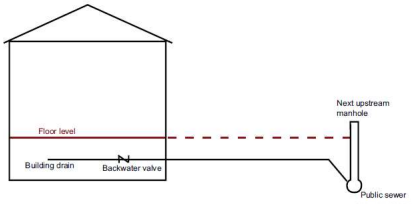
(IPC 712.3.5)



136

Sanitary Drainage – Drainage below the Sewer Level

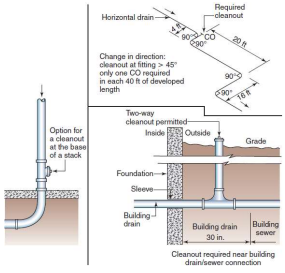
Where the building drain connects to a public sewer, yet the next upstream manhole serving the public sewer is above the building drain floor level, a backwater valve must be installed to prevent any backup of sewer contents into the building.



137

Sanitary Drainage – Cleanouts

- Cleanouts are required at:
  - A minimum of each 100 feet for 8-inch diameter and smaller drain lines and for each change of direction in excess of 45°.
  - The junction of the building drain and the building sewer.
- Cleanouts cannot be concealed.



138

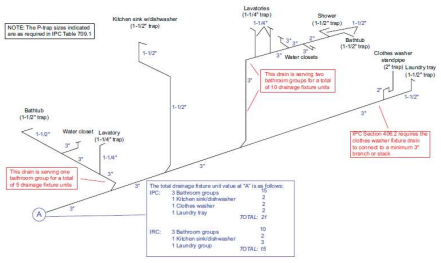
Sanitary Drainage – Sizing of Drains

IPC TABLE 709.1 (SEE ALSO UPC TABLE 702.1)

Fixture or Group Type	IPC DFU	IRC DFU
Automatic clothes washer, residential	2	2
Bathroom group (1.6 gpf water closet)	5	5
Bathtub (with or without overhead shower)	2	2
Dishwashing machine, domestic	2	2
Kitchen sink, domestic	2	2
Kitchen sink, domestic with food waste disposer and dishwasher	2	2
Laundry tray	2	2
Lavatory	1	1
Shower (flow rate of 5.7 gpm or less)	2	2
Water closet, private (1.6 gpf)	3	3
Half-bath (1.6 gpf water closet plus lavatory)	—	4
Laundry group (clothes washer standpipe and laundry tray)	—	3
Multiple bath groups:		
1.5 baths	—	7
2 baths	—	8
2.5 baths	—	9
3 baths	—	10
3.5 baths	—	11

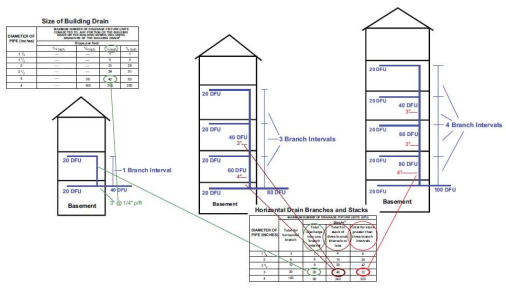
139

Sanitary Drainage – Sizing of Drains



140

Sanitary Drainage – Sizing of Drains



141

Sanitary Drainage – Sizing of Drains

IPC TABLE 709.2 (SEE ALSO UPC TABLE 702.1(1))

Fixture drain or trap size (inches)	Drainage fixture unit value
$1^1/_4$	1
$1^1/_2$	2
2	3
$2^1/_2$	4
3	5
4	6

- Most fixtures are identified in IPC Table 709.1, at times you may find a fixture or an appliance that may not be specifically identified in the table.
- IPC Table 709.2 or UPC Table 702.1(1) can be used to assign drainage fixture units based on the fixture drain or trap size.
- Code recognizes 1 gallon per minute (gpm) being equal to two drainage fixture units.

142

Sanitary Drainage – Joints and Connections

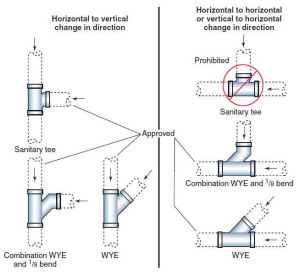
- Proper drainage pattern fittings are necessary for:
  - Proper directional flow of wastes
  - Reducing possibility of blockages
  - Maintaining airflow in drainage system
  - Effectively using drain rodding equipment

Type of fitting pattern	Change in direction		
	Horizontal to vertical	Vertical to horizontal	Horizontal to horizontal
Sixteenth bend	X	X	X
Eighth bend	X	X	X
Sixth bend	X	X	X
Quarter bend	X	X[a]	X[a]
Short sweep	X	X[a,b]	X[a]
Long sweep	X	X	X
Sanitary tee	X[c]	—	—
Wye	X	X	X
Combination wye and eighth bend	X	X	X

143

Sanitary Drainage – Joints and Connections

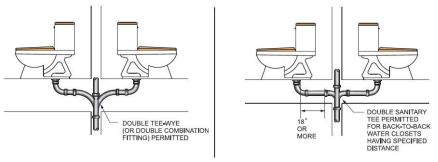
- Do not compare the radius of a 90° bend for one type of material to another.
- A good rule of thumb is to consider the radius of joining two eighth bends (45°) of material to be equivalent to a long sweep of the same material.



144

Sanitary Drainage – Joints and Connections

Double sanitary tee fittings cannot be used to connect back-to-back water closets and fixtures, or appliances with pump discharge, except for back-to-back water closets where the horizontal developed length between the water closet and the connection to the double sanitary tee is 18 inches or more.



145

Part III – Drain, Waste and Vent

1. T F Testing plastic pipe, tubing and fittings with air pressure is required for DWV systems.

False
IPC prohibits testing plastic pipe, tubing and fittings with air pressure due to the risk of injury due to pipe bursting and shattering.

146

Part III – Drain, Waste and Vent

2. T F A good rule of thumb is to consider the radius of joining two eighth bends (45°) of material to be equivalent to a long sweep of the same material.

True

147

Part III – Drain, Waste and Vent

3. How many pipe diameters must horizontal branches connect downstream of the base of a stack at a minimum?
   A. 1 pipe diameter
   B. 5 pipe diameters
   C. 10 pipe diameters

C. 10 pipe diameters
IPC prohibits the connection of branches and fixture drains within 10 pipe diameters downstream of a drainage stack due to hydraulic jump.

148

VENTING - Definitions

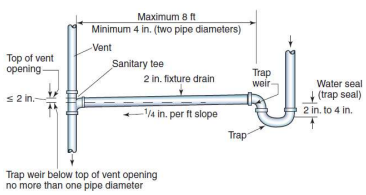
- **BRANCH VENT.** A vent connecting one or more individual vents with a vent *stack* or *stack* vent.
- **CIRCUIT VENT.** A vent that connects to a horizontal drainage *branch* and vents two traps to not more than eight traps or trapped fixtures connected into a battery.
- **COMMON VENT.** A vent connecting at the junction of two *fixture drains* or to a fixture *branch* and serving as a vent for both fixtures.
- **INDIVIDUAL VENT.** A pipe installed to vent a fixture trap and that connects with the vent system above the fixture served or terminates in the open air.
- **RELIEF VENT.** A vent whose primary function is to provide circulation of air between drainage and vent systems.
- **YOKE VENT.** A pipe connecting upward from a soil or waste stack to a vent stack for the purpose of preventing pressure changes in the stacks.

149

Venting – General Requirements

- Venting provisions are designed to provide sufficient air to offset pressure differentials that can affect the water seal of fixture traps.
- Number of venting methods that can be used to meet this need.
- No matter which venting method is utilized, of major importance is to maintain the proper distance and slope of the fixture drain from the trap to its vent in accordance with IPC Table 909.1.

Size of trap (inches)	Slope (inch per foot)	Distance from trap (feet)
1¼	¼	5
1½	¼	6
2	¼	8
3	¼	10
4	¼	16

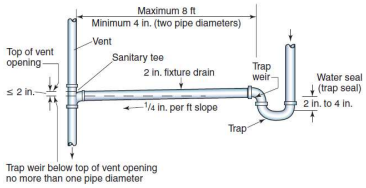


150

Venting – General Requirements

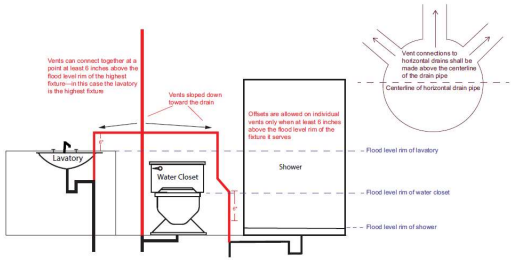
- An exception to this is for self-siphoning fixtures, such as water closets, in which case the distance is not limited.
- The vent system is to be tested in the same manner as the drainage system as part of testing the DWV installation in its entirety or in sections. Vents for a chemical waste system must be separate from the sanitary venting system – do not connect the two systems.

Size of trap (inches)	Slope (inch per foot)	Distance from trap (feet)
1¼	¼	5
1½	¼	6
2	¼	8
3	⅛	12
4	⅛	16



151

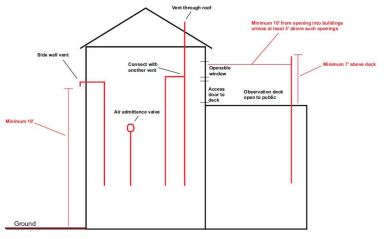
Venting – Vent Connections and Grades



152

Venting – Vent Termination

- Through the roof (most common).
- Through the side wall of a structure.

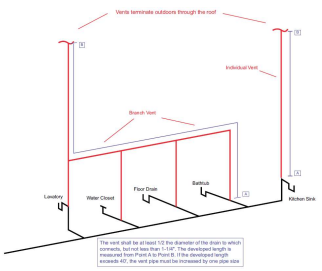


153

Venting – Sizing of Vents

Individual Vents, Branch Vents, Circuit Vents, Relief Vents

- Must be at least half the diameter of the drain served but not less than 1¼ inch.
- Cannot exceed a developed length of 40 feet.

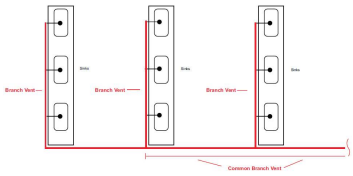


154

Venting – Sizing of Vents

Common Branch Vents

- Connects two or more branch vents together.
- Sized based on the size of the common horizontal drainage branch required to serve the total drainage fixture unit load being vented.



155

Venting – Sizing of Vents

Stack Vents and Vent Stacks

- Sized based on the developed length and the total drainage fixture units connected.
- Vent stacks are required for drainage stacks that have five or more branch intervals.

- **Stack vent –** The extension of a soil or waste stack above the highest horizontal drain connected to the stack.
- **Vent stack –** A vertical vent pipe installed primarily for the purpose of providing circulation of air to and from any part of the drainage system.

156

Venting – Sizing of Vents

Vent Header

- Stack vents and vent stacks connected together into a common vent at the top of the stacks and extended to the vent termination.
- Sized by applying the drainage fixture unit load of all stacks and calculating the developed length from the intersection at the base of the farthest stack to the vent termination.

