Conger Construction Services, LLC.

8 HOUR IRC COURSE

Requirement for Tradesman and Journeyman Licenses

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RULE §363.12 Training Programs Tradesman Plumber-Limited License Applicants

(a) Before an applicant may take an examination for a Tradesman Plumber-Limited license or Journeyman Plumber license, the applicant must complete classroom training provided by a board-approved instructor in a board-approved training program in the areas of health and safety, the latest versions of plumbing codes adopted by the Board, and water conservation for at least:

(1) 24 hours, if the applicant is applying to take a Tradesman Plumber-Limited License examination; or

(2) 48 hours, if the applicant is applying to take a Journeyman Plumber examination.

(b) The classroom training shall include the following Continuing Professional Education (CPE) classes as provided by §365.14 of this title (relating to Continuing Professional Education Programs):

(1) one six hour CPE class, if the applicant is applying for a Tradesman Plumber-Limited license; or

(2) two six hour CPE classes, if the applicant is applying for a Journeyman Plumber license.

(c) In addition to the CPE classes required by subsection (b)(1) and (b)(2) of this section, applicants for a Tradesman Plumber-Limited License and Journeyman Plumber license must complete the OSHA 10-Hour Outreach Training, including Construction Mandatory Topics Review, as set forth in paragraphs (1) - (9) of this subsection:

(1) Introduction to OSHA;

(2) OSHA Focus on Four Hazards, including:

(A) Fall Protection;

(B) Electrical;

(C) Caught in Between; and

(D) Struck By;

(3) Personal Protective and Life Saving Equipment;

(4) Health Hazards in Construction, including:

(A) Hazard Communication; and

(B) Silica;

(5) Tools, including:

(A) hand tools; and

(B) power tools;

(6) Excavations;

(7) Stairways and Ladders;

(8) Hazardous Materials; and

(9) Introduction to Industrial Hygiene and Blood Borne Pathogens.

(d) In addition to the CPE classes and OSHA training required by subsections (b)(1), (b)(2) and (c) of this section, applicants for a Tradesman Plumber-Limited License and Journeyman Plumber license must complete eight hours of classroom training, as set forth in paragraphs (1) - (7) of this subsection:

(1) two hours, to include:

(A) reading and understanding residential construction drawings;

(B) learning the basics of math for plumbing;
(C) drawing rough in and riser diagrams;
(2) one hour to review the International Residential Code chapter on Fuel Gas, including:
(A) definitions;
(B) pipe sizing and layout; and
(C) testing and inspections;
(3) one hour to review the International Residential Code chapter on General Plumbing Requirements, including:
(A) individual water supply and sewage disposal;
(B) structural and piping protection, including notching and boring;
(C) trenching and backfilling;
(D) workmanship and waterproofing penetrations; and
(E) listed, labeled and approved materials;
(4) one hour to review the International Residential Code chapters on Plumbing Fixtures and Water Heaters, including:
(A) the installation of plumbing fixtures and accessories;
(B) water heater installation and replacement, including hazards of improper installations; and
(C) water heater safety devices and alternative methods of existing installations not to code;
(5) one hour to review the International Residential Code chapter on Water Supply and Distribution, including:
(A) understanding and principals of backflow protection for potable water systems;
(B) water supply systems, including thermal expansion control and water hammer arrestors;
(C) water conservation and maximum flow for plumbing fixtures;
(D) sizing and pressures of potable water systems from the meter throughout distribution to fixture connections;
(E) materials and installation of potable water piping;
(F) demonstration of soldering and brazing according to B-828 standards;
(G) hangers, anchors and supports; and
(H) drinking water treatment units;
(6) one hour to review the International Residential Code chapters on Sanitary Drainage and Vents, including:
(A) materials and installation of drainage systems including proper grade and changes in direction of fittings;
(B) preparation of piping;
(C) standards for solvent cementing of pipe and fittings;
(D) cast iron piping and fittings;
(E) location and installation of cleanouts;
(F) sumps and ejectors sizing and installation;
(G) understanding the principals and physics of proper venting;
(H) installation of different types of venting systems; and
(I) improper connections and prohibited venting applications;
(7) one hour to review the International Residential Code chapter on Traps, including:
(A) design and prohibited traps;
(B) sizing and installation of traps and trap arms; and
(C) trap protection.

TEXAS STATE BOARD OF PLUMBING EXAMINERS
PO BOX 4200, AUSTIN, TEXAS, 78765 ▪ 512-936-5200 ▪ www.tsbpe.texas.gov

TRADESMAN PLUMBER-LIMITED EXAMINATION – IMPORTANT INFORMATION

You are eligible to take the Tradesman Plumber-Limited Examination if you meet the following requirements (check each box that applies to you):

Citizenship Status:

- ☐ I am a citizen or national of the United States; OR
- ☐ I am an alien lawfully admitted to the United States for permanent residence; OR
- ☐ I am an alien authorized to work lawfully in the United States.

Accepted forms of proof include: (1) a certified copy of your birth certificate issued by a city/county/state/federal certifying authority (if born in the United States); (2) a certified copy of your Consular Report of Birth (if born abroad to a U.S. citizen/parent); (3) a legible copy of both sides of your Certificate of Naturalization or Certificate of Citizenship (if a naturalized U.S. citizen); (4) a legible copy of both sides of the U.S. Immigration and Naturalization Service document evidencing your current status (if a permanent resident alien or an alien authorized to work lawfully in the United States, or any other status). Foreign birth certificates are **NOT** accepted.

Licensure:

- ☐ I am currently registered as a Plumber's Apprentice in Texas; OR
- ☐ I am currently licensed as a Journeyman Plumber in another state; OR
- ☐ I am currently licensed as a Master Plumber in another state.

An applicant licensed in another state must submit a letter on the official letterhead of the state entity that issued the license stating: (1) the type of license held; (2) the length of time the applicant has been licensed; (3) whether the license is current; (4) whether any complaints have been filed against the applicant; and (5) whether any disciplinary actions have been taken against the applicant.

Work Experience:

- ☐ I have at least 4,000 hours of experience working at the trade of plumbing under the supervision of a Responsible Master Plumber and while registered as a Plumber's Apprentice; OR
- ☐ I have at least 4,000 hours of experience working at the trade of plumbing under the supervision of a Master Plumber licensed in another state.

Proof of hours must be submitted on the Employer Certification Form (ECF), which is available at www.tsbpe.texas.gov under "Forms and Applications." TSBPE only accepts signed, original ECFs. If you earned your hours working for multiple employers, you must submit a separate ECF for each employer.

*** For verification of plumbing training obtained in the military, call (512) 936-5250.**

Classroom Training:

- ☐ I have completed ALL of the following training:
  - o 6-hour continuing professional education course (in the classroom);
  - o OSHA 10-Hour Outreach Training;
  - o 8-hour training on the International Residential Code and/or Uniform Plumbing Code; OR
- ☐ I am exempt from the training listed above because I am enrolled and in good standing with, or have completed, a training program approved by the United States Department of Labor Office of Apprenticeship.

You must take the 24-hour classroom training from a Course Provider approved by the TSBPE. A list of approved providers is posted on the website at www.tsbpe.texas.gov under "CPE and Other Training." The provider will give you a certificate of completion that you must submit with your application.

Application Fee:

- ☐ I have submitted the non-refundable Tradesman Plumber-Limited Examination application fee of $36.

Accepted forms of payment include: cashier's check, money order, personal check, or company check

Required Documentation:

- ☐ I have submitted all of the supporting documents required by the TSBPE (see Item #13 on application).

Your Identity Will be Verified: Current (not expired) photographic identification, such as a driver's license or state issued identification, will be required from the applicant on the day of the examination and must be verified before the examination begins.

Americans with Disabilities Act: The TSBPE offers reasonable accommodations for persons taking the examination, as required by the Americans with Disabilities Act. If you require special accommodations, please make such requests in writing and submit with your application for examination.

Studying for the Exam: An overview of the Tradesman Plumber-Limited examination, an explanation of how to prepare for the examination, and sample questions are provided in detail in the Tradesman Plumber-Limited Examination Review Course and may be downloaded free of charge at www.tsbpe.texas.gov under "Applications and Forms."

Training Periods for Examination Failures: Anyone who fails all or part of an examination must complete a training period before retaking the exam. The length of the training period depends on the number of times a person has failed. (1) First failure: a 30-day training period, (2) Second failure: a 60-day training period, (3) Third and subsequent failures: a 90-day training period.

Equal Opportunity Statement: The Texas State Board of Plumbing Examiners does not discriminate on the basis of race, color, national origin, sex, religion, age or disability in employment or the provision of services.

TEXAS STATE BOARD OF PLUMBING EXAMINERS
PO BOX 4200, AUSTIN, TEXAS, 78765 ▪ 512-936-5200 ▪ www.tsbpe.texas.gov

TRADESMAN PLUMBER-LIMITED EXAMINATION APPLICATION

Revised May 2017

1. Date________________ ►Incomplete applications expire one year from receipt. (See instructions in #13, below.)
2. Last name (Print) ________________________________ First ________________________ MI_________
3. Mailing address____ City______________________________
4. State______________ Zip Code__________________ Date of birth___________________ Age___________
5. Driver's License/ID No._________________________ Social Security No. ______________________________

Disclosure of your social security number is required. Your social security number is being solicited pursuant to Texas Family Code § 231.302 for use by the state's Title IV-D agency to assist in the administration of laws relating to child support enforcement under 42 U.S.C. §§ 601-617 and 651-669.

6. Texas Plumber License #_____________or Out-of-State License #_______________issued by State of _______
7. Home Tel. #___________________ Mobile Tel. #__________________ Email __________________________
8. Employed by____ Employer Tel. # _______________________
9. Please check the box below to indicate where you want to take the written part of the examination. The non-written parts of the examination are only given in Austin.
   - ☐ Austin, Texas: Complete three-part examination given in one day or re-examination of one portion
   - ☐ El Paso, Texas: Written portion only, with final two portions taken in Austin, Texas at a later date
   - ☐ Harlingen, Texas: Written portion only, with final two portions taken in Austin, Texas at a later date
10. **Have you ever been convicted of a misdemeanor in this state or any other state? ☐ Yes or ☐ No**
11. **Have you ever been convicted of a felony in this state or any other state? ☐ Yes or ☐ No**
    If you answer **YES to #11**, you must submit a Supplemental Criminal History Information Form (SCHIF) and all documentation listed on page 2 of the Form with this application. The SCHIF is available on the TSBPE website at www.tsbpe.texas.gov under "Application and Forms."
12. Are you an active member of the military or a veteran? ☐ Yes or ☐ No
13. **Incomplete applications will not be processed. Check the following boxes as you include the items which must be submitted with this application in order for the application to be considered complete. Please submit all items at one time and in one envelope.**
    - ☐ $36 examination fee (the fee is non-refundable)
    - ☐ Proof that the applicant is a citizen or national of the United States, or an alien lawfully admitted to the United States for permanent residence, or an alien authorized to work lawfully in the United States
    - ☐ Legible copy of current photographic identification issued by the State of Texas or another state or jurisdiction
    - ☐ Employer Certification Form(s) verifying 4,000 hours of work experience in the plumbing trade
    - ☐ If you answered "yes" to question #11: Supplemental Criminal History Information Form and required documents
    - ☐ Certificate(s) of completion for 24-hour classroom training or copy of official certificate of completion of a training program approved by the United States Department of Labor Office of Apprenticeship
    - ☐ If licensed in another state: verification letter, on official letterhead, from the entity that issued the license
14. **BY SIGNING BELOW, I TESTIFY THAT I UNDERSTAND THAT SUBMITTING ANY FALSE INFORMATION TO THE BOARD IS A CRIMINAL OFFENSE AND WILL ALSO RESULT IN DISCIPLINARY ACTION, UP TO AND INCLUDING REVOCATION OF MY PLUMBING LICENSE OR REGISTRATION AND AN ADMINISTRATIVE PENALTY UP TO $5,000.00.**

____
Signature of Applicant

TSBPE USE ONLY

Fee____ File No. ____________________________________

1. SCHED:__________________[____] 2. SCHED:_______________[_____] 3. SCHED:_______________[______]

Texas State Board of Plumbing Examiners

Tradesman Plumber-Limited Licensee Examination Review Course

The following Examination Review Course is designed to assist a registered Plumber's Apprentice in preparing for the Tradesman Plumber-Limited Licensee examination.

When Should Examination Preparation Begin?

An individual who wishes to become licensed as a Tradesman Plumber-Limited Licensee should begin preparing for the required examination when the individual registers with the Texas State Board of Plumbing Examiners (Board) as a Plumber's Apprentice and begins his or her first day of the required 4,000 hours of on-the-job training under the supervision of licensed plumbers. While training on the job, the Plumber's Apprentice should gain knowledge of the proper preparation and assembly of plumbing materials as well as how the entire plumbing system for a one-or-two-family dwelling should be installed. This knowledge is gained from the licensed plumbers who work with, train and supervise the Plumber's Apprentice and should always comply with the recommendations of the manufacturers of the plumbing materials, the requirements of the adopted plumbing code and local ordinances.

- In addition to the knowledge gained from his or her 4,000 hours of on-the-job training under licensed plumbers, the Plumber's Apprentice should begin studying the Plumbing License Law, rules of the Texas State Board of Plumbing Examiners and the:

- **2012 International Residential Code**, English and Spanish editions available by calling 800-786-4452 or website address is www.iccsafe.org/

What to Expect From the Examination

The Plumber's Apprentice will be tested on his or her knowledge and understanding of the proper installation of one-family and two-family dwelling plumbing systems. The examination relates to work performed and decisions made on the job by a Tradesman Plumber-Limited Licensee. The examination consists of:

- eighty-five (85) written multiple choice questions;
- "hands-on" shop work, including measuring, cutting, assembly and fitting of commonly used plumbing pipe and fittings (solvent cemented PVC, soldered copper, threaded steel, and compression band type cast iron); identifying proper and improper installation of water heaters; and
- design of a two story sanitary drainage and vent system for eight common plumbing fixtures and the installation of the designed system into a scaled down model of a two story one-or-two family dwelling, using miniature pipe and fittings.

How to Study the Plumbing Codes

The examination contains only questions pertaining to plumbing of one-and-two family dwellings. Knowledge of commercial plumbing systems is not required for the Tradesman Plumber-Limited examination.

In some instances, a plumbing code may refer to a manufacturer's recommendations on a particular subject. For the purposes of the examination, the Plumber's Apprentice needs to be familiar with the manufacturer recommendations for the installation of solvent cemented P.V.C. joints, steel pipe threaded/screwed joints, soldered copper joints and compression band type cast iron joints. These manufacturer recommendations are found in the form of the manufacturer instructions for the assembly of the particular product. For example, the label on most cans of P.V.C. primer and solvent cement have instructions for the proper preparation of the pipe and application of the primer and solvent cement. Manufacturer recommendations are also found on the labels of most pipe joint compounds for threaded/screwed joints and soldering fluxes for copper soldered joints. Manufacturer recommendations for compression band type cast iron joints are supplied with the bands or from the supplier or manufacturer.

The plumbing codes are separated into chapters according to subjects. Some subjects are covered in more than one chapter, depending on which code is chosen to study. For example, installation of methods for plumbing materials are generally covered in the General Regulations chapter, but more specific methods for installing solvent cemented P.V.C. water pipe, may be found in the chapter on Water Supply and Distribution.

When preparing for the examination, the Plumber's Apprentice should pay particular attention to the following chapters and subject matter listed under each chapter:

Chapter on Definitions
Studying a plumbing code should begin with learning and understanding the proper plumbing terms and their meanings found in the chapter on definitions. When the proper terms and their meanings are known and understood, the Plumber's Apprentice will find the other chapters in the plumbing code much easier to understand. The plumbing codes use only correct plumbing terms and do not contain any slang terms. Since the examination is based on the plumbing codes, only correct terms are used in the examination.

<u>A Sample Question from the Tradesman Plumber-Limited Examination</u>:

A vertical vent pipe installed to provide circulation of air to and from any part of the drainage system is known as a/an:

A. individual vent
B. vent stack
C. combination waste and vent
D. wet vent

Chapter on General Regulations or General Requirements

The chapter on general regulations or general requirements, generally addresses the requirements for the installation of plumbing. Some of the subjects in this chapter may be more specifically addressed in the other chapters of the code. Some of the subjects covered in this chapter include:

- types of materials and fixtures which may and may not be used;
- installation methods which may and may not be used;
- protection of piping from corrosion, stress, freezing and physical damage;
- proper bedding, support and protection of pipe installed in trenches and tunnels;
- limitations on cutting, notching and boring of the building structure;
- required types and methods of testing and inspection of the plumbing system.

A Sample Question from the Tradesman Plumber-Limited Examination:

Pipe, fittings, traps, fixtures, material or devices used in a plumbing system shall be:

A. painted blue to indicate waste
B. dyed
C. marked with identification of the manufacturer
D. colored

Chapter on Plumbing Fixtures

The chapter in the codes on plumbing fixtures addresses the approved types and sizes of fixtures, faucets and fixture fittings and their installation. Some of the subjects covered in this chapter are:

- water closets, bidets, lavatories, bathtubs, showers, sinks, automatic clothes washers, dish washers, food grinders;
- fixture fittings and accessories, such as p-traps, tailpieces, slip joint connections, flush valves and overflows in water closet tanks.

A Sample Question from the Tradesman Plumber-Limited Examination:

Concealed slip joint connections on fixtures shall be:

A. plastic
B. prohibited
C. made with pipe dope
D. accessible

Chapter on Water Heaters

The chapter on Water Heaters addresses the installation of water heaters, including the required connections, valves and safety devices. The chapter in the codes on fuel gas, also address many requirements for water heater installation and venting. Some of the subjects addressed in the chapter on Water Heaters are:

- approved locations of water heaters
- supply valves
- pressure and temperature relief valves and drains
- drain pans

During the examination, the Plumber's Apprentice will view several water heater installations. Each water heater installation will be numbered. Each water heater will have the manufacturer's warning and statistical labels affixed to the water heater. Each water heater installation will contain some code violations, which must be identified by the Plumber's Apprentice.