- **Vent header –** A pipe connecting at the top of a stack and extending to the open air at one point.

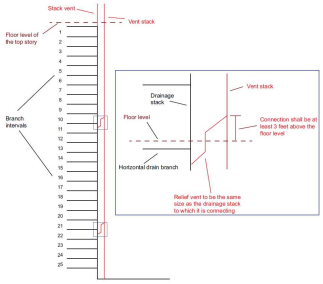
157

Venting – Relief Vents in Multiple-Story Buildings

Relief Vents

- Required for drainage stacks serving more than 10 branch intervals.
- Must be same size as the drainage stack to which it connects.

- **Relief vent –** A vent whose primary function is to provide circulation of air between drainage and vent systems.



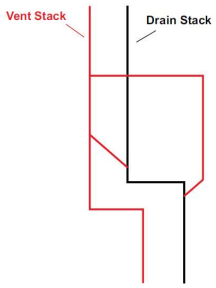
158

Venting – Vents for Horizontal Stack Offsets

Yoke Vents

- Horizontal offsets in drainage stacks must be vented where there are 5 or more branch intervals above offset.
- Both upper and lower section of offset must be vented.
- Must be vertical and same size as required vent stack.

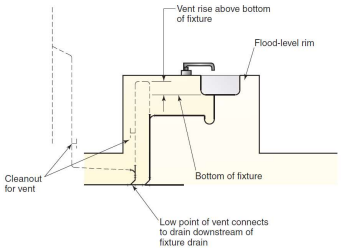
- **Yoke vent –** A pipe connecting upward from a soil or waste stack to a vent stack for the purpose of preventing pressure changes in the stacks.



159

Venting – Venting of Island Fixtures

- Limited to sinks and lavatories, which can include a residential kitchen sink with a connection for a dishwasher and a food waste disposer.
- Vent shall rise vertically to above sink drain outlet and return down vertically to connect with either horizontal drain branch or vertical portion of fixture drain.

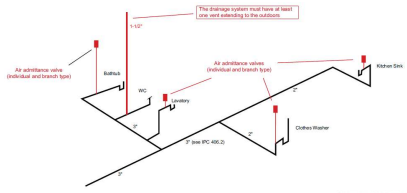


160

Venting – Air Admittance Valves

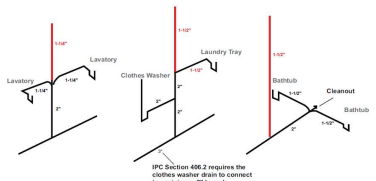
- Used to terminate individual vents, branch vents and circuit vents.
- Plumbing systems using AAVs must have at least one vent stack or stack vent extending to the outdoors.
- Must be installed in locations that allow air to enter.

(IPC Section 918)



161

Venting Methods – Common Vent



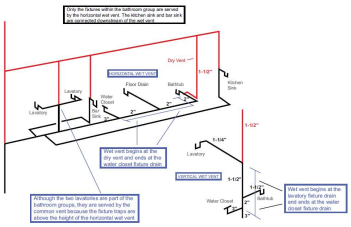
Pipe size (inches)	Maximum discharge from upper fixture drain (dfu)
1¼	1
2	4
2½ to 3	6

- Common venting is just a simple method of allowing an individual vent to serve as the vent for two fixtures.
- The two fixtures must be located on the same floor level and can be connected to the drain and vent at the same level or at different levels.
- When connected at different levels, the size of the pipe between the two fixture drain connections shall be sized per IPC Table 911.3.

162

Venting Methods – Horizontal Wet Venting

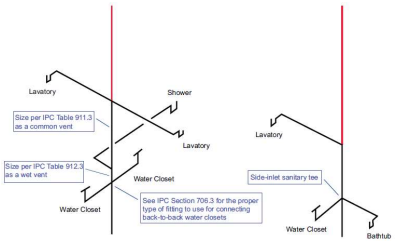
- Wet venting can serve any combination of fixtures within two bathroom groups and can be used in either a vertical or horizontal configuration.
- Fixtures that are not part of a bathroom group must connect downstream of the wet vent.
- In both the horizontal and vertical configuration, the wet vent begins at the connection of the dry vent serving the most upstream fixture drain and continues downstream to the farthest fixture drain being served by the wet vent.



163

Venting Methods – Vertical Wet Venting

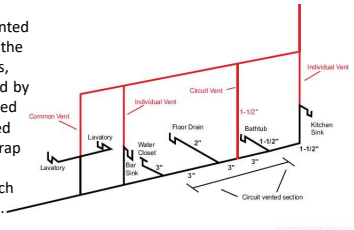
- Wet vented portion of the system serves as the vent for the fixture traps, the fixture drains shall not exceed the maximum distance allowed per IPC Table 909.1, and the trap cannot be located above the wet vent unless it is separately vented.
- Dry vent can be the vent serving any fixture within the bathroom group except an emergency floor drain.
- Both vertical and horizontal wet vents shall be sized in accordance with IPC Table 912.3.



164

Venting Methods – Circuit Vent

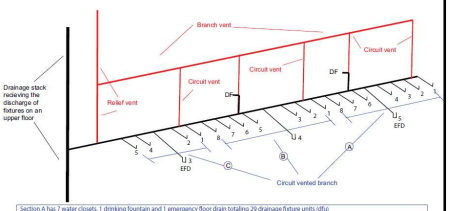
- Circuit venting is a method of horizontal wet venting that is not limited to bathroom group fixtures.
- The horizontal circuit vented section can serve as the vent for up to 8 fixture drains.
- Since the horizontal circuit vented section serves as the vent for the fixture drains and fixture traps, each fixture drain being served by the circuit vent must not exceed the maximum distance allowed per IPC Table 909.1, and the trap cannot be located above the horizontal circuit vented branch unless it is separately trapped.



165

Venting Methods – Circuit Vent

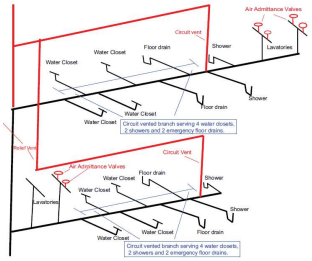
- Circuit vented sections can be connected in series.
- Each circuit vented horizontal section must be sized for its entirety based on the total drainage fixture unit loading at the most downstream point of the circuit vent.
- Includes not only the fixtures drains and traps beings served by that circuit vent, but also the drainage fixture units of other fixtures and branches connected within or upstream of the circuit vent.



166

Venting Methods – Circuit Vent

- Where circuit vented horizontal branches connect to a drainage stack, a relief vent is required where:
  1. Four or more water closets are connected to the horizontal branch.
  2. The drain stack serves fixtures from one or more upper floors.
- The relief vent must connect to the horizontal drain between its connection to the drainage stack and after the most downstream fixture drain of the horizontal circuit vented section.
- The relief vent may also serve as the vent for one or more fixtures located on the same floor level, but not more than 4 drainage fixture units total



167

Venting Methods – Combination Waste and Vent

- **Combination waste and vent system –** A specially designed system of waste piping embodying the horizontal wet venting of one or more sinks, lavatories, drinking fountains or floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain.

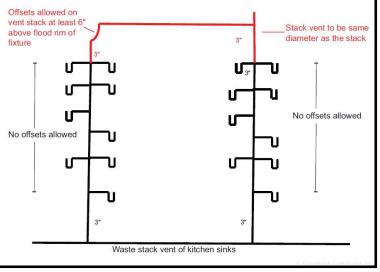
- A horizontal wet vent system best suited for large facilities, such as a grocery store.
- Can only serve floor drains, sinks, lavatories and drinking fountains.
- Can now receive the discharge of a food waste disposer, but not a clinical sink.

	Maximum number of drainage fixture units (dfu)	
Diameter pipe (inches)	Connecting to a horizontal branch or stack	Connecting to a building drain or building subdrain
2	3	4
2½	6	26
3	12	31
4	20	50

168

Venting Methods – Waste Stack Venting

- Waste stack venting is basically a vertical wet vent where the oversized drainage stack also serves as the vent for the fixture drains.
- Neither vertical nor horizontal offsets are allowed in the stack between the lowest fixture drain connection and the highest fixture drain connection.
- The drainage stack cannot serve water closets or urinals.
- In this application, each fixture drain must connect separately to the drainage stack while maintaining the allowed distance from the vent to the trap.



169

Venting Methods – Waste Stack Venting

- Waste stack venting is basically a vertical wet vent whereby the oversized drainage stack also serves as the vent for the fixture drains.
- Neither vertical nor horizontal offsets are allowed in the stack between the lowest fixture drain connection and the highest fixture drain connection.
- The drainage stack cannot serve water closets or urinals. In this application, each fixture drain must connect separately to the drainage stack while maintaining the allowed distance from the vent (in this case, the oversized drainage stack) to the trap, as required in IPC Section 909.

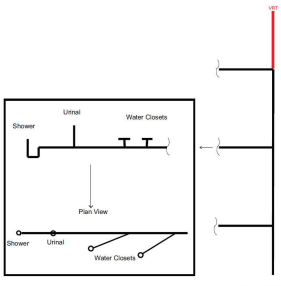
Stack size (inches)	Maximum number of drainage fixture units (dfu)	
	Total discharge into one branch interval	Total discharge for stack
1¼	1	2
2	2	4
2½	No limit	8
3	No limit	24
4	No limit	50
5	No limit	75
6	No limit	100

- The size of the drainage stack shall be in accordance with IPC Table 913.4 for its entire length.

170

Venting Methods – Single Stack Venting

- Single stack vent system is an oversized drainage stack that serves as both a drain and a vent for the fixtures connecting to it, except that the horizontal branches connecting to the stack are also oversized and limited as to their length in order to serve as the vent for water closets and urinals.
- Drainage stack shall be equipped with a stack vent of the same size as the drainage stack. The drainage stack is treated as a typical drainage stack in that offsets are allowed, provided they are installed in accordance with IPC Sections 710.1.1 and 710.1.2, and vented as required in IPC Sections 907 and 908.



171

Venting Methods – Single Stack Venting

- Single stack vent system is an oversized drainage stack that serves as both a drain and a vent for the fixtures connecting to it, except that the horizontal branches connecting to the stack are also oversized and limited as to their length in order to serve as the vent for water closets and urinals.
- The drainage stack must be sized for its entire length based on the drainage fixture unit load as determined in IPC Table 917.2.

Stack size (inches)	Maximum connected drainage fixture units (dfu)		
	Stacks less than 75 feet in height	Stacks 75 feet to less than 160 feet in height	Stacks 160 feet and greater in height
3	24	NP	NP
4	225	24	NP
5	480	225	24
6	1,015	480	225

172

Part III – Drain, Waste and Vent

4. T F Fixtures that are not part of the bathroom group can connect to the wet vented drain.

False
Only bathroom group fixtures can connect to the wet vented drain. Other fixtures must connect downstream of the wet vent section.