A Sample Question from the Tradesman Plumber-Limited Examination:

The gas shutoff valve on water heater #1 must be of an approved type and installed:

A. less than 3 feet from the water heater and in the same room
B. more than three feet from the water heater and down stream of a union
C. more than three feet from the water heater in an adjoining room
D. less than 5 feet from the water heater in an adjoining room

Chapter on Water Supply and Distribution

The chapter on water supply and distribution address materials and installation of hot and cold water supply and distribution systems. Some of the subjects covered in this chapter are:

- cross-connection contamination prevention, including vacuum breakers and air gaps;
- approved materials for water supply piping
- required methods for installation of water piping, including threaded, solvent cement and solder joints

A Sample Question from the Tradesman Plumber-Limited Examination:

To prevent turbulence and flow loss, piping must be:

A. insulated
B. all stainless steel
C. reamed to full bore
D. sleeved

Chapter on Sanitary Drainage

The chapter on sanitary drainage addresses the materials and installation of sanitary drainage piping systems. Some of the subjects covered in this chapter are:

- approved and prohibited materials for sanitary drain piping;
- required methods for installation of drainage piping, including solvent cement joints;
- required distance between building drain and water service
- required locations of cleanouts
- testing of sanitary drainage piping

A Sample Question from the Tradesman Plumber-Limited Examination:

Horizontal drainage piping 2 inches or less in diameter shall be installed with a fall of not less than ____ of an inch per foot.

A. 3/4
B. 1/2
C. 1/4
D. 1/8

Chapter on Vents
The chapter on vents addresses the materials and installation of vent systems, which allow the sanitary drainage system to operate properly. Some of the subjects covered in this chapter are:

- the purpose of properly installed vent systems
- the different vent types and components which create a complete vent system
- vent terminals
- grading of vents
- connection of vent piping to sanitary drainage piping
- wet venting on the same floor versus wet venting one floor above another

A Sample Question from the Tradesman Plumber-Limited Examination:

Horizontal vent pipes shall be level or graded as to drip back by gravity to:

A. the main vent pipe
B. the main soil stack
C. the loop vent
D. the soil or waste pipe that it serves

Chapter on Traps
The chapter on traps addresses the materials and installation of traps in the sanitary drainage system. Some of the subjects covered in this chapter are:

- design of different types of traps
- fixture traps
- protection of trap seals
- prohibited traps

A Sample Question from the Tradesman Plumber-Limited Examination:

In a vertical stack, the use of a wye and 1/8 bend for a trap connection could create:

A. an airlock
B. back pressure
C. an "S" trap
D. backflow

Chapter on Fuel Gas or Fuel Piping
The chapter on fuel gas or fuel piping addresses the pipes, valves, fittings and installation of those materials used for supplying fuel gas to water heaters and appliances. The subjects covered in this chapter that the Plumber's Apprentice should be knowledgeable of are:

- the different types of fuel gasses
- approved and prohibited materials for fuel gas piping
- testing of fuel gas systems

The Plumber's Apprentice should also know that in order to install liquefied petroleum (L.P.) gas, a separate license issued by the Texas Railroad Commission must first be obtained by anyone who installs L.P. gas piping.

A Sample Question from the Tradesman Plumber-Limited Examination:

Which test medium cannot be used for testing a fuel gas system?

A. Air
B. Oxygen
C. Nitrogen
D. Carbon dioxide

How to Study the Plumbing License Law and Board Rules

The Plumbing License Law and Board Rules contain the regulations for persons who work in the plumbing industry to follow. The Plumber's Apprentice should be familiar with all of these regulations. However, for the purposes of preparing for the Tradesman Plumber-Limited examination, the Plumber's Apprentice should study the **Plumbing License Law, Sections** 1301.351, 1301.356, 1301.403, 1301.404, 1301.452, 1301.502, 1301.508, 1301.701, 1301.702 and the **Board Rules, Sections** 361.1, 365.1, 367.2, 367.4, 367.5 and 367.7.

The Plumbing License Law and Board Rules are available on the Texas State Board of Plumbing Examiners website at www.tsbpe.state.tx.us, or by calling the Board's office at 512-936-5200.

A Sample Question from the Tradesman Plumber-Limited Examination:

At least six hours of Board approved continuing professional education is required of:

A. anyone who fails an examination
B. anyone who fails an examination more than once
C. any licensee who has held a license for more than five years
D. any licensee who wishes to renew a license

How to Apply to Take the Tradesman Plumber-Limited Examination

Once the Plumber's Apprentice has:

- met the minimum 4,000 hours of work experience; and
- has gained the knowledge of the proper preparation and assembly of plumbing materials as well as how the entire plumbing system for a one-or-two-family dwelling should be installed,

the Plumber's Apprentice may apply to take the Tradesman Plumber-Limited examination by submitting to the Board, completed:

- Tradesman Plumber-Limited examination application form;
- Employer Certification form (verifying work experience);
- the examination fee; and
- other documentation detailed on the examination application form.

All forms are available on the Texas State Board of Plumbing Examiners website at www.tsbpe.state.tx.us, or by calling the Board's office at 512-936-5200.

8 HOUR IRC COURSE

REQUIRED FOR TRADESMAN AND JOURNEYMAN LICENSES

This course meets the requirements of TSBPE Board Rule 363.12(d)(7)(A)(B)(C), (2)(A)(B)(C), (3)(A)(B)(C)(D)(E), (4)(A)(B)(C), (5)(A)(B)(C)(D)(E)(F)(G)(H), (6)(A)(B)(C)(D)(E)(F)(G)(H)(I), (7)(A)(B)(C) – Training Program for Journeyman Plumber and Tradesman Plumber – Limited License Applicants.

CONGER CONSTRUCTION SERVICES, LLC.

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Chapter 1

Basic Math & Residential Drawings

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This Chapter begins our training program as one of the most important facets of the plumbing industry, it is the foundation of the trade: Math. It is however presented in a fundamental manner and will serve as a basic math skills refresher for the plumber. After the completion of this chapter, you will be able to:

- Add/subtract fractions and whole numbers
- Compute pipe offsets
- Read a ruler accurately to the nearest 1/16”
- Apply formulas in finding area and volume

In this profession, a skilled plumber must have the ability to make accurate measurements and calculations; and must be able to add and subtract dimensions, such as calculating pipe offsets, pipe area and the volume of a tank.

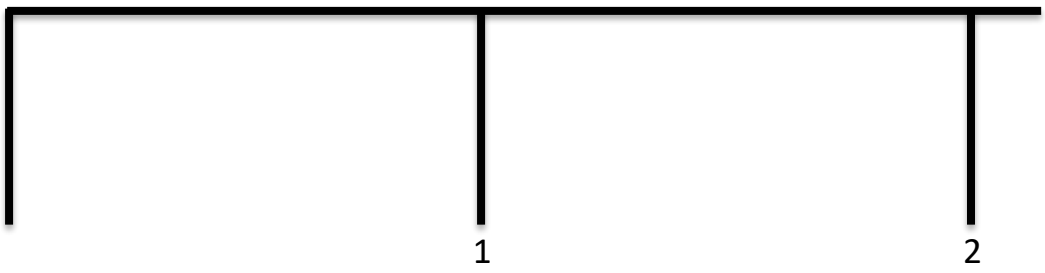
Using Fractions

Industry standard measuring tools are the folding ruler and/or the steel measuring tape, these are most frequently used by plumbers. Choice will dictate type because the result in measurement scale will be the same.

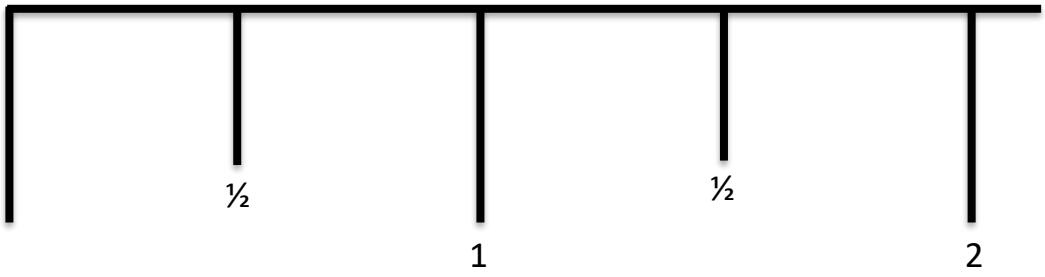
Being able to accurately read a ruler requires close attention and much practice until it becomes second nature. You will begin to notice that the measurement lines vary in length. The longer lines represent inches and the shorter lines detail a fraction of the larger line. The old adage, “Measure twice, cut once,” is quite profound in this sector; remembering this rule will prevent wasted time with costly errors.

Reading the scale to the nearest 1/16” accurately will become less of a chore, if you begin to use the larger dimensions first, such as 1/2" and 1/4” as starting points; and then add or subtract from these pivotal starting points to receive the correct reading. Remember that practice does make perfect for reading correct measurements, but once you master this task, you will quickly and easily be able to calculate the correct measurements, thus saving time and money for you and your employer.

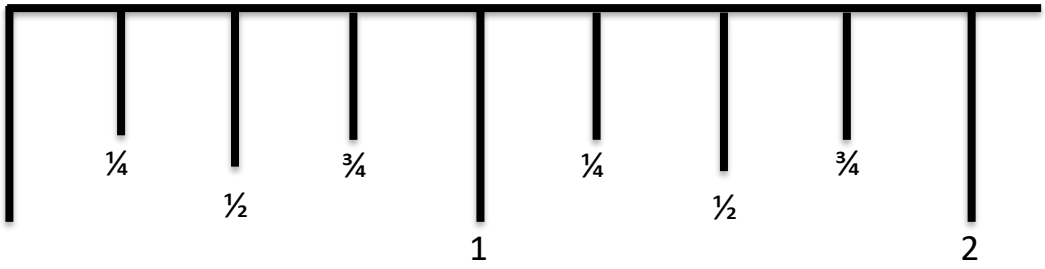
To fully grasp fractions, note how the ruler is broken down into the basic measurements:



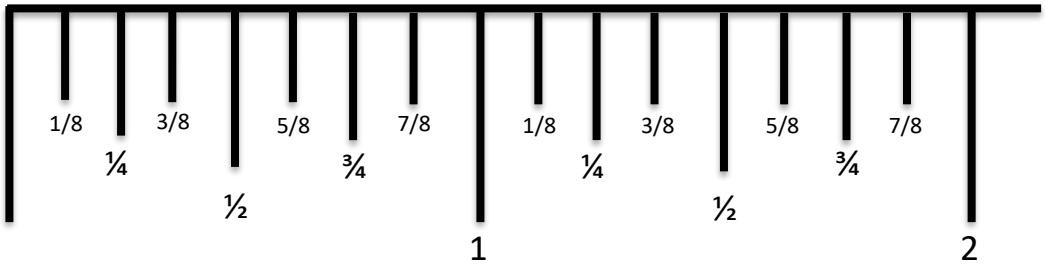
Inch dimensions (“)



1/2” dimensions divide each inch into two equal spaces

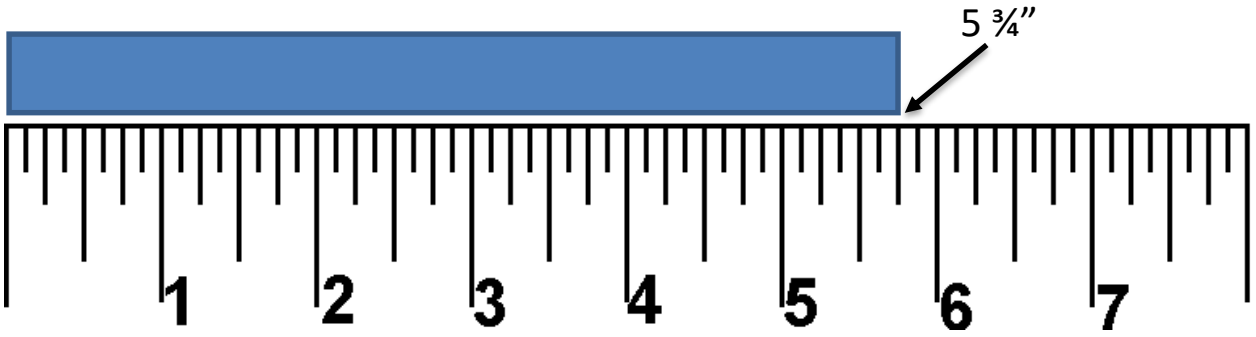


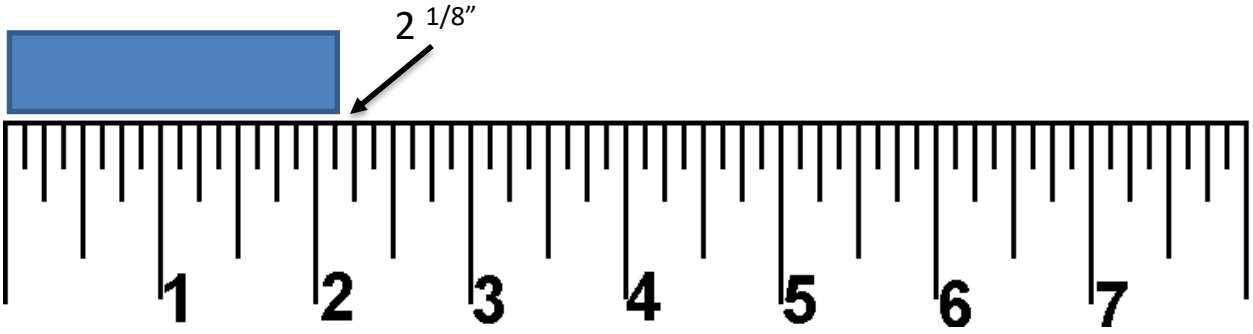
1/4” dimensions divide each inch into four equal spaces

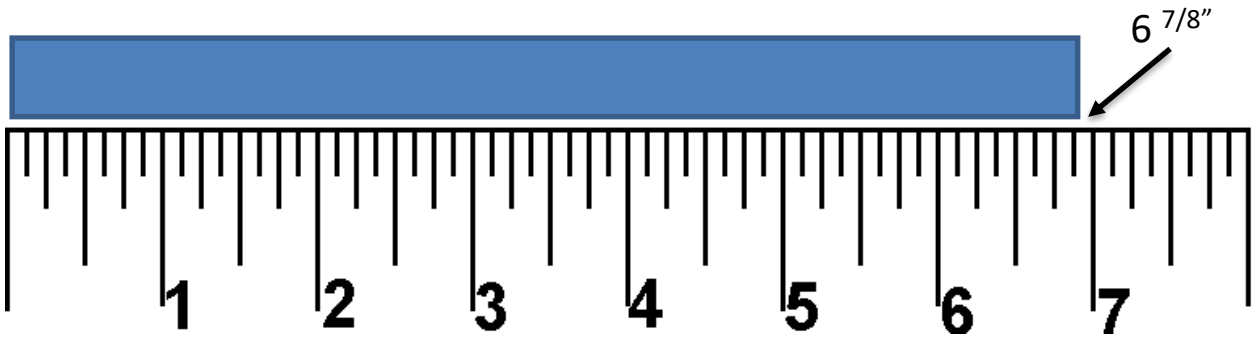


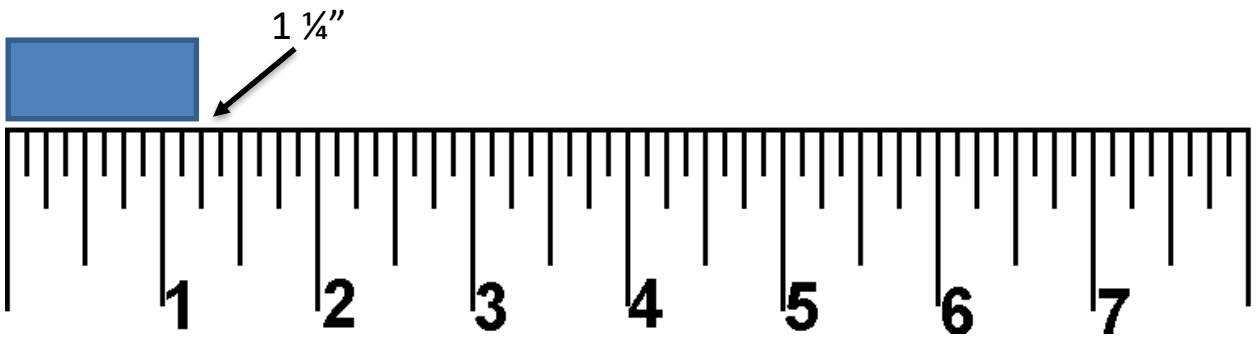
1/8” dimensions divide each inch into eight equal spaces

The measurements are now easily read:

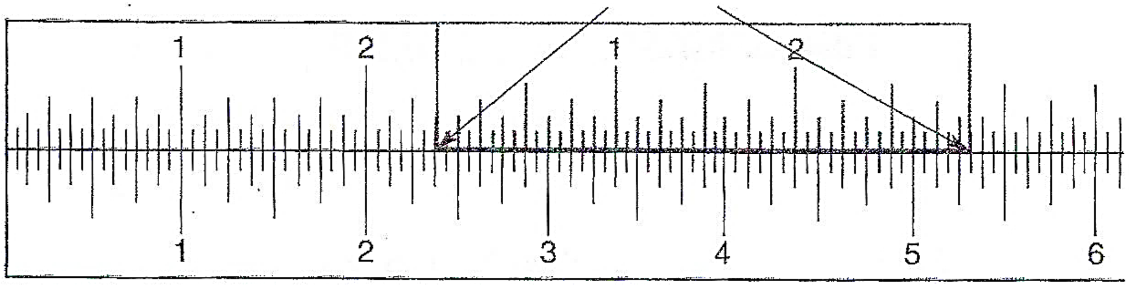








2 $^{3/8''}$ + 2 $^{15/16''}$ = 5 $^{5/16''}$



2 $^{3/8''}$ + 2 $^{15/16''}$ = _____

In this case:

Numerator

6/16" + 15/16" = 21/16"

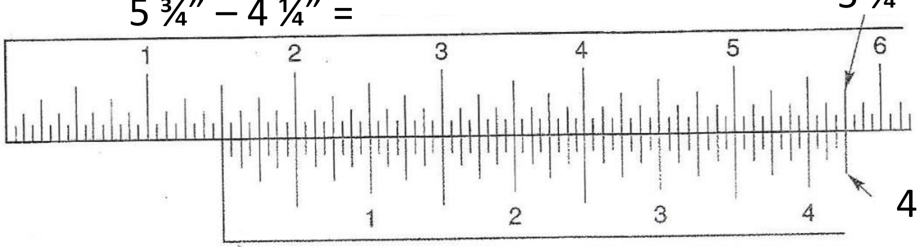
Denominator

Fractions can only be added together when the denominators are the same. The illustration above had to be adjusted; therefore 3/8" becomes 6/16". Now the problem can be solved.

2 3/8" becomes 2 6/16". So 2 6/16" + 2 15/16" = 4 21/16" OR 5 5/16

5 ¾" – 4 ¼" =

5 ¾"



4 ¼"

Subtracting the numerators of the fractions produces the following results:

5 ¾" – 4 ¼" = <u> 2/4"</u>

Subtracting whole numbers gives:

5 ¾" – 4 ¼" = <u> 1 2/4"</u>

Now, 2/4" can be written in a simpler, reduced form:

5 ¾" – 4 ¼" = 1 ½"

Fractions can easily be subtracted in the same manner as simple addition. Adjust the denominators to the same value and continue with the equation.