173

Part III – Drain, Waste and Vent

5. Which venting method connects one or more individual vents with a vent stack or stack vent?

A. Individual Vent
B. Branch Vent
C. Circuit Vent
D. Relief Vent
E. Yoke Vent
F. Common Vent

B
Branch Vent

174

Part III – Drain, Waste and Vent

6. Which venting method provides air circulation between drainage and vent systems?

A. Individual Vent
B. Branch Vent
C. Circuit Vent
D. Relief Vent
E. Yoke Vent
F. Common Vent

D
Relief Vent

175

Part III – Drain, Waste and Vent

7. Which venting method allows an individual vent to serve as the vent for two fixtures?

A. Individual Vent
B. Branch Vent
C. Circuit Vent
D. Relief Vent
E. Yoke Vent
F. Common Vent

F
Common Vent

176

Part III – Drain, Waste and Vent

8. Which venting method connects to a horizontal drainage branch and serves up to 8 drains?

A. Individual Vent
B. Branch Vent
C. Circuit Vent
D. Relief Vent
E. Yoke Vent
F. Common Vent

C
Circuit Vent

177

Part III – Drain, Waste and Vent

9. Which venting method connects the pipe upwards from a waste stack to a vent stack to prevent pressure changes?

A. Individual Vent
B. Branch Vent
C. Circuit Vent
D. Relief Vent
E. Yoke Vent
F. Common Vent

E
Yoke Vent

178

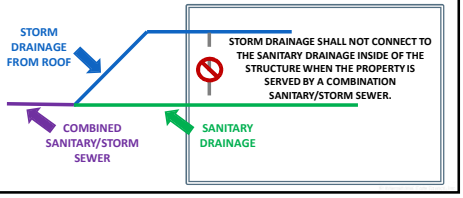
Storm Drainage – Definitions

- **Rainwater –** Water from natural precipitation.
- **Storm water –** Natural precipitation, including snowmelt, that has contacted a surface at or below grade.
- **Conductor –** A pipe inside the building that conveys storm water from the roof to a storm or combined building drain.

179

Storm Drainage – Design Requirements

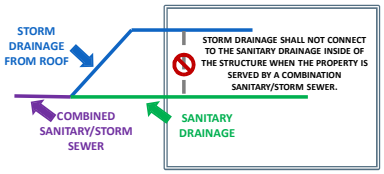
- Rainwater from roofs must be discharged to an approved location.
- Includes storm water from other paved areas on the property. For one- and two-family dwellings, an approved location could be to flat areas, such as the lawn or street, provided that the drainage flows away from the building.
- Each local jurisdiction will likely dictate what is an approved location.



180

Storm Drainage – Design Requirements

- Sanitary and storm systems within the structure shall remain separate until outside of the structure, allowing for future separation without major renovation of the systems within the structure.
- Conductors within the structure cannot serve as a drain or vent for the sanitary system, nor can a drain or vent pipe of the sanitary system be used to convey rainwater.
- Storm sewer systems may become overloaded due to heavy rainfall amounts, more likely with combined sanitary and storm systems.
- IPC requires the installation of a backwater valve to protect the structure from such backflow in the storm system.
- Traps are required for the conductors and leaders to prevent sanitary sewer gasses from entering the structure.



181

Roof Drain - Definition

- **Roof drain –** A drain installed to receive water collecting on the surface of a roof and to discharge such water into a leader or a conductor.

182

Roof Drains – Materials

- Storm drain piping materials within a structure are the same as the material requirements for the drain, waste and vent system as identified in IPC Tables 702.1 and 702.2.
- Approved fittings would also be those approved for the type of material used in accordance with IPC Table 1102.7.

Material	Above ground	Below ground
ABS	X	X
PVC	X	X
PE		X
Cast Iron	X	X
Stainless Steel 304	X	
Stainless Steel 316L	X	X

- Once outside of the structure and underground, building storm sewer pipe may be of materials identified in IPC Table 1102.4.
- Fittings used to connect the pipe must be those approved for the type of material, also identified in IPC Table 1102.7.
- Roof drains must conform to ASME A112.6.4 or ASME A112.3.1 as applicable to the type of piping material being used. These will also be provided with a dome or grate strainer to prevent leaves and debris from entering the storm drainage system.

183

Roof Drains – Installation

- Same installation requirements for the sanitary system apply also to the storm drainage system, such as the appropriate fittings necessary for changes in direction, connecting in such a manner as to prevent obstructions or ledges, not decreasing the size of the drain in the direction of flow and providing cleanouts for proper maintenance of the piping system.
- Note that cleanouts are not required for subsurface drainage systems, such as foundation drains

Type of fitting pattern	Change in direction		
	Horizontal to vertical	Vertical to horizontal	Horizontal to horizontal
Sixteenth bend	X	X	X
Eighth bend	X	X	X
Sixth bend	X	X	X
Quarter bend	X	X[a]	X[a]
Short sweep	X	X[a b]	X[a]
Long sweep	X	X	X
Sanitary tee	X[c]	—	—
Wye	X	X	X
Combination wye and eighth bend	X	X	X

184

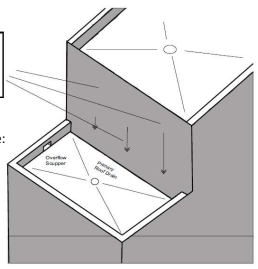
Roof Drains – Definitions

- **conductor –** A pipe inside the building that conveys storm water from the roof to a storm or combined building drain.
- **leader –** An exterior drainage pipe for conveying storm water from roof or gutter drains to an approved means of disposal.

185

Roof Drains – Design and Sizing

Where a vertical wall diverts rainwater to the roof, one half of the wall area shall be added to the projected roof area when calculating storm drain piping



- Typically, there are three methods used for directing rainwater from the roof to a proper point of discharge:
  1. roof drains
  2. Scuppers
  3. Gutters
- *International Building Code* addresses the proper design and structural requirements for roofs, including any ponding or storage of rainwater

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Roof Drains – Design and Sizing

Pipe size (inches)	Capacity (gpm)				
	Vertical drain	Slope of horizontal drain			
		1/16 inch per foot	1/8 inch per foot	1/4 inch per foot	1/2 inch per foot
2	34	15	22	31	44
3	87	39	55	79	111
4	180	81	115	163	231

New in 2021 IPC, is Section 1106.2.1- Rainfall rate conversion method. The rainfall rate falling on a roof surface shall be converted to a gallon per minute flow rate as follows-

GPM = R x A x 0.0104

where:

R = Rainfall intensity in inches per hour.

A = Roof area in square feet.

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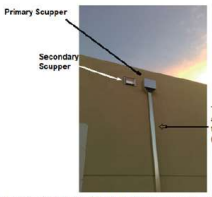
Roof Drains – Design and Sizing

- **conductor –** A pipe inside the building that conveys storm water from the roof to a storm or combined building drain.
- **leader –** An exterior drainage pipe for conveying storm water from roof or gutter drains to an approved means of disposal.
- Leaders will be sized as shown in IPC Table 1106.3.



The vertical leader is to be sized in accordance with IPC Table 1106.3 based on the designed flow rate in gallons per minute (gpm).

The quantity, size, location and inlet elevation of both primary and secondary scuppers must be designed to prevent the depth of ponding water on the roof from exceeding the structural integrity as determined by the *International Building Code*. However, the minimum height of scuppers shall not be less than 4 inches and shall have a width that is equal to or greater than the circumference of a roof drain sized for the same roof area

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Roof Drains – Design and Sizing

IPC Table 1106.3

Size of leader (inches)	Capacity (gpm)
2	30
2 × 2	30
1 1/2 × 2 1/2	30
2 1/2	54
2 1/2 × 2 1/2	54
3	92
2 × 4	92
2 1/2 × 3	92
4	192

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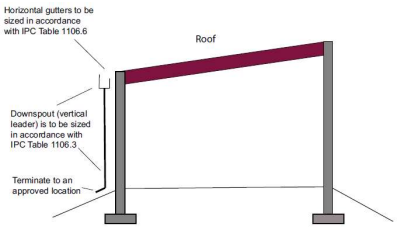
Roof Drains – Design and Sizing

- Scupper openings cannot be less than 4 inches in height and must have a width that is equal to or greater than the circumference of a roof drain sized for the same area.
- Exterior horizontal gutters are sized in accordance with IPC Table 1106.6, and the leaders, often referred to as downspouts, will be sized as indicated in IPC Table 1106.3.



190

Roof Drains – Design and Sizing

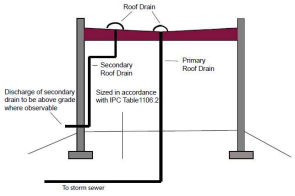
IPC Table 1106.6

Gutter dimensions[a] (inches)	Slope (inch per foot)	Capacity (gpm)
$1^{1}/_{2} \times 2^{1}/_{2}$	$^{1}/_{4}$	26
$1^{1}/_{2} \times 2^{1}/_{2}$	$^{1}/_{2}$	40
4	$^{1}/_{8}$	39
$2^{1}/_{4} \times 3$	$^{1}/_{4}$	55
$2^{1}/_{4} \times 3$	$^{1}/_{2}$	87
5	$^{1}/_{8}$	74
$4 \times 2^{1}/_{2}$	$^{1}/_{4}$	106

191

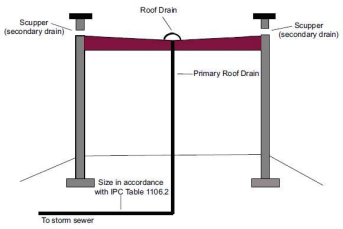
Roof Drains – Design and Sizing

- Important to provide some method of emergency drainage should the primary roof drainage be blocked that serves a roof area surrounded by parapet walls.
- Can be accomplished by adding a secondary roof drain or scupper to prevent the ponding of water beyond what the roof is designed to handle. Typically, this will be a limit of 2 inches of ponding water.
- Sizing of the secondary system, including horizontal drains, conductors, leaders and scuppers, will be the same as required for the primary roof drain system.
- Secondary drainage method must be separate from the primary drains, and the point of discharge needs to be observable, thus indicating to occupants that the primary roof drain is blocked.



192

Roof Drains – Design and Sizing



193

Roof Drains – Testing

- Required for the roof drain system within the structure.
- Not required for storm drainage outside of the structure.
- Standing water test.
- Minimum 5 psi air test (except for PVC pipe).

194

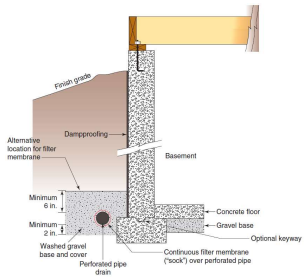
Roof Drains – Siphonic Roof Drain Systems

- Well suited for large open-area buildings, such as major home stores and warehouses, where the design calls for a reduced number of interior support walls or columns.
- Especially suited for geographical regions subject to storms producing extreme hourly rainfall amounts.