Measurement Conversions

Convert the following decimals to fractions:

a) .1250 = _____

b) .4375 = _____

c) .75 = _____

d) .8750 = _____

e) .9375 = _____

f) .1875 = _____

g) .0625 = _____

h) .25 = _____

Convert the following fractions to decimals:

a) 1/2 = _____

b) 11/16 = _____

c) 15/16 = _____

d) 5/8 = _____

e) 1/8 = _____

f) 3/8 = _____

g) 3/4 = _____

h) 7/16 = _____

Useful Math for the Jobsite

One gallon of water = 8.345 pounds

One foot of water = .4335 psi

One cubic foot of water = 7.48 gallons

One cubic foot of water = 62.42 pounds

One square foot = 144 square inches

One cubic foot = 1728 cubic inches

Area of a circle = $A = \pi r^2$ or .7854 x D^2

Circumference = πD or $2\pi R$

Pi or $\pi = 3.1416$

D = Diameter

R = Radius

Common Jobsite Math Problems

Do not use a calculator for questions 1-13:

1. **Add the following numbers, 14, 108, 1027, 6, 339_____**
2. **Add the following numbers, 1.06, 113.94, 0.642, 2.009_____**
3. **Subtract 1026 from 2003._____**
4. **Subtract 56.078 from 87.64_____**
5. **Multiply 43 by 7_____**
6. **Multiply 1137 by 56_____**
7. **Multiply 11.007 by 108.2_____**
8. **Divide 1064 by 8_____**
9. **Divide 109.86 by 10.3_____**
10. **Add the following fractions, 1/4 + 1/8 + 3/16 + ½_____**
11. **Multiply the following fractions 3/7 by 5/9 by ½_____**
12. **Divide the following fractions 1/4 by ½_____**
13. **Divide 3/16 by 1/8_____**
14. **Convert 5/8 to its decimal equivalent, round your answer to three decimal places_____**
15. **A plumber cuts three sections of pipe from a 12' length of PVC the lengths of the sections are 33 3/8", 56 5/8" and 39 7/8". What is left over from the full length, if the saw cut is 1/8" wide?_____**
16. **What is 12% of 63?_____**

17. 17 is what percent of 26._____

18. 12.9 is 15% of what number._____

19. Write 16% as a decimal number and a fraction. (reduce to lowest terms)

Ans._____

20. What is the grade or change in elevation of a 4" sewer line, that is 240 foot long, at a ¼" per foot fall? _____

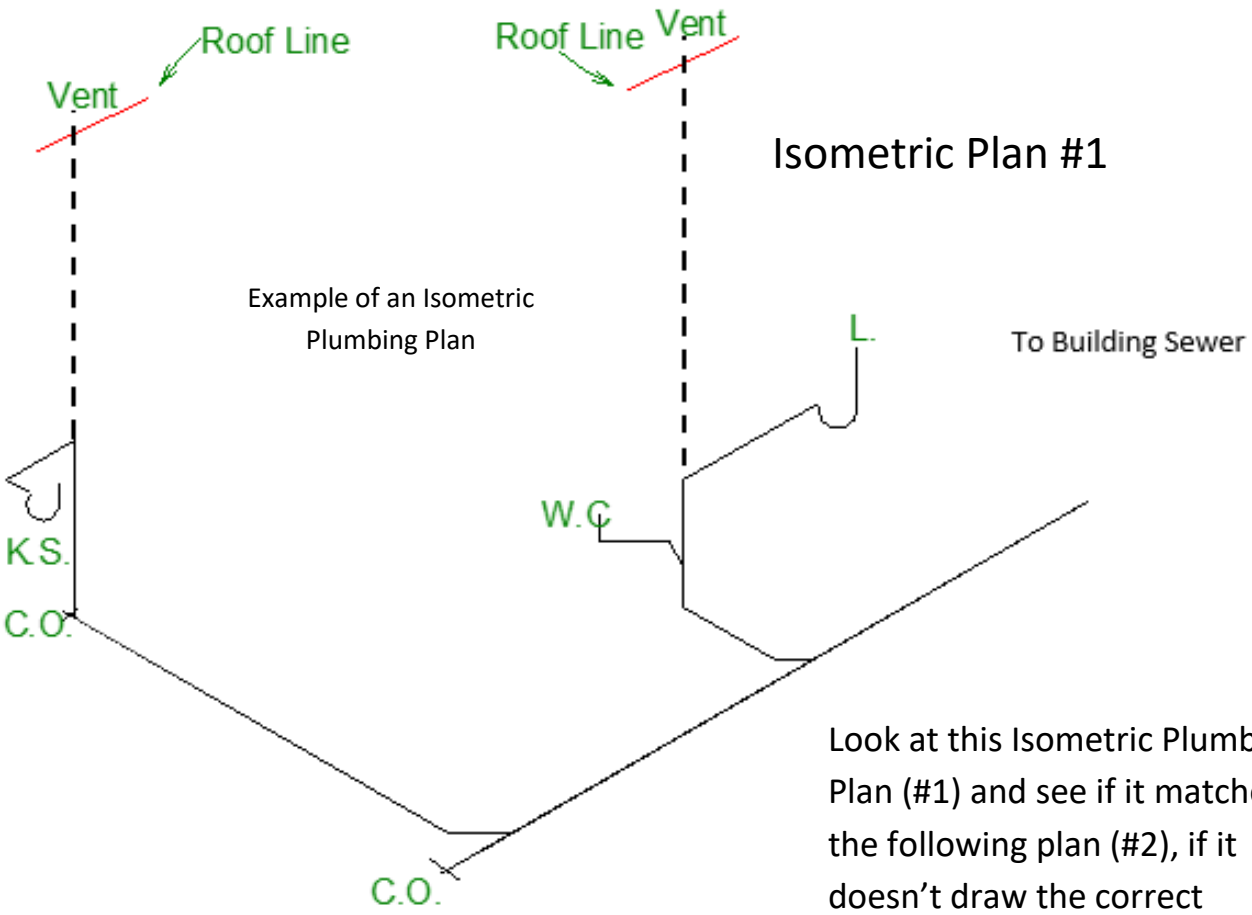
21. What is the grade or change in elevation of a 4" sewer line, that is 240 foot long, at a 2% fall? _____

22. Excluding the weight of the water heater, how much does a full 40 gallon water heater way? _____

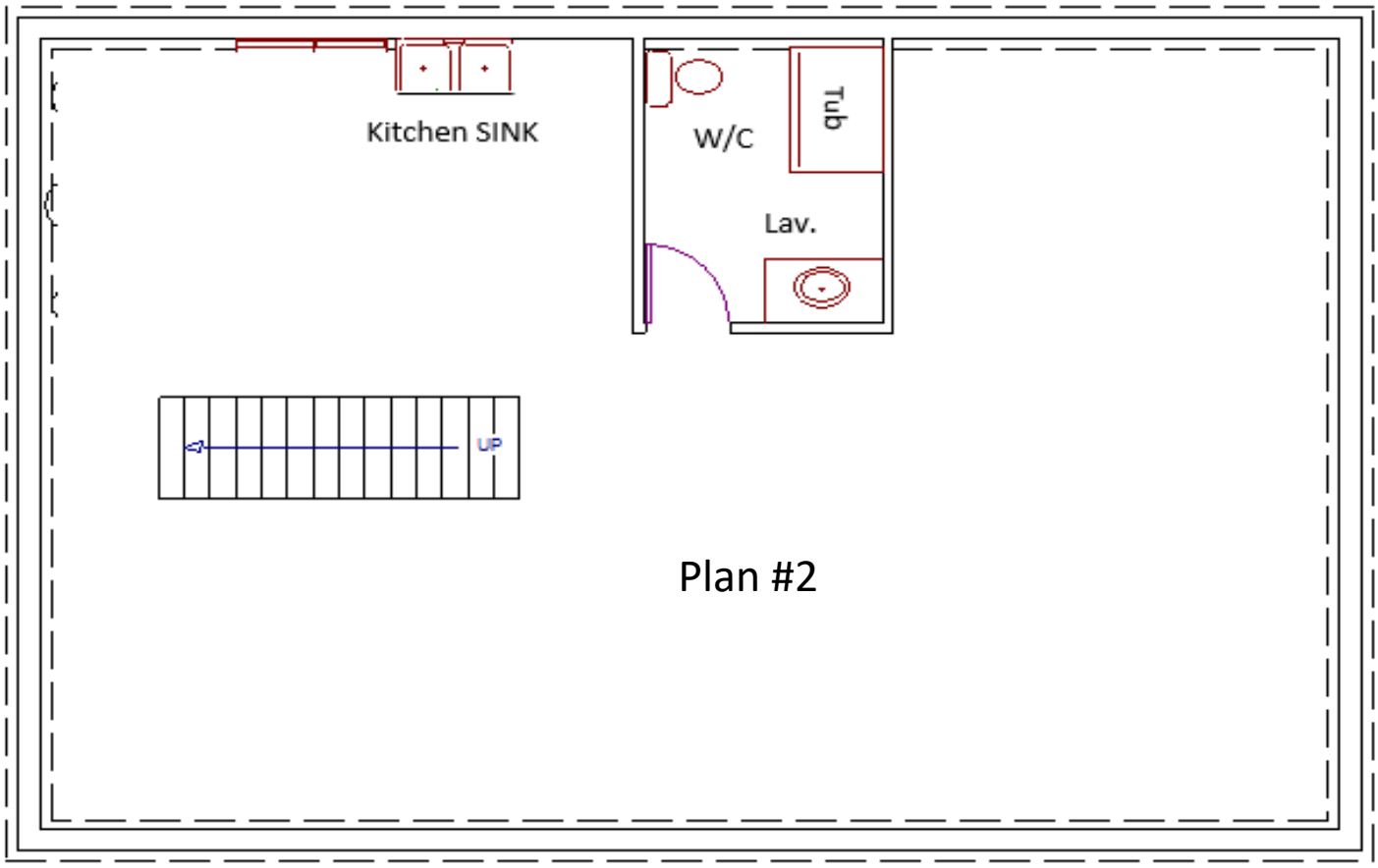
23. The area of a 4" I.D. pipe is equal to? _____

24. You have a section of 3" I.D. pipe suspended horizontally above the cealing. This section of piping is 30 feet long and is full of water. What is the total weight of the water in this section of pipe? _____

Question #25

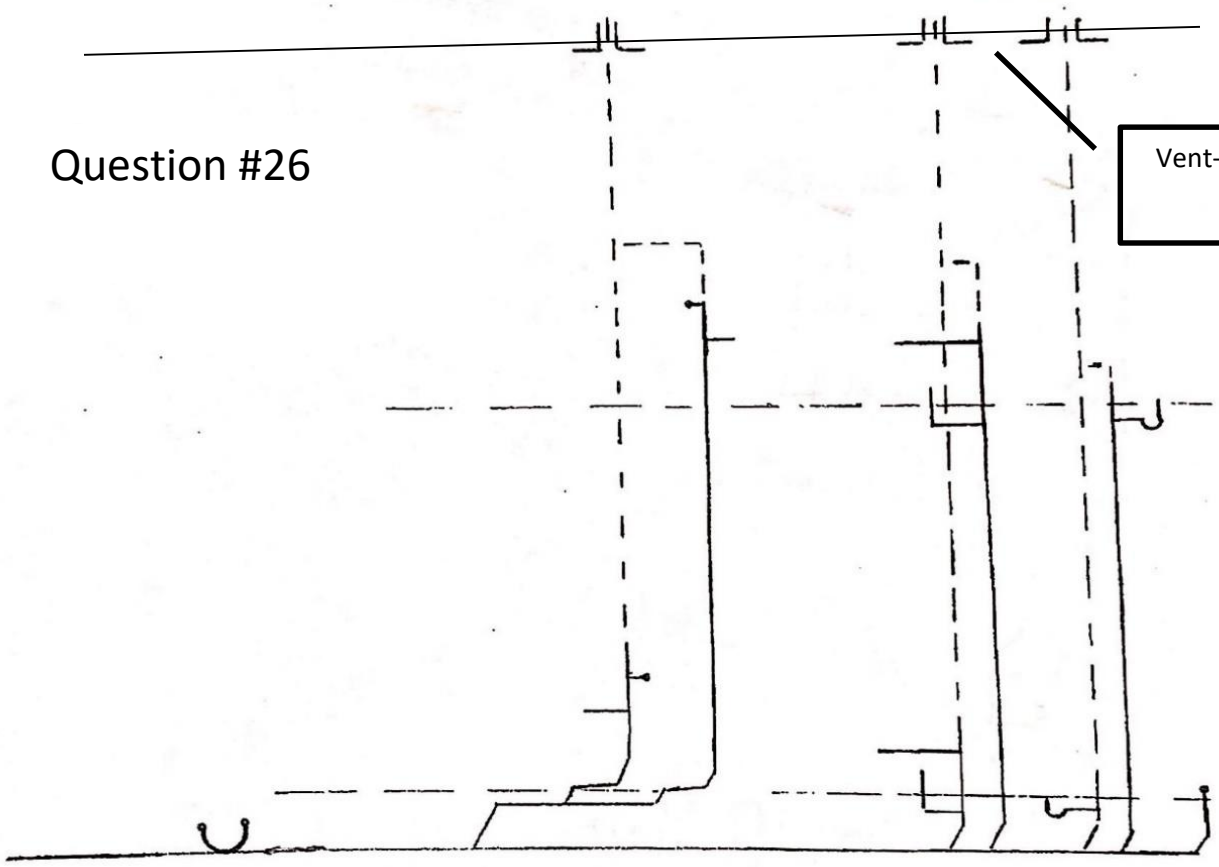


Look at this Isometric Plumbing Plan (#1) and see if it matches the following plan (#2), if it doesn't draw the correct Isometric to reflect the plumbing fixtures below (#2)



Plan #2

Question #26



What fittings are needed to install building drain-lines on this isometric plan (Don't forget…solvent cement)?

Chapter Notes:

To understand the scope of a plumbing project, you must know how to read and interpret drawings. These include civil, architectural, structural, mechanical, plumbing and electrical drawings.

- Electrical with equipment schedules, mechanical, windows/doors are good to note so plumbing can be considered/coordinated to avoid clashing. Mechanical may require plumbing connections (gas); also open-air returns to avoid.
- Many times plumbing plans include isometric draw-ups of the water distribution, building drains and gas distribution. Some show the isometric drawings and the general route of these systems with pipe sizes; and general locations of the urinals, water closets and lavatories. Other plans only have locations, and the plumber must perform their own measurement calculations and draw their own isometrics for these systems.

Schedules:

Residential plumbing plans may include schedules for the individual plumbing systems. Plumbing schedules establish the governing plumbing codes, specify piping materials and call out insulator requirements, if these are not included, the local AHJ (Authority Having Jurisdiction) must be consulted for code requirements and amendments. The first column contains the letter or number key that corresponds to the fixtures locations in the isometric drawings.

Isometric Drawings:

Are three dimensional renderings of fixtures, appliances or installations in which all vertical lines are depicted vertically and all horizontal lines are projected at a 30-degree angle and appear to go back into the horizon.

The Material Take-off:

The shopping list; pull from isometric drawings and/or scaled measurements drawn on plans. Performing the material take-off of the plumbing plan enables the plumber to determine how many of each item (fixtures, piping, fittings and other materials) to complete project for all three phases: Rough-In, Top-Out & Trim-Out. Be sure to include a description of each item, this will help with the estimate of material & labor costs before the project and validation of cost consideration after.

Chapter 2

IRC

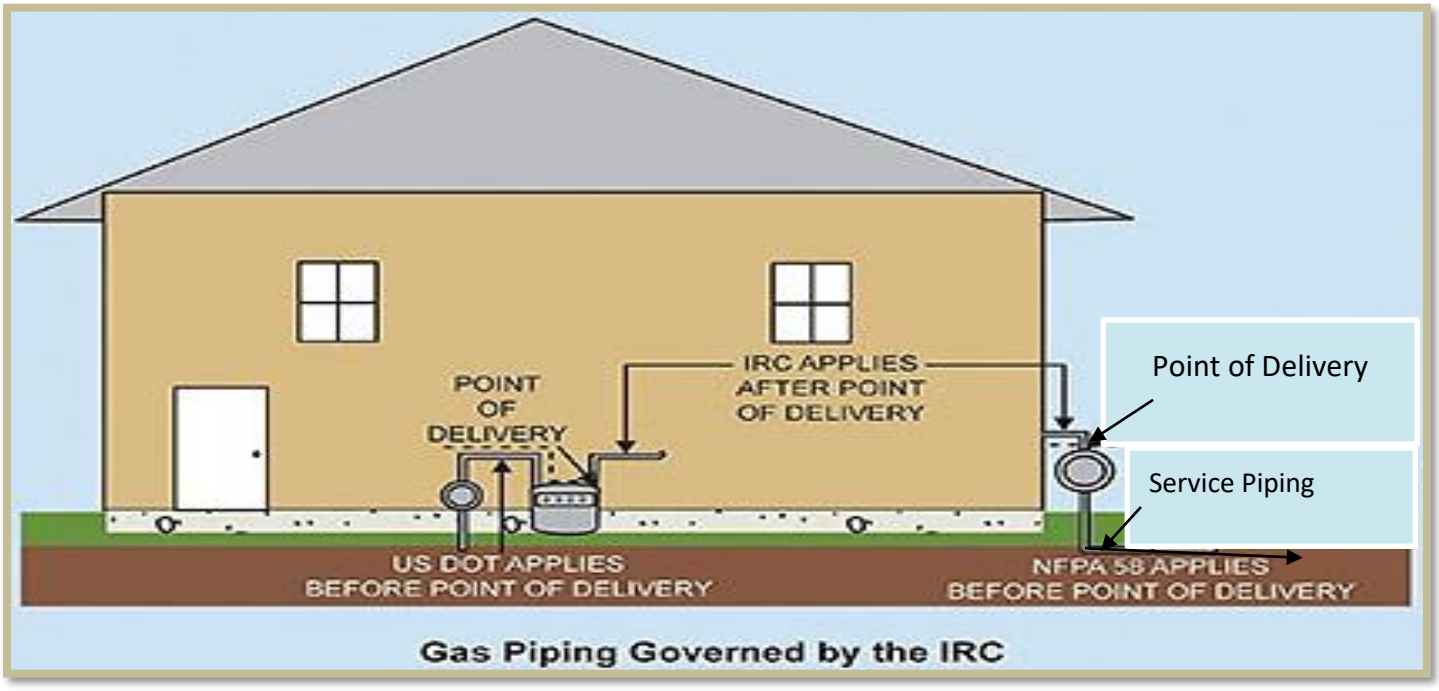
Chapter 24 Fuel Gas

CONGER
CONSTRUCTION
SERVICES, LLC.

Chapter 2 will lay a foundation for fuel-gas piping systems, fuel-gas utilization equipment with related accessories, venting systems and combustion air configurations most commonly used in one and two family dwellings/structures. Definitions, pipe sizing/layout and testing with inspections will be covered in the chapter with regulations of the IRC 2012.

This chapter shall not apply to the following:

1. Liquefied natural gas (LNG) installations
2. Temporary LP-Gas piping for building under construction or renovation that is not to become part of the permanent piping system.
3. Except as provided in Section G2412.1.1 gas piping, meters, gas pressure regulators, and other appurtenances used by the serving gas supplier in the distribution of gas, other than undiluted LP-gas.
4. Portable LP-gas equipment of all types that is not connected to a fixed fuel piping system.
5. Portable fuel cell appliances that are neither connected to a fixed system nor interconnected to a power grid.
6. Installation of hydrogen gas, LP-gas and compressed natural gas (CNG) systems on vehicles.



Service Piping: The piping and equipment between the street gas main and the gas piping system inlet, which is installed by and is under the control and maintenance of the serving gas supplier

Section G2403 General Definitions

AIR CONDITIONING, GAS FIRED. A gas-burning, automatically operated *appliance* for supplying cooled and/or dehumidified air or chilled liquid.

AIR, EXHAUST. Air being removed from any space or piece of *equipment* or *appliance* and conveyed directly to the atmosphere by means of openings or ducts.

AIR-HANDLING UNIT. A blower or fan used for the purpose of distributing supply air to a room, space or area.

AIR, MAKEUP. Air that is provided to replace air being exhausted.

ALTERATION. A change in a system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

ANODELESS RISER. A transition assembly in which plastic *piping* is installed and terminated above ground outside of a building.

APPLIANCE. Any apparatus or device that utilizes a fuel or raw material to produce light, heat, power, refrigeration or air conditioning.

APPLIANCE, AUTOMATICALLY CONTROLLED. Appliances equipped with an automatic *burner* ignition and safety shut-off device and other automatic devices, which accomplish complete turn-on and shut-off of the gas to the *main burner* or *burners*, and graduate the gas supply to the *burner* or *burners*, but do not affect complete shut-off of the gas.

APPLIANCE, FAN-ASSISTED COMBUSTION. An *appliance* equipped with an integral mechanical means to either draw or force products of *combustion* through the *combustion* chamber or heat exchanger.

APPLIANCE, UNVENTED. An *appliance* designed or installed in such a manner that the products of *combustion* are not conveyed by a vent or *chimney* directly to the outside atmosphere.

APPLIANCE, VENTED. An *appliance* designed and installed in such a manner that all of the products of *combustion* are conveyed directly from the *appliance* to the outside atmosphere through an *approved chimney* or vent system.

APPROVED. Acceptable to the *code official* or other authority having jurisdiction.

ATMOSPHERIC PRESSURE. The pressure of the weight of air and water vapor on the surface of the earth, approximately 14.7 pounds per square inch (psia) (101 kPa absolute) at sea level.

AUTOMATIC IGNITION. Ignition of gas at the *burner(s)* when the gas controlling device is turned on, including reignition if the flames on the *burner(s)* have been extinguished by means other than by the closing of the gas controlling device.

BAROMETRIC DRAFT REGULATOR. A balanced *damper* device attached to a *chimney,* vent *connector,* breeching or flue gas manifold to protect *combustion appliances* by controlling *chimney draft*. A double-acting *barometric draft regulator* is one whose balancing *damper* is free to move in either direction to protect *combustion appliances* from both excessive *draft* and backdraft.

BOILER, LOW-PRESSURE. A self-contained gas-fired *appliance* for supplying steam or hot water.

> **Hot water heating boiler.** A boiler in which no steam is generated, from which hot water is circulated for heating purposes and then returned to the boiler, and that operates at water pressures not exceeding 160 psig (1100 kPa gauge) and at water temperatures not exceeding 250°F (121°C) at or near the boiler outlet.
>
> **Hot water supply boiler.** A boiler, completely filled with water, which furnishes hot water to be used externally to itself, and that operates at water pressures not exceeding 160 psig (1100 kPa gauge) and at water temperatures not exceeding 250°F (121°C) at or near the boiler outlet.
>
> **Steam heating boiler.** A boiler in which steam is generated and that operates at a steam pressure not exceeding 15 psig (100 kPa gauge).

BONDING JUMPER. A conductor installed to electrically connect metallic *gas piping* to the grounding electrode system.

BRAZING. A metal joining process wherein coalescence is produced by the use of a nonferrous filler metal having a melting point above 1,000°F (538°C), but lower than that of the base metal being joined. The filler material is distributed between the closely fitted surfaces of the joint by capillary action.

BTU. Abbreviation for British thermal unit, which is the quantity of heat required to raise the temperature of 1 pound (454 g) of water 1°F (0.56°C) (1 *Btu* = 1055 J).

BURNER. A device for the final conveyance of the gas, or a mixture of gas and air, to the *combustion* zone.

Induced-draft. A *burner* that depends on *draft* induced by a fan that is an integral part of the *appliance* and is located downstream from the *burner*.

Power. A *burner* in which gas, air or both are supplied at pressures exceeding, for gas, the line pressure, and for air, *atmospheric pressure*, with this added pressure being applied at the *burner*.

CHIMNEY. A primarily vertical structure containing one or more flues, for the purpose of carrying gaseous products of *combustion* and air from an *appliance* to the outside atmosphere.

Factory-built chimney. A listed and labeled *chimney* composed of factory-made components, assembled in the field in accordance with manufacturer's instructions and the conditions of the listing.

Masonry chimney. A field-constructed *chimney* composed of solid masonry units, bricks, stones or concrete.

CLEARANCE. The minimum distance through air measured between the heat-producing surface of the mechanical *appliance*, device or *equipment* and the surface of the combustible material or assembly.

CLOTHES DRYER. An *appliance* used to dry wet laundry by means of heated air.

Type 1. Factory-built package, multiple production. Primarily used in the family living environment. Usually the smallest unit physically and in function output.

CODE. These regulations, subsequent amendments thereto, or any emergency rule or regulation that the administrative authority having jurisdiction has lawfully adopted.

CODE OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this *code*, or a duly authorized representative.

COMBUSTIBLE ASSEMBLY. Wall, floor, ceiling or other assembly constructed of one or more component materials that are not defined as noncombustible.

COMBUSTIBLE MATERIAL. Any material not defined as noncombustible.

COMBUSTION. In the context of this *code*, refers to the rapid oxidation of fuel accompanied by the production of heat or heat and light.

COMBUSTION AIR. Air necessary for complete *combustion* of a fuel, including theoretical air and excess air.

COMBUSTION CHAMBER. The portion of an *appliance* within which *combustion* occurs.

COMBUSTION PRODUCTS. Constituents resulting from the *combustion* of a fuel with the oxygen of the air, including the inert gases, but excluding excess air.

CONCEALED LOCATION. A location that cannot be accessed without damaging permanent parts of the building structure or finish surface. Spaces above, below or behind readily removable panels or doors shall not be considered as concealed.

CONCEALED PIPING. *Piping* that is located in a *concealed location* (see *"Concealed location"*).

CONDENSATE. The liquid that condenses from a gas (including flue gas) caused by a reduction in temperature or increase in pressure.

CONNECTOR, APPLIANCE (Fuel). Rigid metallic *pipe* and fittings, semirigid metallic *tubing* and fittings or a listed and labeled device that connects an *appliance* to the *gas piping system*.

CONNECTOR, CHIMNEY OR VENT. The *pipe* that connects an *appliance* to a *chimney* or vent.

CONTROL. A manual or automatic device designed to regulate the gas, air, water or electrical supply to, or operation of, a mechanical system.

CONVERSION BURNER. A unit consisting of a *burner* and its *controls* for installation in an *appliance* originally utilizing another fuel.

CUBIC FOOT. The amount of gas that occupies 1 *cubic foot* (0.02832 m^3) when at a temperature of 60°F (16°C), saturated with water vapor and under a pressure equivalent to that of 30 inches of mercury (101 kPa).

DAMPER. A manually or automatically controlled device to regulate *draft* or the rate of flow of air or *combustion* gases.

DECORATIVE GAS APPLIANCE, VENTED. A *vented appliance* wherein the primary function lies in the aesthetic effect of the flames.

DECORATIVE GAS APPLIANCES FOR INSTALLATION IN VENTED FIREPLACES. A *vented appliance* designed for installation within the fire chamber of a vented *fireplace*, wherein the primary function lies in the aesthetic effect of the flames.

DEMAND. The maximum amount of gas input required per unit of time, usually expressed in cubic feet per hour, or *Btu*/h (1 *Btu*/h = 0.2931 W).

DESIGN FLOOD ELEVATION. The elevation of the "design flood," including wave height, relative to the datum specified on the community's legally designated flood hazard map.

DILUTION AIR. Air that is introduced into a *draft hood* and is mixed with the *flue gases*.

DIRECT-VENT APPLIANCES. *Appliances* that are constructed and installed so that all air for *combustion* is derived directly from the outside atmosphere and all *flue gases* are discharged directly to the outside atmosphere.

DRAFT. The pressure difference existing between the *appliance* or any component part and the atmosphere, that causes a continuous flow of air and products of *combustion* through the gas passages of the *appliance* to the atmosphere.

Mechanical or induced draft. The pressure difference created by the action of a fan, blower or ejector that is located between the *appliance* and the *chimney* or vent termination.

Natural draft. The pressure difference created by a vent or *chimney* because of its height, and the temperature difference between the *flue gases* and the atmosphere.

DRAFT HOOD. A nonadjustable device built into an *appliance*, or made as part of the vent *connector* from an *appliance*, that is designed to (1) provide for ready escape of the *flue gases* from the *appliance* in the event of no *draft*, backdraft, or stoppage beyond the *draft hood*, (2) prevent a backdraft from entering the *appliance*, and (3) neutralize the effect of stack action of the *chimney* or gas vent upon operation of the *appliance*.

DRAFT REGULATOR. A device that functions to maintain a desired *draft* in the *appliance* by automatically reducing the *draft* to the desired value.

DRIP. The container placed at a low point in a system of *piping* to collect *condensate* and from which the *condensate* is removable.

DUCT FURNACE. A warm-air *furnace* normally installed in an air-distribution duct to supply warm air for heating. This definition shall apply only to a warm-air heating *appliance* that depends for air circulation on a blower not furnished as part of the *furnace*.

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.

EQUIPMENT. Apparatus and devices other than *appliances*.

EXCESS FLOW VALVE (EFV). A valve designed to activate when the fuel gas passing through it exceeds a prescribed flow rate.

EXTERIOR MASONRY CHIMNEYS. *Masonry chimneys* exposed to the outdoors on one or more sides below the roof line.

FIREPLACE. A fire chamber and hearth constructed of noncombustible material for use with solid fuels and provided with a *chimney*.

Masonry fireplace. A hearth and fire chamber of solid masonry units such as bricks, stones, listed masonry units or reinforced concrete, provided with a suitable *chimney*.

Factory-built fireplace. A *fireplace* composed of listed factory-built components assembled in accordance with the terms of listing to form the completed *fireplace*.

FLAME SAFEGUARD. A device that will automatically shut off the fuel supply to a *main burner* or group of *burners* when the means of ignition of such *burners* becomes inoperative, and when flame failure occurs on the *burner* or group of *burners*.

FLASHBACK ARRESTOR CHECK VALVE. A device that will prevent the backflow of one gas into the supply system of another gas and prevent the passage of flame into the gas supply system.

FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a floodplain subject to a 1 percent or greater chance of flooding in any given year.
2. This area designated as a *flood hazard area* on a community's flood hazard map, or otherwise legally designated.

FLOOR FURNACE. A completely self-contained *furnace* suspended from the floor of the space being heated, taking air for *combustion* from outside such space and with means for observing flames and lighting the *appliance* from such space.

FLUE, APPLIANCE. The passage(s) within an *appliance* through which *combustion products* pass from the *combustion chamber* of the *appliance* to the *draft hood* inlet opening on an *appliance* equipped with a *draft hood* or to the outlet of the *appliance* on an *appliance* not equipped with a *draft hood*.

FLUE COLLAR. That portion of an *appliance* designed for the attachment of a *draft hood*, *vent connector* or venting system.

FLUE GASES. Products of *combustion* plus excess air in *appliance flues* or heat exchangers.

FLUE LINER (LINING). A system or material used to form the inside surface of a flue in a *chimney* or vent, for the purpose of protecting the surrounding structure from the effects of *combustion products* and for conveying *combustion products* without leakage to the atmosphere.

FUEL GAS. A natural gas, manufactured gas, *liquefied petroleum gas* or mixtures of these gases.

FUEL GAS UTILIZATION EQUIPMENT. See *"Appliance."*

FURNACE. A completely self-contained heating unit that is designed to supply heated air to spaces remote from or adjacent to the *appliance* location.

FURNACE, CENTRAL FURNACE. A self-contained *appliance* for heating air by transfer of heat of *combustion* through metal to the air, and designed to supply heated air through ducts to spaces remote from or adjacent to the *appliance* location.

FURNACE PLENUM. An air compartment or chamber to which one or more ducts are connected and which forms part of an air distribution system.

GAS CONVENIENCE OUTLET. A permanently mounted, manually operated device that provides the means for connecting an *appliance* to, and disconnecting an *appliance* from, the gas supply *piping*. The device includes an integral, manually operated *valve* with a nondisplaceable *valve* member and is designed so that disconnection of an *appliance* only occurs when the manually operated *valve* is in the closed position.

GAS PIPING. An installation of *pipe*, *valves* or fittings installed on a premises or in a building and utilized to convey *fuel gas*.

HAZARDOUS LOCATION. Any location considered to be a fire hazard for flammable vapors, dust, combustible fibers or other highly combustible substances. The location is not necessarily categorized in the *International Building Code* as a high-hazard use group classification.

HOUSE PIPING. See *"Piping system."*

IGNITION PILOT. A *pilot* that operates during the lighting cycle and discontinues during *main burner* operation.

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.

INFRARED RADIANT HEATER. A heater which directs a substantial amount of its energy output in the form of infrared radiant energy into the area to be heated. Such heaters are of either the vented or unvented type.

JOINT, FLARED. A metal-to-metal compression joint in which a conical spread is made on the end of a tube that is compressed by a flare nut against a mating flare.

JOINT, MECHANICAL. A general form of gas-tight joints obtained by the joining of metal parts through a positive-holding mechanical construction, such as press joint, flanged joint, threaded joint, flared joint or compression joint.

JOINT, PLASTIC ADHESIVE. A joint made in thermoset *plastic piping* by the use of an adhesive substance which forms a continuous bond between the mating surfaces without dissolving either one of them.

LEAK CHECK. An operation performed on a *gas piping system* to verify that the system does not leak.

LIQUEFIED PETROLEUM GAS or LPG (LP-GAS). *Liquefied petroleum gas* composed predominately of propane, propylene, butanes or butylenes, or mixtures thereof that is gaseous under normal atmospheric conditions, but is capable of being liquefied under moderate pressure at normal temperatures.

LIVING SPACE. Space within a *dwelling unit* utilized for living, sleeping, eating, cooking, bathing, washing and sanitation purposes.

LOG LIGHTER, GAS-FIRED. A manually operated solid-fuel ignition *appliance* for installation in a vented solid-fuel-burning *fireplace*.

MAIN BURNER. A device or group of devices essentially forming an integral unit for the final conveyance of gas or a mixture of gas and air to the *combustion* zone, and on which *combustion* takes place to accomplish the function for which the *appliance* is designed.

METER. The instrument installed to measure the volume of gas delivered through it.

MODULATING. Modulating or throttling is the action of a *control* from its maximum to minimum position in either predetermined steps or increments of movement as caused by its actuating medium.

NONCOMBUSTIBLE MATERIALS. Materials that, when tested in accordance with ASTM E 136, have at least three of four specimens tested meeting all of the following criteria:

1. The recorded temperature of the surface and interior thermocouples shall not at any time during the test rise more than 54°F (30°C) above the furnace temperature at the beginning of the test.

2. There shall not be flaming from the specimen after the first 30 seconds.

3. If the weight loss of the specimen during testing exceeds 50 percent, the recorded temperature of the surface and interior thermocouples shall not at any time during the test rise above the furnace air temperature at the beginning of the test, and there shall not be flaming of the specimen.

OFFSET (VENT). A combination of *approved* bends that make two changes in direction bringing one section of the vent out of line, but into a line parallel with the other section.

OUTLET. The point at which a gas-fired *appliance* connects to the *gas piping system*.

OXYGEN DEPLETION SAFETY SHUTOFF SYSTEM (ODS). A system designed to act to shut off the gas supply to the main and *pilot burners* if the oxygen in the surrounding atmosphere is reduced below a predetermined level.

PILOT. A small flame that is utilized to ignite the gas at the *main burner* or *burners*.

PIPING. Where used in this *code*, *"piping"* refers to either *pipe* or *tubing*, or both.

Pipe. A rigid conduit of iron, steel, copper, brass or plastic.

Tubing. Semirigid conduit of copper, aluminum, plastic or steel.

PIPING SYSTEM. All fuel *piping, valves* and fittings from the outlet of the *point of delivery* to the outlets of the *appliance* shutoff valves.

PLASTIC, THERMOPLASTIC. A plastic that is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

POINT OF DELIVERY. For natural gas systems, the *point of delivery* is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a valve is provided at the outlet of the service meter assembly, such valve shall be considered to be downstream of the *point of delivery*. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the service pressure regulator, exclusive of line gas regulators, in the system.

PRESSURE DROP. The loss in pressure due to friction or obstruction in pipes, *valves*, fittings, *regulators* and *burners*.

PRESSURE TEST. An operation performed to verify the gas-tight integrity of *gas piping* following its installation or modification.

READY ACCESS (TO). That which enables a device, *appliance* or *equipment* to be directly reached, without requiring the removal or movement of any panel, door or similar obstruction. (See "Access.")

REGULATOR. A device for controlling and maintaining a uniform gas supply pressure, either pounds-to-inches water column (MP *regulator*) or inches-to-inches water column (*appliance regulator*).

REGULATOR, GAS APPLIANCE. A *pressure regulator* for controlling pressure to the manifold of the gas *appliance*.

REGULATOR, LINE GAS PRESSURE. A device placed in a gas line between the *service pressure regulator* and the *appliance* for controlling, maintaining or reducing the pressure in that portion of the *piping system* downstream of the device.