195

Subsoil (Foundation/Footing) Drains

- The *IBC and IRC* dictate when subsoil drainage is required and Includes foundation/footing drains.
- These codes also outline this location of drain pipe, depth of the pipe in relation to foundation footing, as well as the type and extent of gravel, rock and membrane material required for the installation of the subsoil drainage system.
- IPC addresses the pipe and fitting installation.
  - Subsoil drains shall not be less than 4 inches in diameter.
  - Type of pipe acceptable for subsoil drains is identified in IPC Table 1102.5, and the fittings used must be approved for the type of piping material selected in accordance with IPC Table 1102.7.



196

Part III – Drain, Waste and Vent

10. What are the three methods for directing rainwater from the roof to a proper point of discharge?

1. Roof Drains
2. Scuppers
3. Gutters

197

Part III – Drain, Waste and Vent

11. T F Testing is not required for storm drainage outside of the structure.

True
Testing is required for the roof drain system *within* the structure. It is not required for storm drainage *outside* of the structure.

198

Part III – Drain, Waste and Vent

12. What type of roof drain system is well suited for large open-area buildings, such as major home stores and warehouses?

Siphonic roof drain systems

199

Part III – Drain, Waste and Vent

Discuss the following questions:

- Why are proper drainage pattern fittings important?
- What type of venting system is considered by many in the plumbing industry to be one of the best designs for plumbing systems?

200

Water Distribution

Part IV

201

Water Piping – General Requirements

- Potable water is to be provided to residential and nonresidential structures equipped with plumbing fixtures used for human occupancy or habitation.
- The authority having jurisdiction, often the local health department, determines the water quality.

- **potable water** – Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects and conforming to the bacteriological and chemical quality requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction.

202

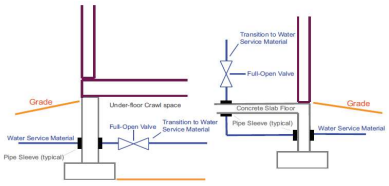
Water Piping – Definitions

- **water distribution pipe –** A pipe within the structure or on the premises that conveys water from the water service pipe, or from the meter when the meter is at the structure, to the points of utilization.
- **water service pipe –** The pipe from the water main or other source of potable water supply, or from the meter when the meter is at the public right of way.
- **water supply system –** The water service pipe, water distribution pipes, and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the structure or premises.

203

Water Piping – Materials

- Must conform to NSF 61 and contain less than 8% lead content.
- For drinking or culinary purposes, must comply with NSF 372 and have a weighted average lead content of 0.25% or less.



204

Water Piping – Materials

IPC Table 605.3

Material	Standard
PEX pipe and tubing	ASTM F876; AWWA C904; CSA B137.5
Ductile iron water pipe	AWWA C151/A21.51; AWWA C115/A21.15
PE plastic tubing	ASTM D2737; AWWA C901; CSA B137.1
Stainless steel pipe (type 304/304L) and (Type 316/316L)	ASTM A312; ASTM A778
PVC plastic pipe	ASTM D1785; ASTM D2241; ASTM D2672; CSA B137.3

New in 2021 IPC, is Section 609.2.1- Tracer wire for nonmetallic piping. An insulated tracer wire listed for the purpose or other approved conductor Shall be installed adjacent to underground nonmetallic piping serving as a water service for a hospital. Access shall be provided to the tracer wire or the tracer wire shall terminate above ground at each end of the Nonmetallic piping. The tracer wire size shall be not less than 18 AWG and the wire insulation type shall be suitable for direct burial.

205

Water Piping – Materials

IPC Table 605.4

Material	Standard
CPVC	ASTM D2846; ASTM F441; ASTM F442 CSA B137.6
Copper tubing (Types K, WK, L, WL, M or WM)	ASTM B75; ASTM B88; ASTM B251; ASTM B447
PEX plastic tubing	ASTM F876; CSA B137.5
PEX-AL-PEX pipe	ASTM F1281; ASTM F2262; CSA B137.10
PP plastic pipe or tubing	ASTM F2389; CSA B137.11
Stainless steel pipe (Type 304/304L) and (Type 316/316L)	ASTM A312; ASTM A778

206

Water Piping – Materials

IPC Table 605.5

Material	Standard
PEX plastic tubing	ASSE 1061; ASTM F877; ASTM F1807; ASTM F1960; ASTM F2080; ASTM F2098; ASTM F2159; ASTM F2434; ASTM F2735; CSA B137.5
PE plastic pipe	ASTM D2609; ASTM D2683; ASTM D3261; ASTM F1055; CSA B137.1
Stainless steel pipe (Type 304/304L) and (Type 316/316L)	ASTM A312; ASTM A778; ASTM F1476; ASTM F1548
PVC plastic	ASTM D2464; ASTM D2466; ASTM D2467; CSA B137.2; CSA B137.3
CPVC plastic	ASSE 1061; ASTM D2846; ASTM F437; ASTM F438; ASTM F439; CSA B137.6
PP plastic pipe or tubing	ASTM F2389; CSA B137.11
Metal (brass) insert fittings for PEX-AL-PEX	ASTM F1974
Copper	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.26; ASME B16.51; ASSE 1061; ASTM F1476; ASTM F1548

207

Water Piping – Joints and Connections

- Approved adapter or transition fittings are required where connecting different types of material.
- Where connecting copper or copper-alloy tubing to galvanized pipe, the joint must be made with a copper-alloy fitting or a dielectric fitting or dielectric union.

208

Water Piping – Testing and Disinfection

- Water Test – Must be obtained from a potable source.
  - Pressure test shall not be less than the working pressure of the system when connected to the property's water source.
  - Duration must be at least 15 minutes.
- Air Test – Not less than 50 psi may be used on piping systems other than plastic.
  - Duration must be at least 15 minutes.
  - Test gauge must have increments of 1 psi or less for tests between 50 psi and 100 psi; and 2 psi or less if test pressure is greater than 100 psi.

209

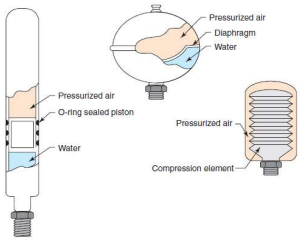
Water Piping – Definitions

- **quick-closing valve –** A valve or faucet that closes automatically when released manually or that is controlled by a mechanical means for fast-action closing.
- **water-hammer arrestor –** A device utilized to absorb the pressure surge (water hammer) that occurs when water flow is suddenly stopped in a water supply system.

210

Water Piping – Design and Installation

- Where quick-closing valves are installed, approved water-hammer arrestors that conform to ASSE 1010 must be installed in order to reduce or control anticipated water hammer in the system when the valves close automatically, and often quite suddenly.
- Applies to hot water connection to a dishwasher, and both the hot and cold water connection to an automatic clothes washer.
- Water hammer arrestors must be installed in accordance with the manufacturer's installation instructions as to the location and connection to the water system in relation to the quick-closing valve.



211

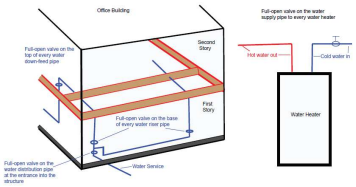
Water Piping – Definitions

- **access (to) –** That which enables a fixture, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction.
- **ready access –** That which enables a fixture, appliance or equipment to be directly reached without requiring the removal or movement of any panel, door or similar obstruction and without the use of a portable ladder, step stool or similar device.
- **fixture supply –** The water supply pipe connecting a fixture to a branch water supply pipe or directly to a main water supply pipe.
- **water pipe riser –** A water supply pipe that extends one full story or more to convey water to branches or to a group of fixtures.
- **full-open valve –** A water control or shutoff component in the water supply system piping that, where adjusted for maximum flow, the flow path through the component's closure member is not a restriction in the component's through-flow area.

212

Water Piping – Valves

- Code requires valves to be placed at certain locations for maintenance purposes. Some locations where full-open valves are required are:
  1. On the water distribution supply pipe at the entrance to a structure.
  2. At the base of every water riser pipe, except in one- and two-family residential occupancies and multiple-family residential occupancies that are no more than two stories in height.
  3. At the entrance of the water supply pipe to a dwelling unit.
  4. On the water supply pipe to the water heater.
- Full-open valves are required to have access.



213

Water Piping – Valves

- Manifold with fixture shutoff valves

- Shutoff valves, such as an angles top shutoff valve, are required on the fixture supply to each fixture or appliance, except for bathtubs and showers in one- and two-family residential occupancies.
- Access shall be provided to all shutoff valves.
- The shutoff valve for fixtures and appliances is allowed to be located at a manifold.
- Shutoff valves must be integral factory- or field-installed valves, and they must be provided with access.

214

Water Piping – Sizing

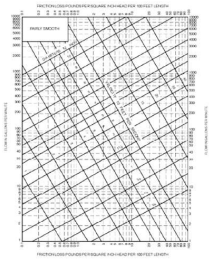
- Size of the water service is determined by the demand load of the fixtures, but in no case shall the water service be less than 3/4 inch diameter.
- Code also prescribes the minimum gallons per minute (gpm) flow rate and flow pressure for fixtures in IPC Table 604.3, as well as the maximum flow rate for certain fixtures in IPC Table 604.4 for the purpose of water conservation.
- Minimum size of the water supply pipe serving the fixture is identified in IPC Table 604.5; this minimum pipe size is the individual fixture branch that terminates with the fixture shutoff valve.

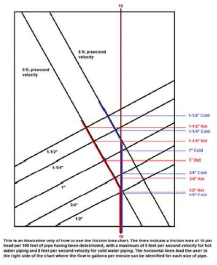
IPC Table 605.6

Fixture	Minimum flow rate	Maximum flow rate	Minimum flow pressure	Minimum pipe size
Bathtub (standard size)	4 gpm	N/A	20 psi	1/2"
Shower (balanced pressure)	2.5 gpm	2.5 gpm @ 60 psi	20 psi	1/2"
Lavatory (private)	0.8 gpm	2.2 gpm @ 60 psi	8 psi	3/8"
Water closet (tank type)	3 gpm	1.6 gpm	20 psi	1/2"
Kitchen sink (residential)	1.75 gpm	2.2 gpm @ 60 psi	8 psi	1/2"
Dishwasher (residential)	2.75 gpm	N/A	8 psi	1/2"
Hose bibb	5 gpm	N/A	8 psi	3/4"

215

Water Piping – Sizing





216

Water Piping – Sizing

IPC Appendix E, Table E103.3(2) is used to determine the water supply fixture units for fixtures based on the type of fixture and whether it is serving a private or public occupancy use.