REGULATOR, MEDIUM-PRESSURE (MP Regulator). A line *pressure regulator* that reduces gas pressure from the range of greater than 0.5 psig (3.4 kPa) and less than or equal to 5 psig (34.5 kPa) to a lower pressure.

REGULATOR, PRESSURE. A device placed in a gas line for reducing, controlling and maintaining the pressure in that portion of the *piping system* downstream of the device.

REGULATOR, SERVICE PRESSURE. For natural gas systems, a device installed by the serving gas supplier to reduce and limit the service line pressure to delivery pressure. For undiluted liquefied petroleum gas systems, the regulator located upstream from all line gas pressure regulators, where installed, and downstream from any first stage or a high pressure regulator in the system.

RELIEF OPENING. The opening provided in a *draft hood* to permit the ready escape to the atmosphere of the flue products from the *draft hood* in the event of no *draft*, backdraft or stoppage beyond the *draft hood*, and to permit air into the *draft hood* in the event of a strong *chimney* updraft.

RELIEF VALVE (DEVICE). A safety *valve* designed to forestall the development of a dangerous condition by relieving either pressure, temperature or vacuum in the hot water supply system.

RELIEF VALVE, PRESSURE. An *automatic valve* which opens and closes a *relief vent*, depending on whether the pressure is above or below a predetermined value.

RELIEF VALVE, TEMPERATURE.

> **Manual reset type.** A *valve* which automatically opens a *relief* vent at a predetermined temperature and which must be manually returned to the closed position.
>
> **Reseating or self-closing type.** An *automatic valve* which opens and closes a *relief* vent, depending on whether the temperature is above or below a predetermined value.

RELIEF VALVE, VACUUM. A *valve* that automatically opens and closes a vent for relieving a vacuum within the hot water supply system, depending on whether the vacuum is above or below a predetermined value.

RISER, GAS. A vertical *pipe* supplying *fuel gas*.

ROOM HEATER, UNVENTED. See *"Unvented room heater."*

ROOM HEATER, VENTED. A free-standing gas-fired heating unit used for direct heating of the space in and adjacent to that in which the unit is located. (See also *"Vented room heater."*)

SAFETY SHUTOFF DEVICE. See *"Flame safeguard."*

SHAFT. An enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and the roof.

SPECIFIC GRAVITY. As applied to gas, *specific gravity* is the ratio of the weight of a given volume to that of the same volume of air, both measured under the same condition.

THERMOSTAT.

> **Electric switch type.** A device that senses changes in temperature and controls electrically, by means of separate components, the flow of gas to the *burner(s)* to maintain selected temperatures.

Integral gas valve type. An automatic device, actuated by temperature changes, designed to control the gas supply to the *burner(s)* in order to maintain temperatures between predetermined limits, and in which the thermal actuating element is an integral part of the device.

1. Graduating thermostat. A *thermostat* in which the motion of the *valve* is approximately in direct proportion to the effective motion of the thermal element induced by temperature change.

2. Snap-acting thermostat. A *thermostat* in which the thermostatic valve travels instantly from the closed to the open position, and vice versa.

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.

THIRD-PARTY TESTED. Procedure by which an approved testing laboratory provides documentation that a product, material or system conforms to specified requirements.

TRANSITION FITTINGS, PLASTIC TO STEEL. An adapter for joining plastic *pipe* to steel *pipe*. The purpose of this fitting is to provide a permanent, pressure-tight connection between two materials that cannot be joined directly one to another.

UNIT HEATER.

High-static pressure type. A self-contained, automatically controlled, *vented appliance* having integral means for circulation of air against 0.2 inch w.c. (50 Pa) or greater static pressure. Such *appliance* is equipped with provisions for attaching an outlet air duct and, where the *appliance* is for indoor installation remote from the space to be heated, is also equipped with provisions for attaching an inlet air duct.

Low-static pressure type. A self-contained, automatically controlled, *vented appliance*, intended for installation in the space to be heated without the use of ducts, having integral means for circulation of air. Such units are allowed to be equipped with louvers or face extensions made in accordance with the manufacturer's specifications.

UNVENTED ROOM HEATER. An unvented heating *appliance* designed for stationary installation and utilized to provide comfort heating. Such *appliances* provide radiant heat or convection heat by gravity or fan circulation directly from the heater and do not utilize ducts.

VALVE. A device used in *piping* to control the gas supply to any section of a system of *piping* or to an *appliance*.

Appliance shutoff. A *valve* located in the *piping system*, used to isolate individual *appliances* for purposes such as service or replacement.

Automatic. An automatic or semiautomatic device consisting essentially of a *valve* and an operator that control the gas supply to the *burner(s)* during operation of an *appliance*. The operator shall be actuated by application of gas pressure on a flexible diaphragm, by electrical means, by mechanical means or by other *approved* means.

Automatic gas shutoff. A *valve* used in conjunction with an automatic gas shutoff device to shut off the gas supply to a water heating system. It shall be constructed integrally with the gas shutoff device or shall be a separate assembly.

Individual main burner. A *valve* that controls the gas supply to an individual *main burner*.

Main burner control. A *valve* that controls the gas supply to the *main burner* manifold.

Manual main gas-control. A manually operated *valve* in the gas line for the purpose of completely turning on or shutting off the gas supply to the *appliance*, except to a *pilot* or pilots that have independent shutoff.

Manual reset. An automatic shutoff *valve* installed in the gas supply *piping* and set to shut off when unsafe conditions occur. The device remains closed until manually reopened.

Service shutoff. A *valve*, installed by the serving gas supplier between the service *meter* or source of supply and the customer *piping system,* to shut off the entire *piping system*.

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*.

Special gas vent. A vent listed and labeled for use with listed Category II, III and IV gas *appliances*.

Type B vent. A vent listed and labeled for use with *appliances* with *draft hoods* and other Category I *appliances* that are listed for use with Type B vents.

Type BW vent. A vent listed and labeled for use with wall *furnaces*.

Type L vent. A vent listed and labeled for use with *appliances* that are listed for use with Type L or Type B vents.

VENT CONNECTOR. See "Connector."

VENT PIPING.

Breather. *Piping* run from a pressure-regulating device to the outdoors, designed to provide a reference to *atmospheric pressure*. If the device incorporates an integral pressure *relief* mechanism, a breather vent can also serve as a *relief* vent.

Relief. *Piping* run from a pressure-regulating or pressure-limiting device to the outdoors, designed to provide for the safe venting of gas in the event of excessive pressure in the *gas piping system*.

VENTED GAS APPLIANCE CATEGORIES. *Appliances* that are categorized for the purpose of vent selection are classified into the following four categories:

Category I. An *appliance* that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive *condensate* production in the vent.

Category II. An *appliance* that operates with a nonpositive *vent* static pressure and with a vent gas temperature that is capable of causing excessive *condensate* production in the vent.

Category III. An *appliance* that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive *condensate* production in the vent.

Category IV. An *appliance* that operates with a positive vent static pressure and with a vent gas temperature that is capable of causing excessive *condensate* production in the vent.

VENTED ROOM HEATER. A vented self-contained, free-standing, nonrecessed *appliance* for furnishing warm air to the space in which it is installed, directly from the heater without duct connections.

VENTED WALL FURNACE. A self-contained *vented appliance* complete with grilles or equivalent, designed for incorporation in or permanent attachment to the structure of a building, mobile home or travel trailer, and furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing. This definition shall exclude *floor furnaces, unit heaters* and *central furnaces* as herein defined.

VENTING SYSTEM. A continuous open passageway from the *flue collar* or *draft hood* of an *appliance* to the outside 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.

WATER HEATER. Any heating *appliance* or *equipment* that heats potable water and supplies such water to the potable hot water distribution system.

WALL HEATER, UNVENTED TYPE. A room heater of the type designed for insertion in or attachment to a wall or partition. Such heater does not incorporate concealed venting arrangements in its construction and discharges all products of *combustion* through the front into the room being heated.

Section G2404 General

G2404.3 Listed and Labeled. Appliance regulated by this code shall be listed and labeled for the application in ehich theya re used otherwise approved in accordance with Section R104.11. The approval of unlisted appliances in accordance with Section R104.11 shall be based upon approved engineering evaluation.

Section G2406 Appliance Location

G2406.1 (303.1) General.
Appliances shall be located as required by this section, specific requirements elsewhere in this *code* and the conditions of the *equipment* and *appliance* listing.

G2406.2 (303.3) Prohibited locations.
Appliances shall not be located in sleeping rooms, bathrooms, toilet rooms, storage closets or surgical rooms, or in a space that opens only into such rooms or spaces, except where the installation complies with one of the following:

1. The *appliance* is a direct-vent *appliance* installed in accordance with the conditions of the listing and the manufacturer's instructions.

2. *Vented room heaters*, wall *furnaces*, vented decorative *appliances*, vented gas *fireplaces*, vented gas *fireplace* heaters and decorative *appliances* for installation in vented solid fuel-burning *fireplaces* are installed in rooms that meet the required volume criteria of Section G2407.5.

3. A single wall-mounted *unvented room heater* is installed in a bathroom and such *unvented room heater* is equipped as specified in Section G2445.6 and has an input rating not greater than 6,000 *Btu*/h (1.76 kW). The bathroom shall meet the required volume criteria of Section G2407.5.

4. A single wall-mounted *unvented room heater* is installed in a bedroom and such *unvented room heater* is equipped as specified in Section G2445.6 and has an input rating not greater than 10,000 *Btu*/h (2.93 kW). The bedroom shall meet the required volume criteria of Section G2407.5.

5. The *appliance* is installed in a room or space that opens only into a bedroom or bathroom, and such room or space is used for no other purpose and is provided with a solid weather-stripped door equipped with an *approved* self-closing device. All *combustion air* shall be taken directly from the outdoors in accordance with Section G2407.6.

G2406.3 (303.6) Outdoor locations.
Appliances installed in outdoor locations shall be either listed for outdoor installation or provided with protection from outdoor environmental factors that influence the operability, durability and safety of the *appliance*.

Section G2407 Combustion, Ventilation, and Dilution Air

G2407.1 (304.1) General.
Air for *combustion*, ventilation and dilution of *flue gases* for *appliances* installed in buildings shall be provided by application of one of the methods prescribed in Sections G2407.5 through G2407.9. Where the requirements of Section G2407.5 are not met, outdoor air shall be introduced in accordance with one of the methods prescribed in Sections G2407.6 through G2407.9. *Direct-vent appliances*, gas *appliances* of other than *natural draft* design and vented gas *appliances* other than Category I shall be provided with *combustion*, ventilation and *dilution air* in accordance with the *appliance* manufacturer's instructions.

Exception: *Type 1 clothes dryers* that are provided with *makeup air* in accordance with Section G2439.4.

G2407.2 (304.2) Appliance location.
Appliances shall be located so as not to interfere with proper circulation of *combustion*, ventilation and *dilution air*.

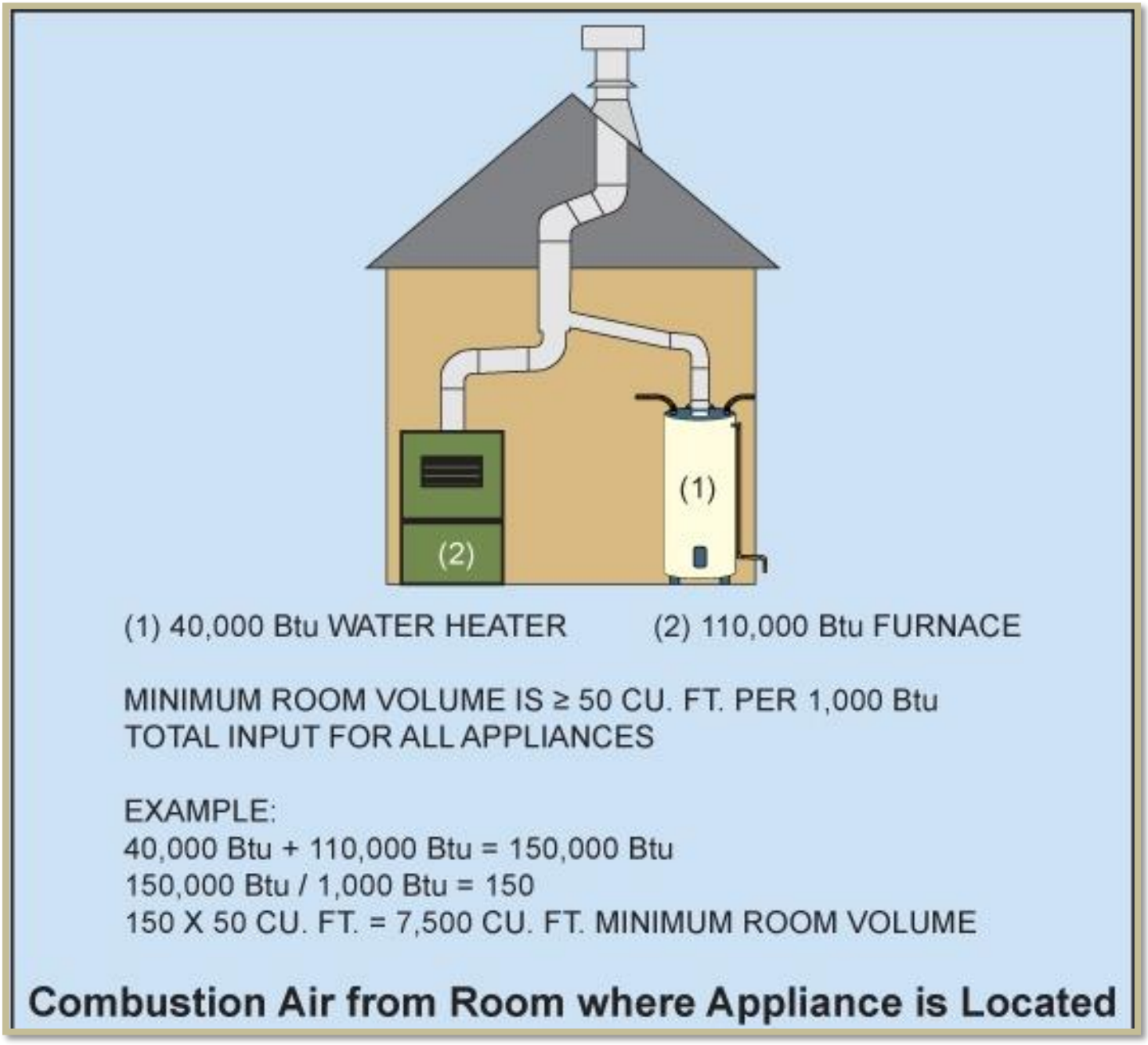
G2407.3 (304.3) Draft hood/regulator location.
Where used, a *draft hood* or a *barometric draft regulator* shall be installed in the same room or enclosure as the *appliance* served so as to prevent any difference in pressure between the hood or *regulator* and the *combustion air* supply.

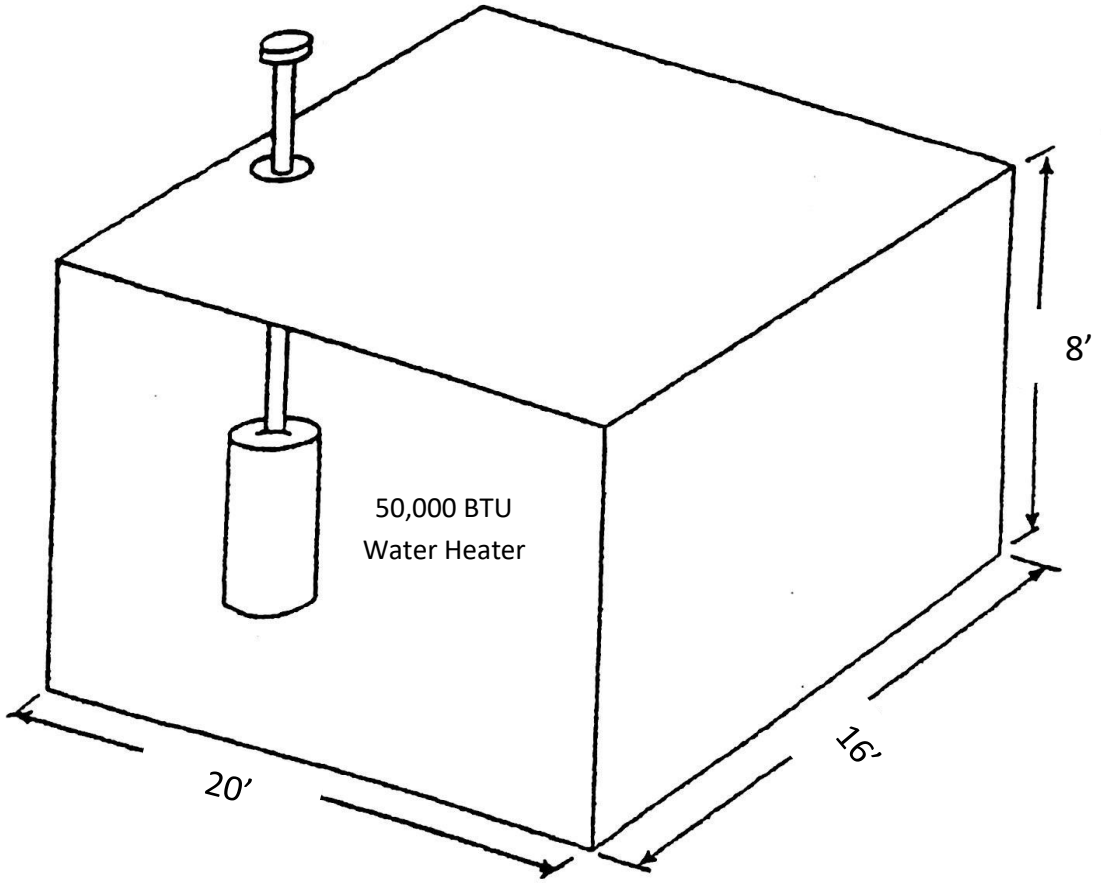
G2407.4 (304.4) Makeup air provisions.
Where exhaust fans, *clothes dryers* and kitchen ventilation systems interfere with the operation of *appliances, makeup air* shall be provided.

G2407.5 (304.5) Indoor combustion air.
The required volume of indoor air shall be determined in accordance with Section G2407.5.1 or G2407.5.2, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), Section G2407.5.2 shall be used. The total required volume shall be the sum of the required volume calculated for all *appliances* located within the space. Rooms communicating directly with the space in which the *appliances* are installed through openings not furnished with doors, and through *combustion air* openings sized and located in accordance with Section G2407.5.3, are considered to be part of the required volume.

G2407.5.1 Standard Method.

The minimum required volume shall be 50 cubic feet per 1,000 BTU/h.