IPC Appendix E, Table E103.3(2)

Fixture	Occupancy	Type of supply control	Load values, in water supply fixture units (wsfu)		
			Cold	Hot	Total
Bathroom group	Private	Flush tank	2.7	1.5	3.6
Bathroom group	Private	Flushometer valve	6.0	3.0	8.0
Bathtub	Private	Faucet	1.0	1.0	1.4
Bathtub	Public	Faucet	3.0	3.0	4.0
Bidet	Private	Faucet	1.5	1.5	2.0
Combination fixture	Private	Faucet	2.25	2.25	3.0
Dishwashing machine	Private	Automatic	—	1.4	1.4
Drinking fountain	Offices, etc.	3/8" valve	0.25	—	0.25
Kitchen sink	Private	Faucet	1.0	1.0	1.4
Kitchen sink	Hotel, restaurant	Faucet	3.0	3.0	4.0
Laundry trays (1 to 3)	Private	Faucet	1.0	1.0	1.4
Lavatory	Private	Faucet	0.5	0.5	0.7
Lavatory	Public	Faucet	1.5	1.5	2.0
Service sink	Offices, etc.	Faucet	2.25	2.25	3.0
Shower head	Public	Mixing valve	3.0	3.0	4.0
Shower head	Private	Mixing valve	1.0	1.0	1.4
Urinal	Public	1" flushometer valve	10.0	—	10.0
Urinal	Public	3/4" flushometer valve	5.0	—	5.0
Urinal	Public	Flush tank	3.0	—	3.0
Washing machine (8 lb)	Private	Automatic	1.0	1.0	1.4
Washing machine (8 lb)	Public	Automatic	2.25	2.25	3.0
Washing machine (15 lb)	Public	Automatic	3.0	3.0	4.0
Water closet	Private	Flushometer valve	6.0	—	6.0
Water closet	Private	Flush tank	2.2	—	2.2
Water closet	Public	Flushometer valve	10.0	—	10.0
Water closet	Public	Flush tank	5.0	—	5.0
Water closet	Public or private	Flushometer tank	2.0	—	2.0

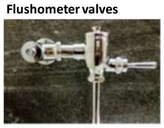
For SI: 1 inch = 25.4 mm, 1 pound = 0.454 kg.
For fixtures not listed, loads should be assumed by comparing the fixture to one listed using water in similar quantities and at similar rates. The assigned loads for fixtures with both hot and cold water supplies are given for separate hot and cold water loads and for total load. The separate hot and cold water loads being three-fourths of the total load for the fixture in each case.

217

Water Piping – Sizing

Flush Tank

Flushometer valves



IPC Appendix E, Table E103.3(3)

SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSH TANKS			SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSHOMETER VALVES		
Load	Demand		Load	Demand	
(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)	(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)
1	3.0	0.04104	—	—	—
2	5.0	0.0684	—	—	—
3	6.5	0.86892	—	—	—
4	8.0	1.06944	—	—	—
5	9.4	1.256592	5	15.0	2.0052
6	10.7	1.430376	6	17.4	2.326032
7	11.8	1.577424	7	19.8	2.646364
8	12.8	1.711104	8	22.2	2.967696
9	13.7	1.831416	9	24.6	3.288528
10	14.6	1.951728	10	27.0	3.60936
11	15.4	2.058672	11	27.8	3.716304
12	16.0	2.13888	12	28.6	3.823248
13	16.5	2.20572	13	29.4	3.930192
14	17.0	2.27256	14	30.2	4.037136
15	17.5	2.3394	15	31.0	4.14408
16	18.0	2.90624	16	31.8	4.241024
17	18.4	2.459712	17	32.6	4.357968
18	18.8	2.513184	18	33.4	4.464912
19	19.2	2.566656	19	34.2	4.571856
20	19.6	2.620128	20	35.0	4.6788
25	21.5	2.87412	25	38.0	5.07984
30	23.3	3.114744	30	42.0	5.61356
35	24.9	3.328632	35	44.0	5.88192
40	26.3	3.515784	40	46.0	6.14928
45	27.7	3.702936	45	48.0	6.41664
50	29.1	3.890088	50	50.0	6.684
60	32.0	4.27776	60	54.0	7.21872
70	35.0	4.6788	70	58.0	7.75344
80	38.0	5.07984	80	61.2	8.181216
90	41.0	5.48088	90	64.3	8.595624
100	43.5	5.81508	100	67.5	9.0234
120	48.0	6.41664	120	73.0	9.75864
140	52.5	7.0182	140	77.0	10.29336
160	57.0	7.61976	160	81.0	10.82808
180	61.0	8.15448	180	85.5	11.42964
200	65.0	8.6892	200	90.0	12.0312
225	70.0	9.3576	225	95.5	12.76644
250	75.0	10.026	250	101.0	13.50168

218

Water Piping – Sizing

METER AND SERVICE PIPE (inches)	DISTRIBUTION PIPE (inches)	MAXIMUM DEVELOPMENT LENGTH (feet)									
Pressure Range 30 to 39 psi		40	60	80	100	150	200	250	300	400	500
3/4	1/2[a]	2.5	2	1.5	1.5	1	1	0.5	0.5	0	0
3/4	3/4	9.5	7.5	6	5.5	4	3.5	3	2.5	2	1.5
3/4	1	32	25	20	16.5	11	9	7.8	6.5	5.5	4.5
1	1	32	32	27	21	13.5	10	8	7	5.5	5
3/4	1 1/4	32	32	32	32	30	24	20	17	13	10.5
1	1 1/4	80	80	70							
1 1/2	1 1/4	80	80	80							
1	1 1/2	87	87	87							
1 1/2	1 1/2	151	151	151							
2	1 1/2	151	151	151							
1	2	87	87	87							
1 1/2	2	275	275	275							
2	2	365	365	365							
2	2 1/2	533	533	533							

METER AND SERVICE PIPE (inches)	DISTRIBUTION PIPE (inches)	MAXIMUM DEVELOPMENT LENGTH (feet)									
Pressure Range 40 to 49 psi		40	60	80	100	150	200	250	300	400	500
3/4	1/2[a]	3	2.5	2	1.5	1.5	1	1	0.5	0.5	0.5
3/4	3/4	9.5	9.5	8.5	7	5.5	4.5	3.5	3	2.5	2
3/4	1	32	32	32	26	18	13.5	10.5	9	7.5	6
1	1	32	32	32	32	21	15	11.5	9.5	7.5	6.5
3/4	1 1/4	32	32	32	32	32	32	32	27	21	16.5
1	1 1/4	80	80	80	80	65	52	42	35	26	20
1 1/2	1 1/4	80	80	80	80	75	59	48	39	28	21
1	1 1/2	87	87	87	87	87	87	87	78	65	55
1 1/2	1 1/2	151	151	151	151	151	130	109	93	75	63
2	1 1/2	151	151	151	151	151	139	115	98	77	64
1	2	87	87	87	87	87	87	87	87	87	87
1 1/2	2	275	275	275	275	275	275	264	238	198	169
2	2	365	365	365	365	365	349	304	270	220	185
2	2 1/2	533	533	533	533	533	533	533	528	456	403

219

Part IV – Water Distribution

1. What percent of lead content in materials for distributing water other than for drinking or culinary is acceptable?
   A. 0.25%
   B. 1%
   C. 3%
   D. 8%

D. 8%
IPC mandates not more than 8 percent lead content in materials used for the distribution of water other than for drinking or culinary purposes

220

Part IV – Water Distribution

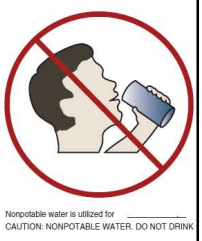
2. What percent of lead content in materials for supplying drinking or culinary water is acceptable?
   A. 0.25%
   B. 1%
   C. 3%
   D. 8%

A. 0.25%
All materials supplying water for drinking or culinary purposes must have a weighted average lead content of 0.25% or less.

221

Backflow Protection – Identification of Nonpotable Water

- Identification of nonpotable water components includes:
  - Pipe and tubing to be purple in color.
  - Labeling of contents.
  - Pictograph indicating "DO NOT DRINK".
  - The color purple and the pictograph are readily identified regardless of language barriers.



222

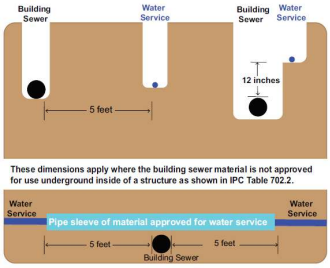
Backflow Protection – Definitions

- **potable water –** Water free from impurities present in amounts sufficient to cause disease or harmful physiological effects and conforming to the bacteriological and chemical quality requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction.
- **nonpotable water –** Water not safe for drinking, personal or culinary utilization.
- **pollution –** An impairment of the quality of the potable water to a degree that does not create a hazard to public health but that does adversely and unreasonably affect the aesthetic qualities of such potable water for domestic use.
- **contamination –** An impairment of the quality of the potable water that creates an actual hazard to the public health through poisoning or the spread of disease by sewage, industrial fluids or waste.
- **backflow –** Pressure created by any means in the water distribution system, which by being in excess of the pressure in the water supply mains causes a potential backflow condition.
- **backflow connection –** Any arrangement whereby backflow is possible.
- **cross connection –** Any physical connection or arrangement between two otherwise separate piping systems, one of which contains potable water and the other, either water of unknown or questionable safety or steam, gas or chemical, whereby there exists the possibility for flow from one system to the other, with the direction of flow depending on the pressure differential between the two systems (see "Backflow").

223

Backflow Protection – General Requirements

- Water service needs to be separated from sources of contamination, such as sewer lines and septic systems.
- Allowed to be in the same ditch with the building sewer, provided that the building sewer material is approved for use underground inside of a structure per IPC Table 702.2.
- Otherwise, separation is required as outlined in IPC Section 603.2.



224

Backflow Protection – General Requirements

IPC Table 608.18.1 addresses minimum separation distance from areas or uses to potable ground water sources (wells):

- 25 feet from a septic tank
- 50 feet from drain fields
- 100 feet from a pasture or barnyard
- 25 feet from a farm silo

225

Backflow Protection – General Requirements

A kitchen sink or bathtub faucet with a hand-held spray can easily be submerged below the flood level rim of the sink or tub, but the attachment will include a diverter that closes automatically to prevent backflow

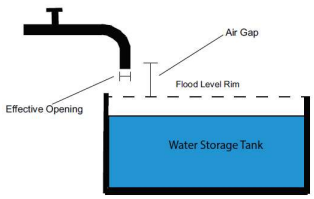
226

Backflow Protection – Definitions

- **backsiphonage –** The backflow of potentially contaminated water into the potable water system as a result of the pressure in the potable water system falling below atmospheric pressure of the plumbing fixtures, pools, tanks or vats connected to the potable water distribution piping.
- **backpressure, low head –** A pressure less than or equal to 4.33 psi (29.88 kPa) or the pressure exerted by a 10-foot (3048 mm) column of water.
- **air gap (water distribution system) –** The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device and the flood level rim of the receptacle.
- **effective opening –** The minimum cross-sectional area at the point of water supply discharge, measured or expressed in terms of the diameter of a circle or, if the opening is not circular, the diameter of a circle of equivalent cross-sectional area. For faucets and similar fittings, the effective opening shall be measured at the smallest orifice in the fitting body or in the supply piping to the fitting.
- **backflow preventer –** A backflow prevention assembly, a backflow prevention device or other means or method to prevent backflow into the potable water supply.

227

Backflow Protection – Backflow Assemblies, Devices and Methods



228

Backflow Protection – Backflow Assemblies, Devices and Methods

FIXTURE	MINIMUM AIR GAP
Lavatories and other fixtures with effective openings not greater than ½ inch in diameter	1 inch
Sinks, laundry trays and other fixtures with effective openings not greater than ¾ inch in diameter	1½ inches
Over-rim bath fillers and other fixtures with effective openings not greater than 1 inch in diameter	2 inches
Effective openings greater than 1 inch	Two times the diameter of the effective opening

229

Backflow Protection – Backflow Assemblies, Devices and Methods

DEVICE	DEGREE OF HAZARD[a]	APPLICATION[b]	APPLICABLE STANDARDS
Backflow prevention assemblies			
Double check backflow prevention assembly and double check protection backflow prevention assembly	Low hazard	Backpressure or backsiphonage Sizes ¼"–10"	ASSE 1015, AWWA C510, CSA B64.5, CSA B64.5.1
Double check detector fire protection backflow prevention assemblies	Low hazard	Backpressure or backsiphonage Sizes 2"–10"	ASSE 1048
Pressure vacuum breaker assembly	High or low hazard	Backsiphonage only Sizes ½"–2"	ASSE 1020, CSA B64.1.2
Reduced pressure principle backflow prevention assembly and reduced pressure principle fire protection backflow assembly	High or low hazard	Backpressure or backsiphonage Sizes ¼"–10"	ASSE 1013, AWWA C511, CSA B64.4, CSA B64.4.1
Reduced pressure detector fire protection backflow prevention assemblies	High or low hazard	Backsiphonage or backpressure (fire sprinkler systems)	ASSE 1047
Spill-resistant vacuum breaker assembly	High or low hazard	Backsiphonage only Sizes ¼"–2"	ASSE 1056, CSA B64.1.3
Backflow preventer plumbing devices:			
Antisiphon-type fill valves for gravity water closet flush tanks	High hazard	Backsiphonage only	ASSE 1002/ASME A112.1002/CSA B125.10, CSA B125.3
Backflow preventer for carbonated beverage machines	Low hazard	Backpressure or backsiphonage Sizes ¼"–¾"	ASSE 1022
Backflow preventer with intermediate atmospheric vents	Low hazard	Backpressure or backsiphonage Sizes ½"–¾"	ASSE 1012, CSA B64.3
Dual-check-valve-type backflow preventer	Low hazard	Backpressure or backsiphonage Sizes ¼"–1"	ASSE 1024, CSA B64.6
Hose connection backflow preventer	High or low hazard	Low head backpressure, rated working pressure, backpressure or backsiphonage Sizes ½"–1"	ASME A112.21.3, ASSE 1052, CSA B64.2.1.1
Hose connection vacuum breaker	High or low hazard	Low head backpressure or backsiphonage Sizes ½", ¾", 1"	ASME A112.21.3, ASSE 1011, CSA B64.2, CSA B64.2.1
Laboratory faucet backflow preventer	High or low hazard	Low head backpressure and backsiphonage	ASSE 1035, CSA B64.7
Pipe-applied atmospheric-type vacuum breaker	High or low hazard	Backsiphonage only Sizes ¼"–4"	ASSE 1001, CSA B64.1.1
Vacuum breaker wall hydrants, frost-resistant, automatic-draining type	High or low hazard	Low head backpressure or backsiphonage Sizes ½", ¾"	ASME A112.21.3, ASSE 1019, CSA B64.2.2
Other means or methods			
Air gap	High or low hazard	Backsiphonage or backpressure	ASME A112.1.2
Air gap fittings for use with plumbing fixtures, appliances and appurtenances	High or low hazard	Backsiphonage or backpressure	ASME A112.1.3
Barometric loop	High or low hazard	Backsiphonage only	(See Section 608.14.4)

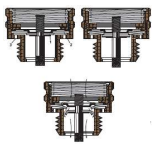
230

Protection of Potable Water Outlets

- Most public water utility purveyors have cross connection control requirements that apply to the protection of the public water system.
- It is important for the code official and the public water utility agency to review local regulations and procedures in a cooperative manner for the benefit of the public they serve.

231

Protection of Potable Water Outlets – Hose Connections



- Outlets with a hose connection, such as hose bibbs and wall hydrants, must be protected by means of an atmospheric-type or pressure-type vacuum breaker.
- Most wall hydrants in today's market include a permanently attached hose connection vacuum breaker. This requirement does not apply to water heater and boiler drain valves or to the water supply connections serving a clothes washer.

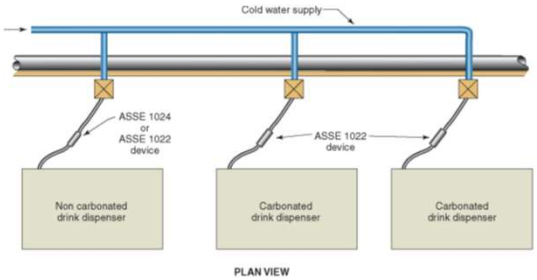
232

Protection of Potable Water Outlets – Carbonated Beverage Dispensers

- Backflow preventer conforming to ASSE 1022 is required for connections serving a carbonated beverage dispenser.
- Since each dispenser requires the backflow preventer, the code does not allow a single backflow preventer to serve more than one dispenser.
- Code is very specific in stating that the "portion of the backflow preventer device downstream of the second check valve of the device and the piping downstream there-from shall not be affected by carbon dioxide gas."

233

Protection of Potable Water Outlets – Coffee Machines



234

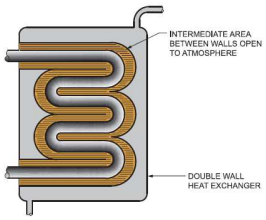
Protection of Potable Water Outlets – Boilers

- If the boiler system does not include the introduction of conditioning chemicals (low hazard), the protection can be by means of a backflow preventer with an intermediate atmospheric vent that complies with either ASSE 1012 or CSA B64.3.
- Where chemicals are introduced (high hazard), the protection must be by means of an air gap or a reduced pressure principle backflow preventer complying with ASSE 1013, CSA B64.4, or AWWA C511.

235

Protection of Potable Water Outlets – Heat Exchangers

- If the heat exchanger utilizes a toxic transfer fluid, it is deemed a high hazard and must be a double-wall type where the intermediate area is open to the atmosphere, thus providing an air gap.
- If the transfer fluid is nontoxic (having a Gosselin Rating of 1) a single-wall type heat exchanger can be used and no further protection is required.



236

Protection of Potable Water Outlets – Fire Sprinklers

- If fire sprinkler system contains chemicals, such as some type of antifreeze, or if it is connected to a nonpotable secondary water supply.
- If the system is under continuous pressure, a reduced pressure principle backflow prevention assembly or reduced pressure principle fire protection backflow prevention assembly is required due to its being classified as a high hazard.
- If not under continuous pressure, an air gap or an atmospheric vacuum breaker conforming to ASSE 1001 or CSA B64.1.1 may be used.

237

Protection of Potable Water Outlets – Lawn Irrigation Systems

- An atmospheric vacuum breaker, a pressure vacuum breaker assembly or a reduced pressure principle backflow prevention assembly may be used for protection.
- For systems where chemicals are introduced, the method of protection shall be by means of a reduced pressure principle backflow prevention assembly.
- Residential lawn irrigation systems are often purchased and installed on existing properties and without the benefit of review or inspection by the local jurisdiction.

238

Protection of Potable Water Outlets – Chemical Dispensers

- Code lists a number of approved methods and devices for backflow protection since there are many different types of chemical dispensing equipment on the market. Such as the chemical (soap) dispensers often used in commercial kitchens and for janitorial uses at service (mop) sinks.
- One of the most common means of protection is by an air gap.
- Air gap may be in the form of an air gap complying with ASME A112.1.2 or an air gap fitting complying with ASME A112.1.3.
- Code states that products listed to either of those standards are considered code compliant.
- A chemical dispenser that complies with ASSE 1055 is also code compliant for the required backflow protection.

239

Required Test and Inspection of Backflow Preventers

- Testing is required for:
  - Backflow preventers with test cocks.
  - Hose connection backflow preventers.
  - Backflow prevention assemblies and air gaps.
- Testing is required:
  - At time of installation.
  - When repairs are made.
  - When assembly is relocated.
  - At least annually.

240

Part IV – Water Distribution

3. Which color is used to identify nonpotable water lines and outlets?
   A. Red
   B. Yellow
   C. Green
   D. Purple

D. Purple
All nonpotable piping is to be identified with the color purple.

241

Part IV – Water Distribution

4. What is the minimum distance from septic tanks to potable ground water sources?
   A. 25 feet
   B. 50 feet
   C. 75 feet
   D. 100 feet

A. 25 feet

242

Part IV – Water Distribution

5. What is the minimum distance from pastures or barnyards to potable ground water sources?
   A. 25 feet
   B. 50 feet
   C. 75 feet
   D. 100 feet

D. 100 feet

243

Water Reuse – General Provisions

Three types of nonpotable water systems:

1. On-site nonpotable water reuse systems.
2. Nonpotable rainwater collection and distribution systems.
3. Reclaimed water systems.

244

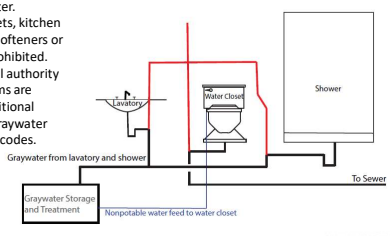
Water Reuse Systems- Definitions

- **Alternate on-site nonpotable water –** Nonpotable water from other than public utilities, on-site surface sources and subsurface natural freshwater sources. Examples of such water are graywater, on-site reclaimed water, collected rainwater, captured condensate and rejected water from reverse osmosis systems.
- **On-site nonpotable water reuse system –** A water system for the collection, treatment, storage, distribution and reuse of nonpotable water generated on-site, including but not limited to a graywater system. This definition does not include a rainwater harvesting system.
- **Rainwater –** Water from natural precipitation.
- **Reclaimed water –** Nonpotable water that has been derived from the treatment of waste water by a facility or system licensed or permitted to produce water meeting the jurisdiction's water requirements for its intended uses. Also known as "recycled water."

245

On-site Nonpotable Water Reuse Systems

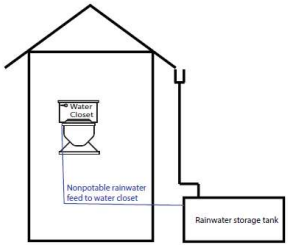
- On-site nonpotable water reuse systems collect waste water from bathing and laundry drainage, often referred to as light graywater.
- Discharge from water closets, kitchen sinks, dishwashers, water softeners or reverse osmosis units is prohibited.
- Always check with the local authority to determine if such systems are allowed or if there are additional regulations that apply to graywater reuse, such as local health codes.



246

Nonpotable Rainwater Collection and Distribution Systems

- Nonpotable rainwater collection and distribution systems are becoming more common with water conservation measures.
- Important to verify what local regulations may apply to these systems.