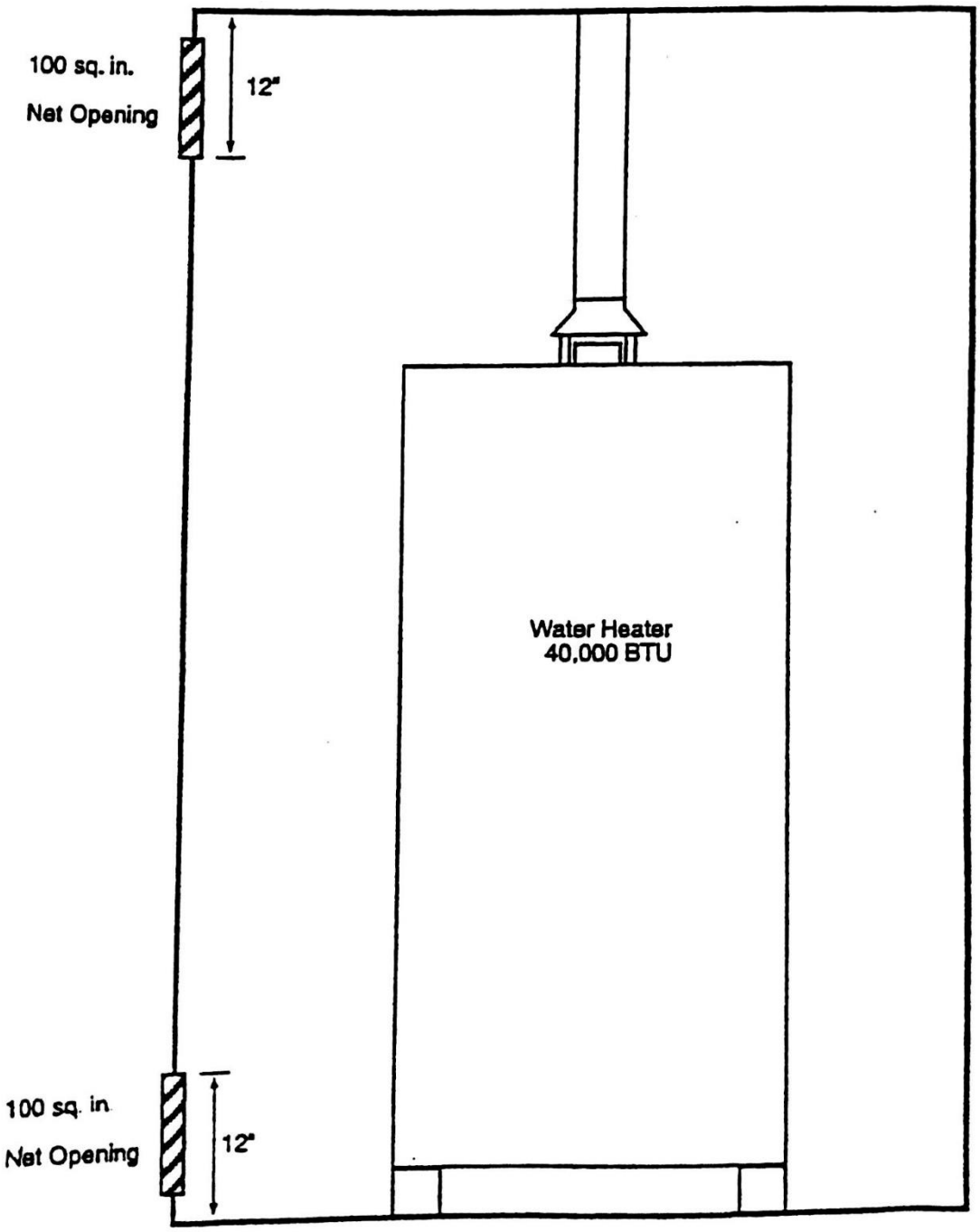
50 Cubic Ft. 1,000 BTU Input

50 X 50,000 = 50 X 50 = 2,500 CU ft. (required)

20 ft. X 16 ft. = 320 ft. (CU) X 8 ft. (ceiling height) = 2,560 CU ft.

This size room meets the 2,500 CU ft. requirement with 2,560 CU ft.

This is an ***Unconfined Space and Ordinary Tightness (All-Air from Interior Space)***


100 sq. in.
Net Opening
12"
Water Heater
40,000 BTU
100 sq. in.
Net Opening
12"

G2407.5.3 (304.5.3) Indoor opening size and location.
Openings used to connect indoor spaces shall be sized and located in accordance with Sections G2407.5.3.1 and G2407.5.3.2 (see Figure G2407.5.3).

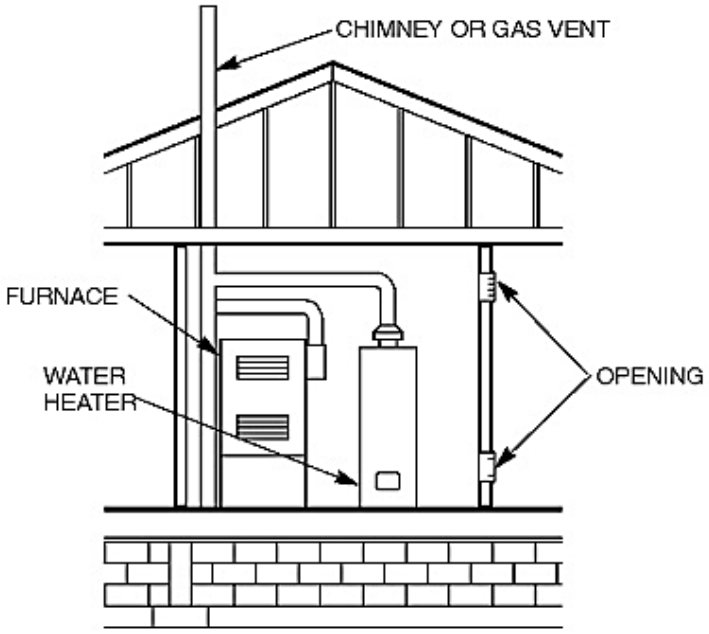


FIGURE G2407.5.3 (304.5.3)
ALL AIR FROM INSIDE THE BUILDING
(see Section G2407.5.3)

G2407.5.3.1 (304.5.3.1) Combining spaces on the same story.
Each opening shall have a minimum free area of 1 square inch per 1,000 *Btu*/h (2,200 mm^2/kW) of the total input rating of all *appliances* in the space, but not less than 100 square inches (0.06 m^2). One opening shall commence within 12 inches (305 mm) of the top and one opening shall commence within 12 inches (305 mm) of the bottom of the enclosure. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

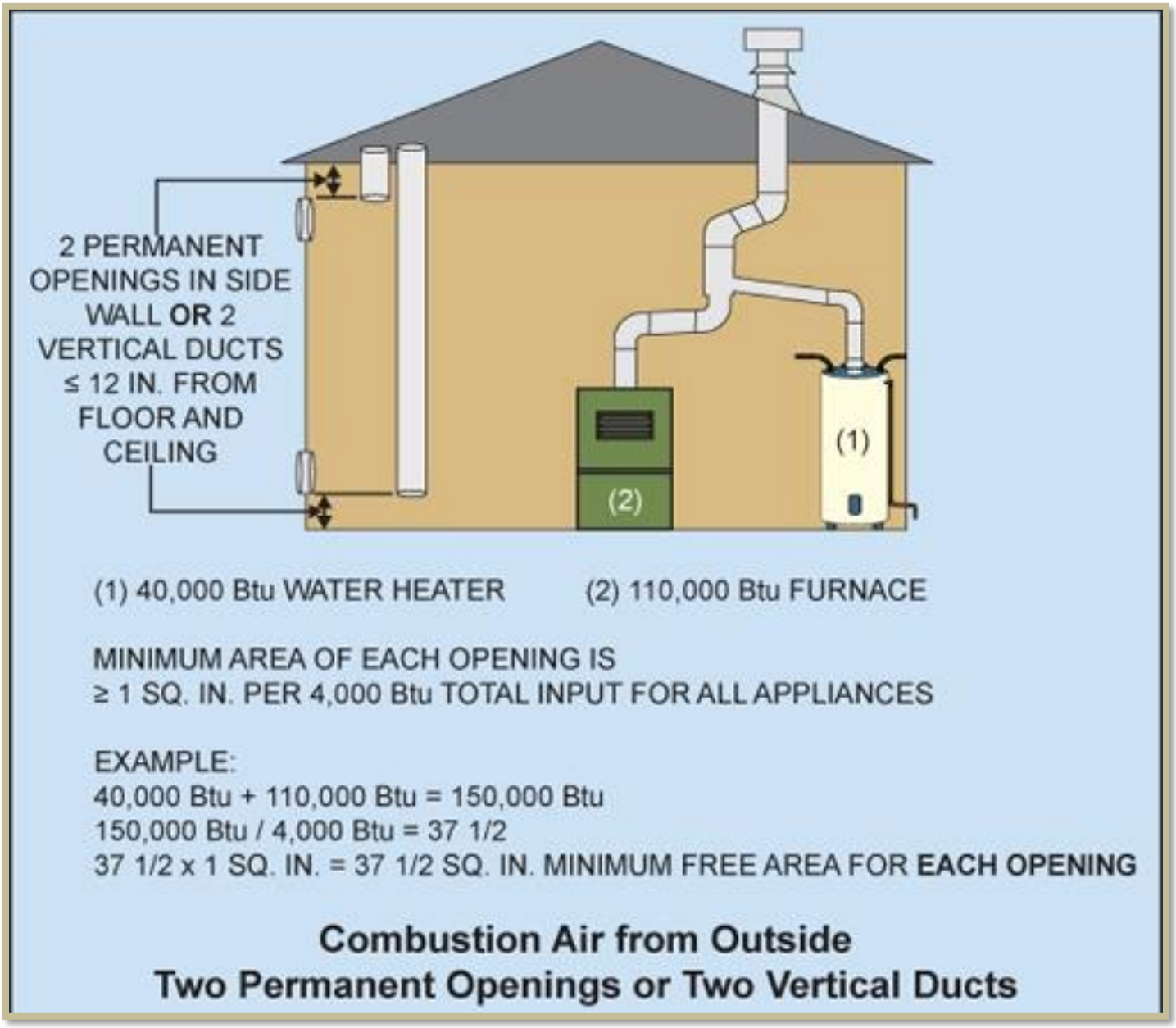
G2407.5.3.2 (304.5.3.2) Combining spaces in different stories.
The volumes of spaces in different stories shall be considered as communicating spaces where such spaces are connected by one or more openings in doors or floors having a total minimum free area of 2 square inches per 1,000 *Btu*/h (4402 mm^2/kW) of total input rating of all *appliances*.

G2407.6 (304.6) Outdoor combustion air.
Outdoor *combustion* air shall be provided through opening(s) to the outdoors in accordance with Section G2407.6.1 or G2407.6.2. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

G2407.6.1 (304.6.1) Two-permanent-openings method.
Two permanent openings, one commencing within 12 inches (305 mm) of the top and one commencing within 12 inches (305 mm) of the bottom of the enclosure, shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces that freely communicate with the outdoors.

Where directly communicating with the outdoors, or where communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 *Btu*/h (550 mm^2/kW) of total input rating of all *appliances* in the enclosure [see Figures G2407.6.1(1) and G2407.6.1(2)].

Where communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of not less than 1 square inch per 2,000 *Btu*/h (1,100 mm^2/kW) of total input rating of all *appliances* in the enclosure [see Figure G2407.6.1(3)].


2 PERMANENT OPENINGS IN SIDE WALL OR 2 VERTICAL DUCTS ≤ 12 IN. FROM FLOOR AND CEILING
(1)
(2)
(1) 40,000 Btu WATER HEATER
(2) 110,000 Btu FURNACE
MINIMUM AREA OF EACH OPENING IS
≥ 1 SQ. IN. PER 4,000 Btu TOTAL INPUT FOR ALL APPLIANCES
EXAMPLE:
40,000 Btu + 110,000 Btu = 150,000 Btu
150,000 Btu / 4,000 Btu = 37 1/2
37 1/2 x 1 SQ. IN. = 37 1/2 SQ. IN. MINIMUM FREE AREA FOR EACH OPENING
Combustion Air from Outside
Two Permanent Openings or Two Vertical Ducts

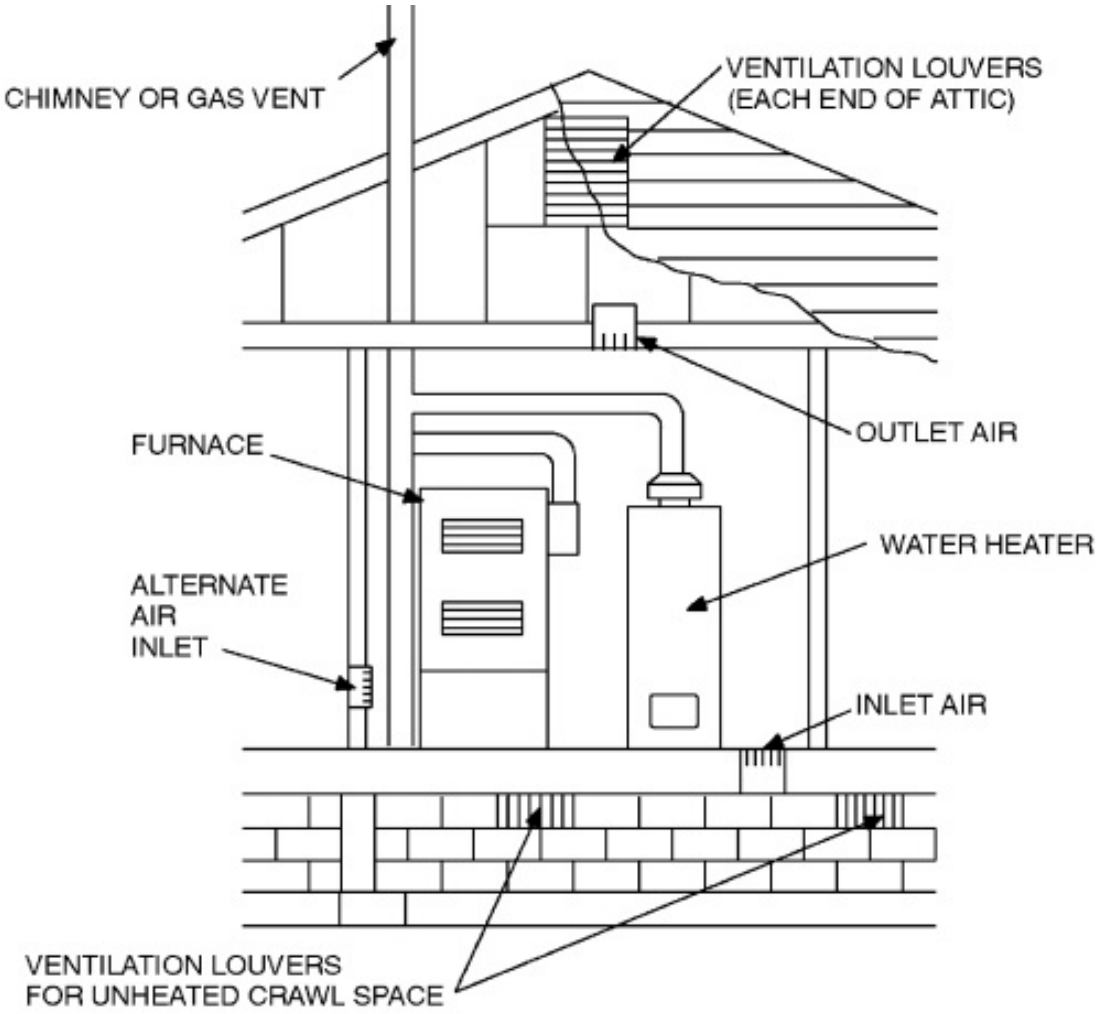


FIGURE G2407.6.1(1) [304.6.1(1)]
ALL AIR FROM OUTDOOR-INLET AIR FROM VENTILATED CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC
(see Section G2407.6.1)

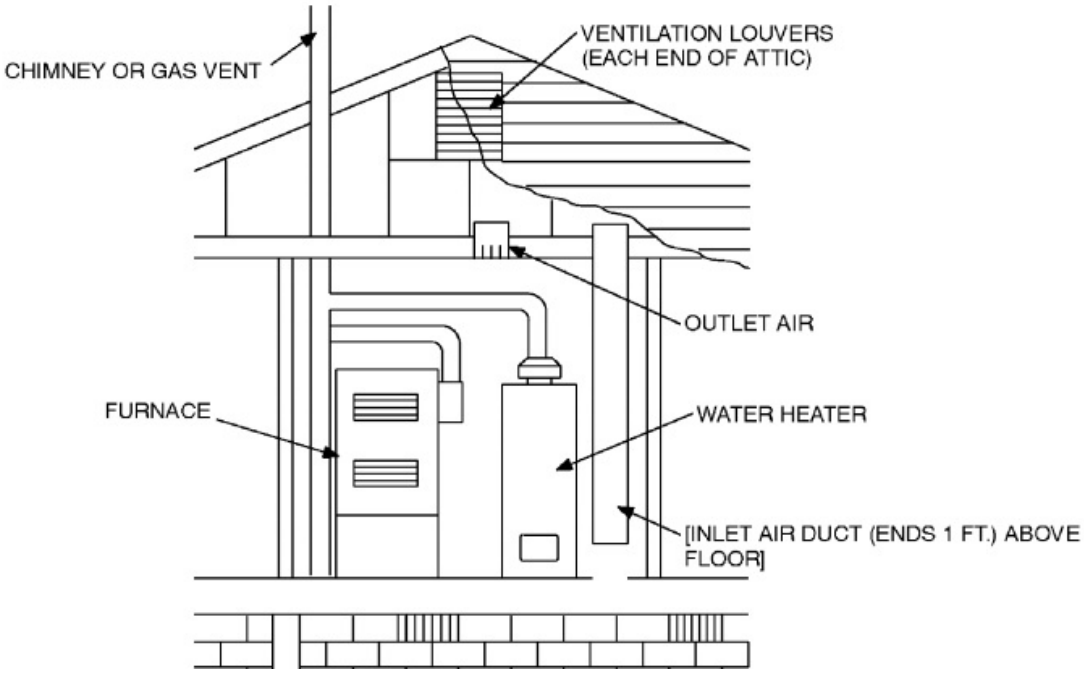


FIGURE G2407.6.1(2) [304.6.1(2)]
ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC (see Section G2407.6.1)