247

Nonpotable Rainwater Collection and Distribution Systems

248

Water Quality and Treatment

Graywater reuse:

- Cannot be stored untreated in excess of 24 hours.
- When used for flushing water closets and urinals, it must be treated by means of an on-site treatment system that complies with NSF 350.
- Untreated graywater may be discharged to a subsurface landscape irrigation system in accordance with **IPC Chapter 14**.

249

Protection of Potable Water

- International Code Council® (ICC®) and Canadian Standards Association (CSA) formed a joint standards committee.
- Developed CSA B805-18/ICC 805-2018 Rainwater Harvesting Systems, an ANSI standard for rainwater and storm water catchment, storage, treatment and distribution.
- Includes provisions for treating rainwater for potable use.

250

Protection of the Water Reuse System

- Storage tanks located above ground must be of UV-resistant material or protected by sun barriers or from direct exposure to sunlight.
- Must be protected from freezing conditions and screening of necessary openings to prevent the entrance of insects and vermin.

251

System Abandonment

- Storage tank must be:
  - Secured from accidental access by sealing or locking all inlets.
  - Filled with sand or an equivalent material.
- Fixtures and outlets supplied with nonpotable water and now intended to be supplied with potable water:
  - Distribution piping must be replaced with new piping approved for potable use.

252

Part IV – Water Distribution

6. T F Graywater reuse can be stored untreated in excess of 24 hours.

False
Graywater shall not be stored for more than 24 hours.

253

Part IV – Water Distribution

7. T F When a system is no longer in use and is not intended to be used again, the storage tank can be filled with sand or equivalent material.

True
This may be the best option in protecting from any possible collapse of the tank in the ground.

254

Part IV – Water Distribution

Discuss the following questions:

- What are the differences in *prescriptive* design versus *performance* design in sizing the water supply and distribution system?
- What types of fixtures, appliances, equipment, systems and uses that require some level of backflow protection? Why is this important?
- How does the *CSA B805-18/ICC 805-2018 Rainwater Harvesting Systems* standard help jurisdictions meet challenges of water conservation and safety in collecting rainwater and storm water?

255

Gas Piping and Appliances

Part V

256

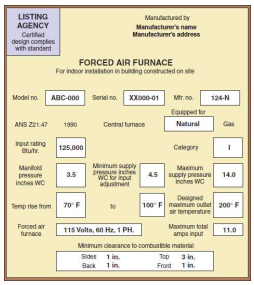
Fuel Gas – Definitions

- **appliance –** Any apparatus or device that utilizes a fuel or a raw material as a fuel to produce light, heat, power, refrigeration or air conditioning. Also, an apparatus that compresses fuel gases.
- **combustion air –** Air necessary for complete combustion of a fuel, including theoretical air and excess air.
- **direct-vent appliances –** Appliances that are constructed and installed so that all air for combustion is derived directly from the outdoor atmosphere and all flue gases are discharged directly to the outdoor atmosphere.
- **ignition source –** A flame, spark or hot surface capable of igniting flammable vapors or fumes. Such sources include appliance burners, burner ignitors and electrical switching devices.
- **vent –** A pipe or other conduit composed of factory-made components, containing a passageway for conveying combustion products and air to the atmosphere, listed and labeled for use with a specific type or class of appliance.
- **venting system –** A continuous open passageway from the flue collar or draft hood of an appliance to the outdoor atmosphere for the purpose of removing flue or vent gases. A venting system is usually composed of a vent or a chimney and vent connector, if used, assembled to form the open passageway.

257

Fuel Gas – Appliances

- Listing and labeling of appliances by qualified nationally recognized third-party agencies gives assurance that an appliance, when installed in accordance with the manufacturer's instructions, will function satisfactorily for the intended purpose and will operate safely.



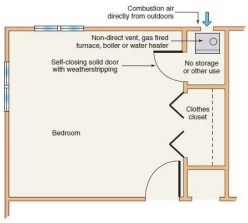
258

Appliance Installation and Location – Clearances

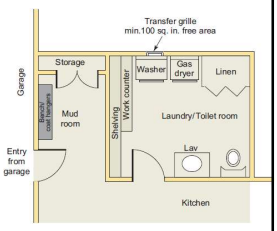
- Appliance listing and manufacturer's installation instructions generally determine minimum clearance to combustibles and minimum air clearance around the appliance for proper operation.

259

Appliance Installation and Location – Location Limitations



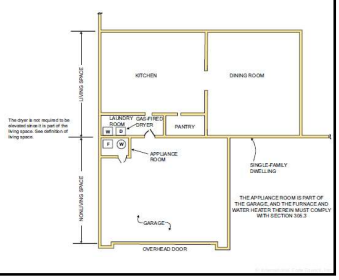
- Gas clothes dryer in a toilet room



260

Appliance Installation and Location – Location Limitations

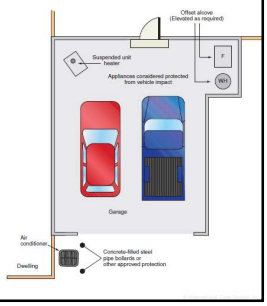
- The IFGC requires any ignition source of an appliance installed in a garage to be at least 18 inches above the floor unless the appliance is listed as flammable-vapor-ignition resistant.



261

Appliance Installation and Location – Protection from Impact

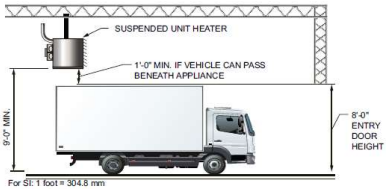
- Installing bollards, curbs or other approved barriers provide protection from impact by vehicles.



262

Appliance Installation and Location – Protection from Impact

- Suspended appliances located in a public garage must be installed with clearance of not less than 1 foot higher than the tallest vehicle garage door opening.



263

Appliance Installation and Location – Exterior Installation

- Appliances installed outdoors must be:
  - Listed for exterior locations (or provided with protection from the weather).
  - Supported on a level concrete slab or other approved material extending at least 3 inches above grade; and require a minimum 6-inch clearance above grade.
- Clearance-to-grade requirements also apply to appliances installed in crawl spaces.

264

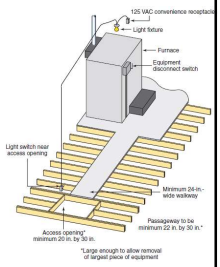
Appliance Installation and Location – Access to Appliances

- Provide adequate access and clearance to facilitate the service, repair and replacement of appliances.
- Require a minimum 30-inch by 30-inch working space in front of the controls.
- Access doors and passageways to appliances must be at least 24 inches wide and large enough to remove the largest appliance.

265

Appliance Installation and Location – Appliances in Attics

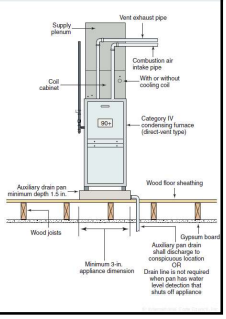
- Minimum opening size is 30 in x 20 in.
- Length of passageway is limited to less than 20 ft unless there is a clear path at least 22 in wide x 6 ft high.
- Requires light fixture and receptacle outlet at appliance location.



266

Fuel Gas – Condensate

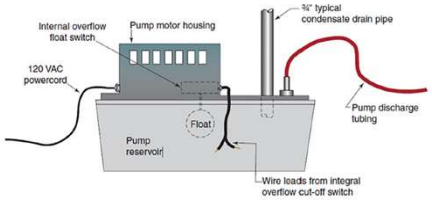
- Most common method to prevent water damage to construction materials because of a stoppage in the primary drain is to install an auxiliary drain pan below the appliance.



267

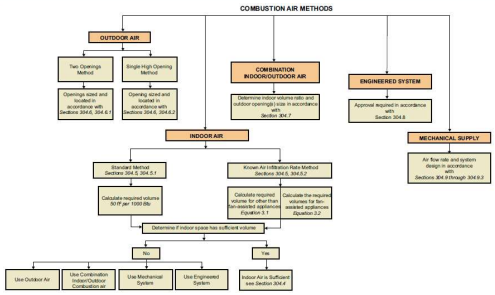
Fuel Gas – Condensate

Where condensate pumps are used and are located in uninhabitable spaces, such as an attic, the pump must be interconnected with the appliance such that if the pump fails, the appliance will not operate



268

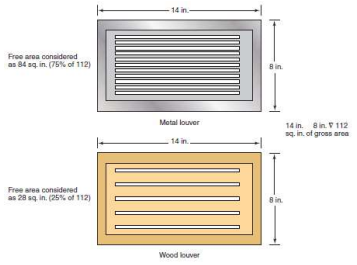
Fuel Gas – Combustion Air



269

Calculating the Net Free Area of Vents or Grilles

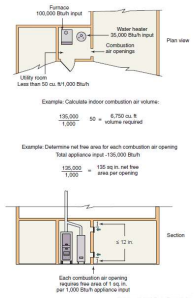
- 75% of the gross area for metal louvers
- 25% of the gross area for wood louvers.



270

Combustion Air from Inside the Building

- Combustion air for gas-fired appliances may be obtained from an indoor space having a volume of at least 50 cubic feet per 1,000 Btu/h input rating of all appliances being served within the space.
- IFGC also allows drawing combustion air from adjacent rooms through two permanent openings.
- One opening must be within 12 inches of the ceiling, and one must be within 12 inches of the floor.
- The code requires each opening to have a free area of not less than 100 square inches and at least 1 square inch per 1,000 Btu/h input rating of all appliances installed within the space.



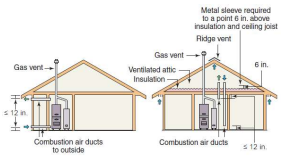
271

Combustion Air from Outdoors

- Obtained through Two Openings or Ducts
- Obtained through a Single Opening or Duct

272

Outdoor Combustion Air Obtained through Two Openings or Ducts



Horizontal combustion air ducts minimum free area of 1 sq. in. per 2,000 Btu/h for each opening

Example: Calculate size of each opening
Total appliance input rating is 135,000 Btu/h

135,000 / 2,000 = 67.5 sq. in. free area per opening

Vertical combustion air ducts minimum free area of 1 sq. in. per 4,000 Btu/h for each opening

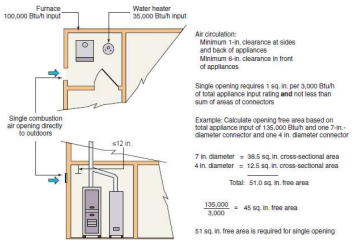
Example: Calculate size of each opening
Total appliance input rating is 135,000 Btu/h

135,000 / 4,000 = 33.75 sq. in. free area per opening

273

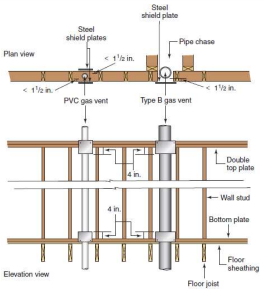
Outdoor Combustion Air Obtained through a Single Opening or Duct

IFGC also permits combustion air for gas-fired appliances to be obtained through a single opening located within 12 inches of the ceiling when the size is increased to meet three criteria. The free area of the opening must be at least 1 square inch per 3,000 Btu/h of the total appliance input rating and must be at least the sum of the areas of all vent connectors in the space. The code also prescribes minimum clearances around the appliances for free circulation of air.