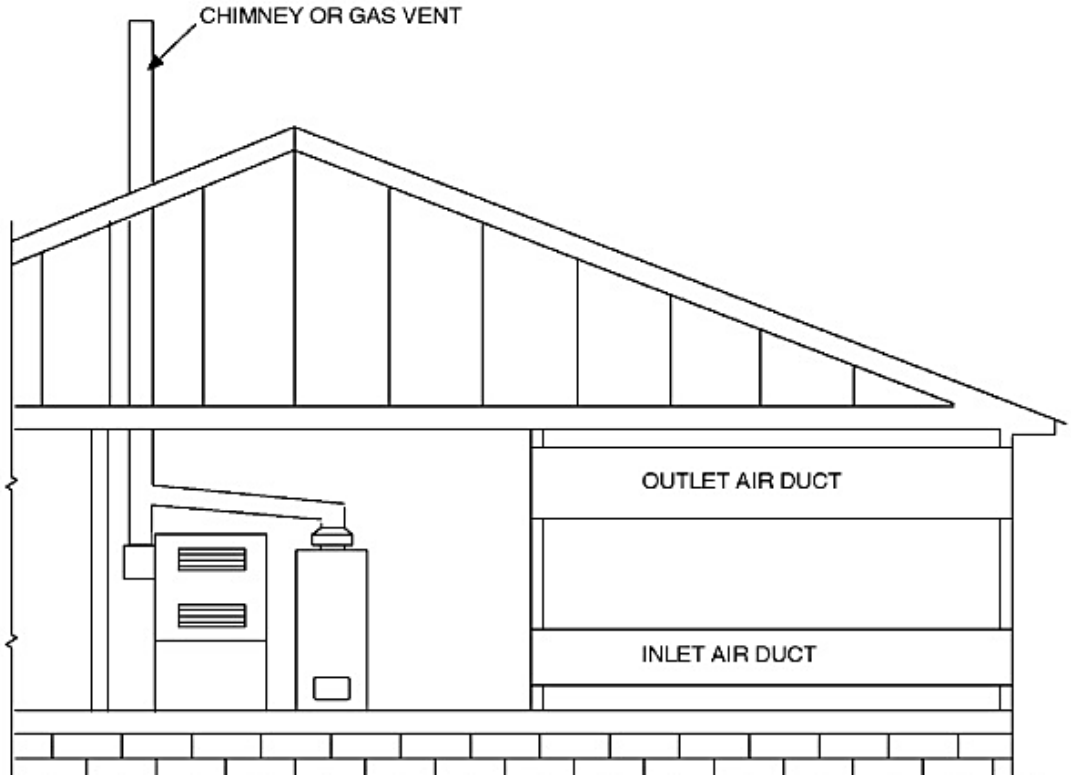
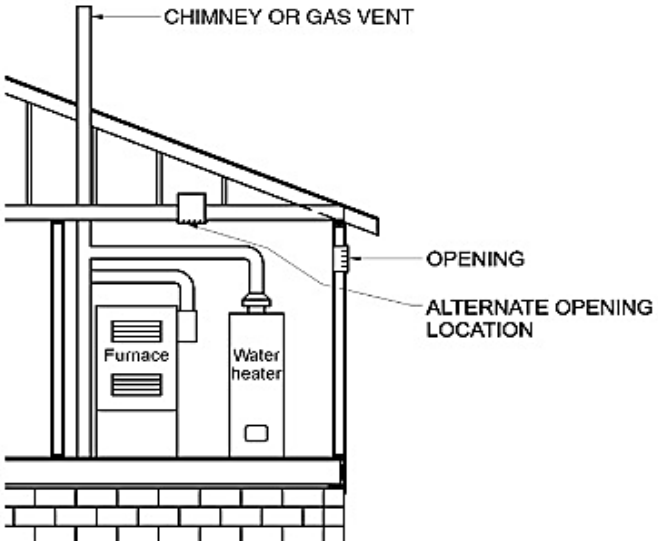


FIGURE G2407.6.1(3) [304.6.1(3)]
ALL AIR FROM OUTDOORS (see Section G2407.6.1)

G2407.6.2 (304.6.2) One-permanent-opening method.
One permanent opening, commencing within 12 inches (305 mm) of the top of the enclosure, shall be provided. The *appliance* shall have *clearances* of at least 1 inch (25 mm) from the sides and back and 6 inches (152 mm) from the front of the *appliance*. The opening shall directly communicate with the outdoors or through a vertical or horizontal duct to the outdoors, or spaces that freely communicate with the outdoors (see Figure G2407.6.2) and shall have a minimum free area of 1 square inch per 3,000 *Btu*/h (734 mm^2/kW) of the total input rating of all *appliances* located in the enclosure and not less than the sum of the areas of all *vent connectors* in the space.



G2407.10 (304.10) Louvers and grilles.
The required size of openings for *combustion*, ventilation and *dilution air* shall be based on the net free area of each opening. Where the free area through a design of louver, grille or screen is known, it shall be used in calculating the size opening required to provide the free area specified. Where the design and free area of louvers and grilles are not known, it shall be assumed that wood louvers will have 25-percent free area and metal louvers and grilles will have 75-percent free area. Screens shall have a mesh size not smaller than $^1/_4$ inch (6.4 mm). Nonmotorized louvers and grilles shall be fixed in the open position. Motorized louvers shall be interlocked with the *appliance* so that they are proven to be in the full open position prior to *main burner* ignition and during *main burner* operation. Means shall be provided to prevent the *main burner* from igniting if the louvers fail to open during *burner* start-up and to shut down the *main burner* if the louvers close during operation.

SECTION G2408 (305)
INSTALLATION

G2408.1 (305.1) General.
Equipment and *appliances* shall be installed as required by the terms of their approval, in accordance with the conditions of listing, the manufacturer's instructions and this *code*. Manufacturer's installation instructions shall be available on the job site at the time of inspection. Where a *code* provision is less restrictive than the conditions of the listing of the *equipment* or *appliance* or the manufacturer's installation instructions, the conditions of the listing and the manufacturer's installation instructions shall apply.

Unlisted *appliances approved* in accordance with Section G2404.3 shall be limited to uses recommended by the manufacturer and shall be installed in accordance with the manufacturer's instructions, the provisions of this *code* and the requirements determined by the *code official*.

G2408.2 (305.3) Elevation of ignition source.
Equipment and *appliances* having an *ignition source* shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor in *hazardous locations* and public garages, private garages, repair garages, motor fuel-dispensing facilities and parking garages. For the purpose of this section, rooms or spaces that are not part of the *living space* of a *dwelling unit* and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

Exception: Elevation of the *ignition source* is not required for *appliances* that are listed as flammable vapor ignition resistant.

G2408.2.1 (305.3.1) Installation in residential garages.
In residential garages where *appliances* are installed in a separate, enclosed space having access only from outside of the garage, such *appliances* shall be permitted to be installed at floor level, provided that the required *combustion air* is taken from the exterior of the garage.

G2408.3 (305.5) Private garages.
Appliances located in private garages shall be installed with a minimum *clearance* of 6 feet (1829 mm) above the floor.

Exception: The requirements of this section shall not apply where the *appliances* are protected from motor vehicle impact and installed in accordance with Section G2408.2.

G2408.4 (305.7) Clearances from grade.
Equipment and *appliances* installed at grade level shall be supported on a level concrete slab or other *approved* material extending not less than 3 inches (76 mm) above adjoining grade or shall be suspended not less than 6 inches (152 mm) above adjoining grade. Such supports shall be installed in accordance with the manufacturer's installation instructions.

G2408.5 (305.8) Clearances to combustible construction.
Heat-producing *equipment* and *appliances* shall be installed to maintain the required clearances to combustible construction as specified in the listing and manufacturer's instructions. Such *clearances* shall be reduced only in accordance with Section G2409. *Clearances* to combustibles shall include such considerations as door swing, drawer pull, overhead projections or shelving and window swing. Devices, such as door stops or limits and closers, shall not be used to provide the required *clearances*.

G2408.6 (305.12) Avoid strain on gas piping.
Appliances shall be supported and connected to the *piping* so as not to exert undue strain on the connections.

SECTION G2412 (401)
GENERAL

G2412.1 (401.1) Scope.
This section shall govern the design, installation, modification and maintenance of *piping systems*. The applicability of this *code* to *piping systems* extends from the *point of delivery* to the connections with the *appliances* and includes the design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance of such *piping systems*.

G2412.1.1 (401.1.1) Utility piping systems located within buildings.
Utility service *piping* located within buildings shall be installed in accordance with the structural safety and fire protection provisions of this *code*.

G2412.2 (401.2) Liquefied petroleum gas storage.
The storage system for *liquefied petroleum gas* shall be designed and installed in accordance with the *International Fire Code* and NFPA 58.

G2412.3 (401.3) Modifications to existing systems.
In modifying or adding to existing *piping systems*, sizes shall be maintained in accordance with this chapter.

G2412.4 (401.4) Additional appliances.
Where an additional *appliance* is to be served, the existing *piping* shall be checked to determine if it has adequate capacity for all *appliances* served. If inadequate, the existing system shall be enlarged as required or separate *piping* of adequate capacity shall be provided.

G2412.5 (401.5) Identification.
For other than steel *pipe*, exposed *piping* shall be identified by a yellow label marked "Gas" in black letters. The marking shall be spaced at intervals not exceeding 5 feet (1524 mm). The marking shall not be required on *pipe* located in the same room as the *appliance* served.

G2412.6 (401.6) Interconnections.
Where two or more *meters* are installed on the same premises, but supply separate consumers, the *piping systems* shall not be interconnected on the outlet side of the *meters*.

G2412.7 (401.7) Piping meter identification.
Piping from multiple *meter* installations shall be marked with an *approved* permanent identification by the installer so that the *piping system* supplied by each *meter* is readily identifiable.

G2412.8 (401.8) Minimum sizes.
All *pipe* utilized for the installation, extension and *alteration* of any *piping system* shall be sized to supply the full number of outlets for the intended purpose and shall be sized in accordance with Section G2413.

G2412.9 (401.9) Identification.
Each length of pipe and tubing and each pipe fitting, utilized in a fuel gas system, shall bear the identification of the manufacturer.

G2412.10 (401.10) Third-party testing and certification.
All piping, tubing and fittings shall comply with the applicable referenced standards, specifications and performance criteria of this code and shall be identified in accordance with Section G2412.9. Piping, tubing and fittings shall either be tested by an approved third-party testing agency or certified by an approved *third-party certification agency*.

SECTION G2413 (402)
PIPE SIZING

G2413.1 (402.1) General considerations.
Piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum *demand* and supply gas to each *appliance* inlet at not less than the minimum supply pressure required by the *appliance*.

G2413.2 (402.2) Maximum gas demand.
The volumetric flow rate of gas to be provided, in cubic feet per hour, shall be calculated using the manufacturer's input ratings of the *appliance*s served adjusted for altitude. Where an input rating is not indicated, the gas supplier, *appliance* manufacturer or a qualified agency shall be contacted, or the rating from Table G2413.2 shall be used for estimating the volumetric flow rate of gas to be supplied.

The total connected hourly load shall be used as the basis for pipe sizing, assuming that all appliances could be operating at full capacity simultaneously. Where a diversity of load can be established, pipe sizing shall be permitted to be based on such loads.

TABLE G2413.2 (402.2)
APPROXIMATE GAS INPUT FOR TYPICAL APPLIANCES

APPLIANCE	INPUT BTU/H (Approx.)
Space Heating Units	
Hydronic boiler	
Single family	100,000
Multifamily, per unit	60,000
Warm-air furnace	
Single family	100,000
Multifamily, per unit	60,000
Space and Water Heating Units	
Hydronic boiler	
Single family	120,000
Multifamily, per unit	75,000
Water Heating Appliances	
Water heater, automatic instantaneous	
Capacity at 2 gal./minute	142,800
Capacity at 4 gal./minute	285,000
Capacity at 6 gal./minute	428,400
Water heater, automatic storage, 30- to 40-gal. tank	35,000
Water heater, automatic storage, 50-gal. tank	50,000
Water heater, domestic, circulating or side-arm	35,000
Cooking Appliances	
Built-in oven or broiler unit, domestic	25,000
Built-in top unit, domestic	40,000
Range, free-standing, domestic	65,000
Other Appliances	
Barbecue	40,000
Clothes dryer, Type 1 (domestic)	35,000
Gas fireplace, direct-vent	40,000
Gas light	2,500
Gas log	80,000
Refrigerator	3,000

G2413.4.1 (402.4.1) Longest length method.
The *pipe* size of each section of *gas piping* shall be determined using the longest length of *piping* from the *point of delivery* to the most remote *outlet* and the load of the section.

G2413.4.2 (402.4.2) Branch length method.
Pipe shall be sized as follows:

1. *Pipe* size of each section of the longest *pipe* run from the *point of delivery* to the most remote *outlet* shall be determined using the longest run of *piping* and the load of the section.

2. The *pipe* size of each section of branch *piping* not previously sized shall be determined using the length of *piping* from the *point of delivery* to the most remote *outlet* in each branch and the load of the section.

G2413.4.3 (402.4.3) Hybrid pressure.
The *pipe* size for each section of higher pressure *gas piping* shall be determined using the longest length of *piping* from the *point of delivery* to the most remote line *pressure regulator*. The *pipe* size from the line *pressure regulator* to each *outlet* shall be determined using the length of *piping* from the *regulator* to the most remote outlet served by the *regulator*.

G2413.5 (402.5) Allowable pressure drop.
The design pressure loss in any *piping system* under maximum probable flow conditions, from the *point of delivery* to the inlet connection of the *appliance*, shall be such that the supply pressure at the *appliance* is greater than or equal to the minimum pressure required by the *appliance*.

G2413.6 (402.6) Maximum design operating pressure.
The maximum design operating pressure for *piping systems* located inside buildings shall not exceed 5 pounds per square inch gauge (psig) (34 kPa gauge) except where one or more of the following conditions are met:

1. The *piping system* is welded.
2. The *piping* is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
3. The *piping* is a temporary installation for buildings under construction.

G2413.6.1 (402.6.1) Liquefied petroleum gas systems.
LP-gas systems designed to operate below -5°F (-21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-gas or prevent LP-gas vapor from condensing into a liquid.

SECTION G2414 (403)
PIPING MATERIALS

G2414.1 (403.1) General.
Materials used for piping systems shall comply with the requirements of this chapter or shall be *approved*.

G2414.2 (403.2) Used materials.
Pipe, fittings, *valves* or other materials shall not be used again unless they are free of foreign materials and have been ascertained to be adequate for the service intended.

G2414.3 (403.3) Other materials.
Material not covered by the standards specifications listed herein shall be investigated and tested to determine that it is safe and suitable for the proposed service, and, in addition, shall be recommended for that service by the manufacturer and shall be *approved* by the *code official*.

G2414.4 (403.4) Metallic pipe.
Metallic *pipe* shall comply with Sections G2414.4.1 and G2414.4.2.

G2414.4.1 (403.4.1) Cast iron.
Cast-iron *pipe* shall not be used.

G2414.4.2 (403.4.2) Steel.
Steel and wrought-iron *pipe* shall be at least of standard weight (Schedule 40) and shall comply with one of the following:

1. ASME B 36.10, 10M;
2. ASTM A 53/A 53M; or
3. ASTM A 106.

G2414.5 (403.5) Metallic tubing.
Seamless copper, aluminum alloy or steel *tubing* shall be permitted to be used with gases not corrosive to such material.

G2414.5.1 (403.5.1) Steel tubing.
Steel *tubing* shall comply with ASTM A 254.

G2414.5.2 (403.5.2) Copper tubing.
Copper *tubing* shall comply with standard Type K or L of ASTM B 88 or ASTM B 280.

Copper and brass *tubing* shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas (0.7 milligrams per 100 liters).

G2414.5.3 (403.5.4) Corrugated stainless steel tubing.
Corrugated stainless steel *tubing* shall be listed in accordance with ANSI LC 1/CSA 6.26.

G2414.6 (403.6) Plastic pipe, tubing and fittings.
Polyethylene plastic pipe, tubing and fittings used to supply fuel gas shall conform to the 2009 edition of ASTM D 2513. Such pipe shall be marked "Gas" and "ASTM D 2513."

Plastic pipe, tubing and fittings, other than polyethylene, shall be identified and conform to the 2008 edition of ASTM D 2513. Such pipe shall be marked "Gas" and "ASTM D 2513."

G2414.6.1 (403.6.1) Anodeless risers.
Plastic pipe, tubing and anodeless risers shall comply with the following:

1. Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used and shall be leak tested by the manufacturer in accordance with written procedures.

2. Service head adapters and field-assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used, and shall be designed and certified to meet the requirements of Category I of the 2009 edition of ASTM D 2513, and U.S. Department of Transportation, Code of Federal Regulations, Title 49, Part 192.281(e). The manufacturer shall provide the user with qualified installation instructions as prescribed by the U.S. Department of Transportation, Code of Federal Regulations, Title 49, Part 192.283(b).

G2414.6.2 (403.6.2) LP-gas systems.
The use of plastic pipe, tubing and fittings in undiluted liquefied petroleum gas *piping* systems shall be in accordance with NFPA 58.

G2414.6.3 (403.6.3) Regulator vent piping.
Plastic *pipe*, *tubing* and fittings used to connect *regulator* vents to remote vent terminations shall be of PVC conforming to ANSI/UL 651. PVC vent *piping* shall not be installed indoors.

G2414.7 (403.7) Workmanship and defects.
Pipe or *tubing* and fittings shall be clear and free from cutting burrs and defects in structure or threading, and shall be thoroughly brushed, and chip and scale blown.

Defects in *pipe* or *tubing* or fittings shall not be repaired. Defective *pipe*, *tubing* or fittings shall be replaced. (See Section G2417.1.2.)

G2414.8 (403.8) Protective coating.
Where in contact with material or atmosphere exerting a corrosive action, metallic *piping* and fittings coated with a corrosion-resistant material shall be used. External or internal coatings or linings used on *piping* or components shall not be considered as adding strength.

G2414.9 (403.9) Metallic pipe threads.
Metallic *pipe* and fitting threads shall be taper *pipe* threads and shall comply with ASME B 1.20.1.

G2414.9.1 (403.9.1) Damaged threads.
Pipe with threads that are stripped, chipped, corroded or otherwise damaged shall not be used. If a weld opens during the operation of cutting or threading, that portion of the *pipe* shall not be used.

G2414.9.2 (403.9.2) Number of threads.
Field threading of metallic *pipe* shall be in accordance with Table G2414.9.2.

TABLE G2414.9.2 (403.9.2)
SPECIFICATIONS FOR THREADING METALLIC PIPE

IRON PIPE SIZE (inches)	APPROXIMATE LENGTH OF THREADED PORTION (inches)	APPROXIMATE NO. OF THREADS TO BE CUT
1/2	3/4	10
3/4	3/4	10
1	7/8	10
1 1/4	1	11
1 1/2	1	11

For SI: 1 inch = 25.4 mm.