274

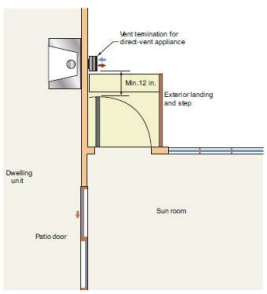
Vent Installation



275

Vent Installation

- Vent termination must be located so doors cannot swing within 12 inches to protect against physical damage.



276

Gas-Vent Roof Termination

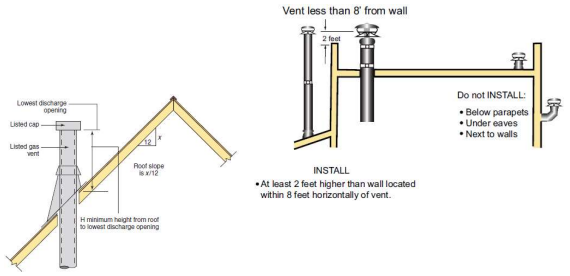
- The required termination height for gas vents not more than 12 inches in size and located at least 8 feet from a vertical wall is based on the roof pitch.
- Gas vents larger than 12 inches or less than 8 feet from a vertical wall must terminate at least 2 feet above the roof or any portion of a building within 10 feet horizontally.

Roof slope	Minimum height (ft) from roof to lowest discharge opening
Flat to 6/12	1.0
Over 6/12 to 7/12	1.25
Over 7/12 to 8/12	1.5
Over 8/12 to 9/12	2.0
Over 9/12 to 10/12	2.5
Over 10/12 to 11/12	3.25
Over 11/12 to 12/12	4.0
Over 12/12 to 14/12	5.0
Over 14/12 to 16/12	6.0
Over 16/12 to 18/12	7.0
Over 18/12 to 20/12	7.5
Over 20/12 to 21/12	8.0

[Ref. IRC Figure G2427.6.3]

277

Gas-Vent Roof Termination



278

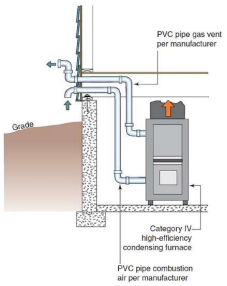
Direct-Vent Appliance Vent

- Direct-vent appliances draw all combustion air directly from outside.
- Direct-vent appliances often produce lower-temperature flue gases that may be vented through the exterior wall and terminate near the combustion air intake location.
- Clearances from vent terminations to building openings are less than would otherwise be required for non-direct-vent appliances.
- Clearances must also comply with the listing of the appliance and the manufacturer's instructions.
- Where such appliances utilize plastic piping material for the air intake and vent exhaust, it is important to the manufacturer's installation instructions for both the design and type of piping material to be used.

Appliance btu/h input rating		Min. clearance to air openings into building (in.)	Min. clearance above grade (in.)
Over	Not over		
–	10,000	6	12
10,000	50,000	9	12
50,000	150,000	12	12

279

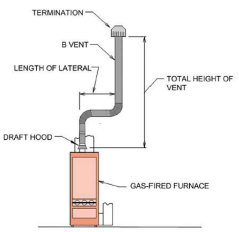
Direct-Vent Appliance Vent



280

Vent Sizing and Installation Requirements

- IFGC provides prescriptive sizing and design requirements for venting gas-fired appliances.
- For a single Category I appliance with a draft hood served by a Type B vent, the vent connector and vent must not be less than the size of the draft hood.
- Where two such appliances are connected to the same vent, as is common with a residential furnace and water heater, the vent cannot be less than 50 percent of the area of the smaller draft hood.



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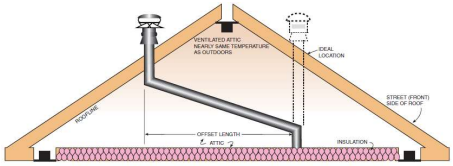
Vent Sizing and Installation Requirements



- The vent must extend vertically with offsets not exceeding 45 degrees, except that one offset of not more than 60 degrees is acceptable and is considered to be a horizontal, or lateral, offset.
- The horizontal distance, including the horizontal portion of the vent connector, cannot exceed 75 percent of the vertical height of the vent.
- The code provides a series of sizing tables to address variable conditions beyond the simple prescriptive criteria previously discussed.

282

Fuel-Gas Piping – Pipe Sizing

- Fuel-gas piping can be sized in accordance with:
  - The prescriptive pipe sizing tables provided in the code (*longest length* and *branch length* methods).
  - The performance-based (friction loss) method outlined in IFGC Appendix A when acceptable to the code official.
  - The sizing tables included in the manufacturer's installation instructions for listed piping systems, such as those provided by CSST manufacturers.
  - Other engineering methods when first approved by the code official.

283

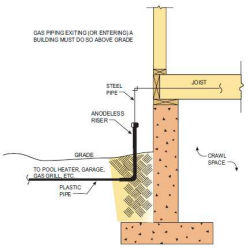
Fuel-Gas Piping – Piping Materials

- Approved gas piping materials include:
  - Schedule 40 steel.
  - Schedule 10 steel.
  - Approved seamless metallic tubing.
  - Corrugated stainless steel tubing (CSST)
- Approved plastic pipe, tubing and fittings are permitted in exterior underground installations.
- When fittings and thread joint compounds are used, they must be compatible with the piping material and gas and must be approved for the specific use.

284

Fuel-Gas Piping – Piping System Prohibited Locations

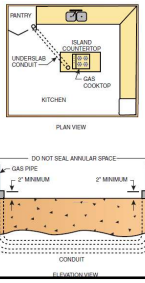
- IFGC does not permit the installation of gas piping within an air duct, clothes chute, chimney or gas vent or through any townhouse unit other than the unit being served.
- Gas piping is not permitted to penetrate foundation walls below grade and must enter and exit a building at a point above grade.



285

Fuel-Gas Piping – Piping System Prohibited Locations

- There are limited provisions in the code to allow piping to be installed below ground underneath a building or within a concrete slab floor.
- A common method of installation is a conduit for the installation of gas piping, such as CSST to serve an appliance located in an island away from surrounding walls.
- Piping under slab between interior points



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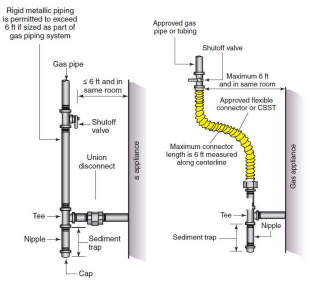
Fuel-Gas Piping – Other Installation Requirements

- Above-ground piping outdoors requires a clearance of 3½ inches above ground and above roof surfaces.
- Protection from corrosion, such as painting or galvanizing, is required for exposed exterior ferrous metal piping.
- Underground piping must be buried at least 12 inches deep.
- Where plastic piping is installed underground, it must also be provided with a yellow tracer material.
- IRC requires inspection and pressure testing of fuel-gas piping systems before they are concealed or put into service.

287

Fuel-Gas Piping – Appliance Connectors

- Rigid metallic pipe and fittings, CSST, and listed and labeled appliance connectors are approved for appliance connection to the gas piping system.
- Connectors are not allowed to pass through walls, floors, partitions, ceilings or appliance housings (other than connectors to fireplace inserts with proper grommets, in accordance with the manufacturer's instructions).
- For other than rigid metallic pipe, connector length is limited to no more than 6 feet.



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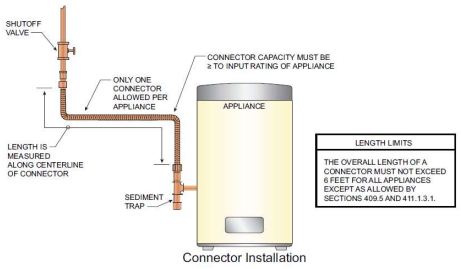
Fuel-Gas Piping – Appliance Connectors



Connector Installation

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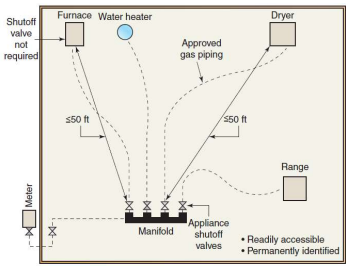
Fuel-Gas Piping – Shutoff Valve

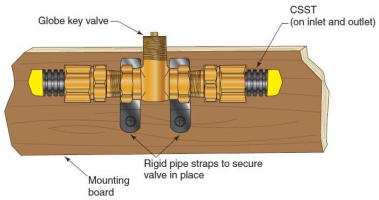
- To facilitate service and replacement, each appliance requires an accessible shutoff valve located upstream of the connector in the same room and within 6 feet of the appliance.
- Code permits shutoff valves located as much as 50 feet from the appliance when installed at a manifold and clearly identified.



290

Fuel-Gas Piping – Shutoff Valve

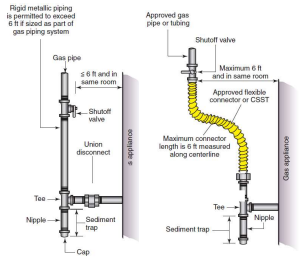
- It is especially important to secure shutoff valves in a CSST system.



291

Fuel-Gas Piping – Sediment Trap

- A sediment trap is generally required downstream of the shutoff valve and adjacent to the inlet of equipment.
- The IRC does not require sediment traps for illuminating appliances, ranges, clothes dryers and outdoor grills.



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Fuel-Gas Piping – Piping Support

IFGC Table 11-3

Steel pipe, nominal size (in.)	Spacing of supports (ft)	Nominal size of tubing smooth-wall (in., outside diameter)	Spacing of supports (ft)
½	6	½	4
¾ or 1	8	⅝ or ¾	6
1¼ or larger (horizontal)	10	⅞ or 1 (horizontal)	8
1¼ or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

[Ref. IRC Table G2424.1]

- Adequate piping support is necessary to prevent stresses on the pipe, fittings and connections.
- Table 11-3 shows maximum spacing of supports for gas piping. CSST supports must follow the manufacturer's instructions.

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Part V – Gas Piping and Appliances

1. What is the most common method to prevent water damage to construction materials because of a stoppage in the primary drain?

Install an auxiliary drain pan below the appliance

294

Part V – Gas Piping and Appliances

2. What are the two methods the IFGC prescribes for obtaining combustion air from the outdoors?

1. Obtained through Two Openings or Ducts
2. Obtained through a Single Opening or Duct

295

Part V – Gas Piping and Appliances

3. What are the two prescriptive sizing methods provided in the IFGC?

1. Longest length method
2. Branch length method

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Part V – Gas Piping and Appliances

Discuss the following question:

- What are the various methods of sizing fuel-gas piping?

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Discussion

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KEY POINTS

1. **What? What happened and what was observed in the training?**
2. **So what? What did you learn? What difference did this training make?**
3. **Now what? How will you do things differently back on the job as a result of this training?**

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