G2414.9.3 (403.9.3) Thread joint compounds.
Thread joint compounds shall be resistant to the action of liquefied petroleum gas or to any other chemical constituents of the gases to be conducted through the *piping*.

G2414.10 (403.10) Metallic piping joints and fittings.
The type of *piping* joint used shall be suitable for the pressure-temperature conditions and shall be selected giving consideration to joint tightness and mechanical strength under the service conditions. The joint shall be able to sustain the maximum end force due to the internal pressure and any additional forces due to temperature expansion or contraction, vibration, fatigue, or to the weight of the *pipe* and its contents.

G2414.10.1 (403.10.1) Pipe joints.
Pipe joints shall be threaded, flanged, brazed or welded. Where nonferrous *pipe* is brazed, the *brazing* materials shall have a melting point in excess of 1,000°F (538°C). *Brazing* alloys shall not contain more than 0.05-percent phosphorus.

G2414.10.2 (403.10.2) Tubing joints.
Tubing joints shall be made with *approved gas tubing* fittings or be brazed with a material having a melting point in excess of 1,000°F (538°C) or made with press-connect fittings complying with ANSI LC-4. *Brazing alloys* shall not contain more than 0.05-percent phosphorus.

G2414.10.3 (403.10.3) Flared joints.
Flared joints shall be used only in systems constructed from nonferrous *pipe* and *tubing* where experience or tests have demonstrated that the joint is suitable for the conditions and where provisions are made in the design to prevent separation of the joints.

G2414.10.4 (403.10.4) Metallic fittings.
Metallic fittings, including *valves*, strainers and filters shall comply with the following:

1. Fittings used with steel or wrought-iron *pipe* shall be steel, brass, bronze, malleable iron, ductile iron or cast iron.

2. Fittings used with copper or brass *pipe* shall be copper, brass or bronze.

3. Cast-iron bushings shall be prohibited.

4. Special fittings. Fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless or compression-type *tubing* fittings shall be: used within the fitting manufacturer's pressure-temperature recommendations; used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion or contraction; installed or braced to prevent separation of the joint by gas pressure or external physical damage; and shall be *approved*.

G2414.11 (403.11) Plastic piping, joints and fittings.
Plastic *pipe, tubing* and fittings shall be joined in accordance with the manufacturers' instructions. Such joints shall comply with the following:

1. The joints shall be designed and installed so that the longitudinal pull-out resistance of the joints will be at least equal to the tensile strength of the plastic *piping* material.

2. Heat-fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gas-tight joints at least as strong as the *pipe* or *tubing* being joined. Joints shall be made with the joining method recommended by the *pipe* manufacturer. Heat fusion fittings shall be marked "ASTM D 2513."

3. Where compression-type *mechanical joints* are used, the gasket material in the fitting shall be compatible with the plastic *piping* and with the gas distributed by the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting. The stiffener shall be flush with the end of the *pipe* or *tubing* and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. Split tubular stiffeners shall not be used.

4. Plastic *piping* joints and fittings for use in *liquefied petroleum gas piping systems* shall be in accordance with NFPA 58.

G2414.12 (403.13) Flange gaskets.
Material for gaskets shall be capable of withstanding the design temperature and pressure of the *piping* system, and the chemical constituents of the gas being conducted, without change to its chemical and physical properties. The effects of fire exposure to the joint shall be considered in choosing material. Acceptable materials include metal (plain or corrugated), composition, and aluminum "O" rings and spiral wound metal gaskets. When a flanged joint is opened, the gasket shall be replaced. Full-face gaskets shall be used with all bronze and cast-iron flanges.

SECTION G2415 (404)
PIPING SYSTEM INSTALLATION

G2415.1 (404.1) Installation of materials.
All materials used shall be installed in strict accordance with the standards under which the materials are accepted and approved. In the absence of such installation procedures, the manufacturer's instructions shall be followed. Where the requirements of referenced standards or manufacturer's instructions do not conform to minimum provisions of this code, the provisions of this code shall apply.

G2415.2 (404.2) CSST.
CSST piping systems shall be installed in accordance with the terms of their approval, the conditions of listing, the manufacturer's instructions and this code.

G2415.3 (404.3) Prohibited locations.
Piping shall not be installed in or through a ducted supply, return or exhaust, or a clothes chute, *chimney* or gas vent, dumbwaiter or elevator *shaft*. *Piping* installed downstream of the *point of delivery* shall not extend through any townhouse unit other than the unit served by such *piping*.

G2415.4 (404.4) Piping in solid partitions and walls.
Concealed piping shall not be located in solid partitions and solid walls, unless installed in a chase or casing.

G2415.5 (404.5) Piping in concealed locations.
Portions of a *piping system* installed in *concealed locations* shall not have unions, *tubing* fittings, right and left couplings, bushings, compression couplings, and swing joints made by combinations of fittings.

Exceptions:

1. *Tubing* joined by *brazing*.

2. Fittings listed for use in *concealed locations*.

G2415.6 (404.6) Underground penetrations prohibited.
Gas piping shall not penetrate building foundation walls at any point below grade. *Gas piping* shall enter and exit a building at a point above grade and the annular space between the *pipe* and the wall shall be sealed.

G2415.7 (404.7) Protection against physical damage.
In *concealed locations*, where *piping* other than black or galvanized steel is installed through holes or notches in wood studs, joists, rafters or similar members less than $1^1/_2$ inches (38 mm) from the nearest edge of the member, the *pipe* shall be protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575-inch (1.463 mm) (No. 16 Gage) shall cover the area of the *pipe* where the member is notched or bored and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

G2415.8 (404.8) Piping in solid floors.
Piping in solid floors shall be laid in channels in the floor and covered in a manner that will allow access to the *piping* with a minimum amount of damage to the building. Where such *piping* is subject to exposure to excessive moisture or corrosive substances, the *piping* shall be protected in an *approved* manner. As an alternative to installation in channels, the *piping* shall be installed in a conduit of Schedule 40 steel, wrought iron, PVC or ABS *pipe* in accordance with Section G2415.6.1 or G2415.6.2.

G2415.8.1 (404.8.1) Conduit with one end terminating outdoors.
The conduit shall extend into an occupiable portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the *gas piping* shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the *pipe* emerges from the floor. If the end sealing is capable of withstanding the full pressure of the gas *pipe,* the conduit shall be designed for the same pressure as the *pipe*. Such conduit shall extend not less than 4 inches (102 mm) outside of the building, shall be vented above grade to the outdoors and shall be installed to prevent the entrance of water and insects.

G2415.8.2 (404.8.2) Conduit with both ends terminating indoors.
Where the conduit originates and terminates within the same building, the conduit shall originate and terminate in an accessible portion of the building and shall not be sealed. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the *pipe* emerges from the floor.

G2415.9 (404.9) Above-ground piping outdoors.
All *piping* installed outdoors shall be elevated not less than $3^1/_2$ inches (152 mm) above ground and where installed across roof surfaces, shall be elevated not less than $3^1/_2$ inches (152 mm) above the roof surface. *Piping* installed above ground, outdoors, and installed across the surface of roofs shall be securely supported and located where it will be protected from physical damage. Where passing through an outside wall, the *piping* shall also be protected against corrosion by coating or wrapping with an inert material. Where *piping* is encased in a protective *pipe* sleeve, the annular space between the *piping* and the sleeve shall be sealed.

G2415.10 (404.10) Isolation.
Metallic *piping* and metallic *tubing* that conveys *fuel gas* from an LP-gas storage container shall be provided with an *approved* dielectric fitting to electrically isolate the underground portion of the *pipe* or tube from the above ground portion that enters a building. Such dielectric fitting shall be installed aboveground outdoors.

G2415.11 (404.11) Protection against corrosion.
Metallic *pipe* or *tubing* exposed to corrosive action, such as soil condition or moisture, shall be protected in an *approved* manner. Zinc coatings (galvanizing) shall not be deemed adequate protection for *gas piping* underground. Where dissimilar metals are joined underground, an insulating coupling or fitting shall be used. *Piping* shall not be laid in contact with cinders.

G2415.11.1 (404.11.1) Prohibited use.
Uncoated threaded or socket welded joints shall not be used in *piping* in contact with soil or where internal or external crevice corrosion is known to occur.

G2415.11.2 (404.11.2) Protective coatings and wrapping.
Pipe protective coatings and wrappings shall be *approved* for the application and shall be factory applied.

Exception: Where installed in accordance with the manufacturer's installation instructions, field application of coatings and wrappings shall be permitted for *pipe* nipples, fittings and locations where the factory coating or wrapping has been damaged or necessarily removed at joints.

G2415.12 (404.12) Minimum burial depth.
Underground *piping systems* shall be installed a minimum depth of 12 inches (305 mm) below grade, except as provided for in Section G2415.12.1.

G2415.12.1 (404.12.1) Individual outside appliances.
Individual lines to outside lights, grills or other *appliances* shall be installed a minimum of 8 inches (203 mm) below finished grade, provided that such installation is *approved* and is installed in locations not susceptible to physical damage.

G2415.13 (404.13) Trenches.
The trench shall be graded so that the *pipe* has a firm, substantially continuous bearing on the bottom of the trench.

G2415.14 (404.14) Piping underground beneath buildings.
Piping installed underground beneath buildings is prohibited except where the *piping* is encased in a conduit of wrought iron, plastic *pipe*, steel *pipe* or other *approved* conduit material designed to withstand the superimposed loads. The conduit shall be protected from corrosion in accordance with Section G2415.9 and shall be installed in accordance with Section G2415.12.1 or G2415.12.2.

G2415.14.1 (404.14.1) Conduit with one end terminating outdoors.
The conduit shall extend into an occupiable portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the *gas piping* shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the *pipe* emerges from the floor. Where the end sealing is capable of withstanding the full pressure of the gas *pipe*, the conduit shall be designed for the same pressure as the *pipe*. Such conduit shall extend not less than 4 inches (102 mm) outside the building, shall be vented above grade to the outdoors and shall be installed so as to prevent the entrance of water and insects.

G2415.14.2 (404.14.2) Conduit with both ends terminating indoors.
Where the conduit originates and terminates within the same building, the conduit shall originate and terminate in an accessible portion of the building and shall not be sealed. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the *pipe* emerges from the floor.

G2415.15 (404.15) Outlet closures.
Gas *outlets* that do not connect to *appliances* shall be capped gas tight.

Exception: Listed and labeled flush-mounted-type quick-disconnect devices and listed and labeled *gas convenience outlets* shall be installed in accordance with the manufacturer's installation instructions.

G2415.16 (404.16) Location of outlets.
The unthreaded portion of *piping outlets* shall extend not less than I inch (25 mm) through finished ceilings and walls and where extending through floors, outdoor patios and slabs, shall not be less than 2 inches (51 mm) above them. The *outlet* fitting or *piping* shall be securely supported. *Outlets* shall not be placed behind doors. *Outlets* shall be located in the room or space where the *appliance* is installed.

Exception: Listed and labeled flush-mounted-type quick-disconnect devices and listed and labeled *gas convenience outlets* shall be installed in accordance with the manufacturer's installation instructions.

G2415.17 (404.17) Plastic pipe.
The installation of plastic *pipe* shall comply with Sections G2415.15.1 through G2415.15.3.

G2415.17.1 (404.17.1) Limitations.
Plastic *pipe* shall be installed outdoors underground only. Plastic *pipe* shall not be used within or under any building or slab or be operated at pressures greater than 100 psig (689 kPa) for natural gas or 30 psig (207 kPa) for LP-gas.

Exceptions:

1. Plastic *pipe* shall be permitted to terminate above ground outside of buildings where installed in premanufactured *anodeless risers* or service head adapter risers that are installed in accordance with the manufacturer's installation instructions.

2. Plastic *pipe* shall be permitted to terminate with a wall head adapter within buildings where the plastic *pipe* is inserted in a *piping* material for *fuel gas* use in buildings.

3. Plastic pipe shall be permitted under outdoor patio, walkway and driveway slabs provided that the burial depth complies with Section G2415.10.

G2415.17.2 (404.17.2) Connections.
Connections outdoors and underground between metallic and plastic *piping* shall be made only with transition fittings conforming to ASTM D 2513 Category I or ASTM F 1973.

G2415.17.3 (404.17.3) Tracer.
A yellow insulated copper tracer wire or other *approved* conductor shall be installed adjacent to underground nonmetallic *piping*. 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 not be less than 18 AWG and the insulation type shall be suitable for direct burial.

G2415.18 (404.18) Prohibited devices.
A device shall not be placed inside the *piping* or fittings that will reduce the cross-sectional area or otherwise obstruct the free flow of gas.

Exceptions:

1. Approved gas filters.

2. An approved fitting or device where the gas piping system has been sized to accommodate the pressure drop of the fitting or device.

G2415.19 (404.19) Testing of piping.
Before any system of *piping* is put in service or concealed, it shall be tested to ensure that it is gas tight. Testing, inspection and purging of *piping systems* shall comply with Section G2417.

SECTION G2417 (406)
INSPECTION, TESTING AND PURGING

G2417.1 (406.1) General.
Prior to acceptance and initial operation, all *piping* installations shall be visually inspected and pressure tested to determine that the materials, design, fabrication and installation practices comply with the requirements of this code.

G2417.1.1 (406.1.1) Inspections.
Inspection shall consist of visual examination, during or after manufacture, fabrication, assembly or *pressure tests* as appropriate.

G2417.1.2 (406.1.2) Repairs and additions.
In the event repairs or additions are made after the *pressure test*, the affected *piping* shall be tested.

Minor repairs and additions are not required to be *pressure tested* provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other *approved* leak-detecting methods.

G2417.1.3 (406.1.3) New branches.
Where new branches are installed to new *appliances*, only the newly installed branches shall be required to be *pressure tested*. Connections between the new *piping* and the existing *piping* shall be tested with a noncorrosive leak-detecting fluid or other *approved* leak-detecting methods.

G2417.1.4 (406.1.4) Section testing.
A *piping system* shall be permitted to be tested as a complete unit or in sections. Under no circumstances shall a *valve* in a line be used as a bulkhead between gas in one section of the *piping system* and test medium in an adjacent section, unless two *valves* are installed in series with a valved "tell-tale" located between these *valves*. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve closing mechanism, is designed to safely withstand the test pressure.

G2417.1.5 (406.1.5) Regulators and valve assemblies.
Regulator and valve assemblies fabricated independently of the *piping system* in which they are to be installed shall be permitted to be tested with inert gas or air at the time of fabrication.

G2417.1.6 (406.1.6) Pipe clearing.
Prior to testing, the interior of the pipe shall be cleared of all foreign material.

G2417.2 (406.2) Test medium.
The test medium shall be air, nitrogen, carbon dioxide or an inert gas. Oxygen shall not be used.

G2417.3 (406.3) Test preparation.
Pipe joints, including welds, shall be left exposed for examination during the test.

Exception: Covered or *concealed pipe* end joints that have been previously tested in accordance with this *code*.

G2417.3.1 (406.3.1) Expansion joints.
Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.

G2417.3.2 (406.3.2) Equipment isolation.
Equipment that is not to be included in the test shall be either disconnected from the *piping* or isolated by blanks, blind flanges or caps.

G2417.3.3 (406.3.3) Appliance and equipment disconnection.
Where the *piping system* is connected to *appliances* or *equipment* designed for operating pressures of less than the test pressure, such *appliances* or *equipment* shall be isolated from the *piping system* by disconnecting them and capping the *outlet(s)*.

G2417.3.4 (406.3.4) Valve isolation.
Where the *piping system* is connected to *appliances* or *equipment* designed for operating pressures equal to or greater than the test pressure, such *appliances* or *equipment* shall be isolated from the *piping system* by closing the individual *appliance* or *equipment* shutoff valve(s).

G2417.3.5 (406.3.5) Testing precautions.
All testing of *piping* systems shall be performed in a manner that protects the safety of employees and the public during the test.

G2417.4 (406.4) Test pressure measurement.
Test pressure shall be measured with a manometer or with a pressure-measuring device designed and calibrated to read, record, or indicate a pressure loss caused by leakage during the *pressure test* period. The source of pressure shall be isolated before the *pressure tests* are made. Mechanical gauges used to measure test pressures shall have a range such that the highest end of the scale is not greater than five times the test pressure.

G2417.4.1 (406.4.1) Test pressure.
The test pressure to be used shall be not less than one and one-half times the proposed maximum working pressure, but not less than 3 psig (20 kPa gauge), irrespective of design pressure. Where the test pressure exceeds 125 psig (862 kPa gauge), the test pressure shall not exceed a value that produces a hoop stress in the *piping* greater than 50 percent of the specified minimum yield strength of the *pipe*.

G2417.4.2 (406.4.2) Test duration.
The test duration shall be not less than 10 minutes.

G2417.5 (406.5) Detection of leaks and defects.
The *piping system* shall withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.

G2417.5.1 (406.5.1) Detection methods.
The leakage shall be located by means of an *approved* combustible gas detector, a noncorrosive leak detection fluid or an equivalent nonflammable solution. Matches, candles, open flames or other methods that could provide a source of ignition shall not be used.

G2417.5.2 (406.5.2) Corrections.
Where leakage or other defects are located, the affected portion of the *piping system* shall be repaired or replaced and retested.

G2417.6 (406.6) Piping system and equipment leakage check.
Leakage checking of systems and *equipment* shall be in accordance with Sections G2417.6.1 through G2417.6.4.

G2417.6.1 (406.6.1) Test gases.
Fuel gas shall be permitted to be used for *leak checks* in *piping systems* that have been tested in accordance with Section G2417.

G2417.6.2 (406.6.2) Turning gas on.
During the process of turning gas on into a system of new *gas piping*, the entire system shall be inspected to determine that there are no open fittings or ends and that all *valves* at unused outlets are closed and plugged or capped.

G2417.6.3 (406.6.3) Leak check.
Immediately after the gas is turned on into a new system or into a system that has been initially restored after an interruption of service, the *piping system* shall be checked for leakage. Where leakage is indicated, the gas supply shall be shut off until the necessary repairs have been made.

SECTION G2418 (407)
PIPING SUPPORT

G2418.1 (407.1) General.
Piping shall be provided with support in accordance with Section G2418.2.

G2418.2 (407.2) Design and installation.
Piping shall be supported with metal *pipe* hooks, metal *pipe* straps, metal bands, metal brackets, metal hangers or building structural components suitable for the size of *piping*, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. *Piping* shall be anchored to prevent undue strains on connected *appliances* and shall not be supported by other *piping*. *Pipe* hangers and supports shall conform to the requirements of MSS SP-58 and shall be spaced in accordance with Section G2424. Supports, hangers and anchors shall be installed so as not to interfere with the free expansion and contraction of the *piping* between anchors. All parts of the supporting *equipment* shall be designed and installed so that they will not be disengaged by movement of the supported *piping*.

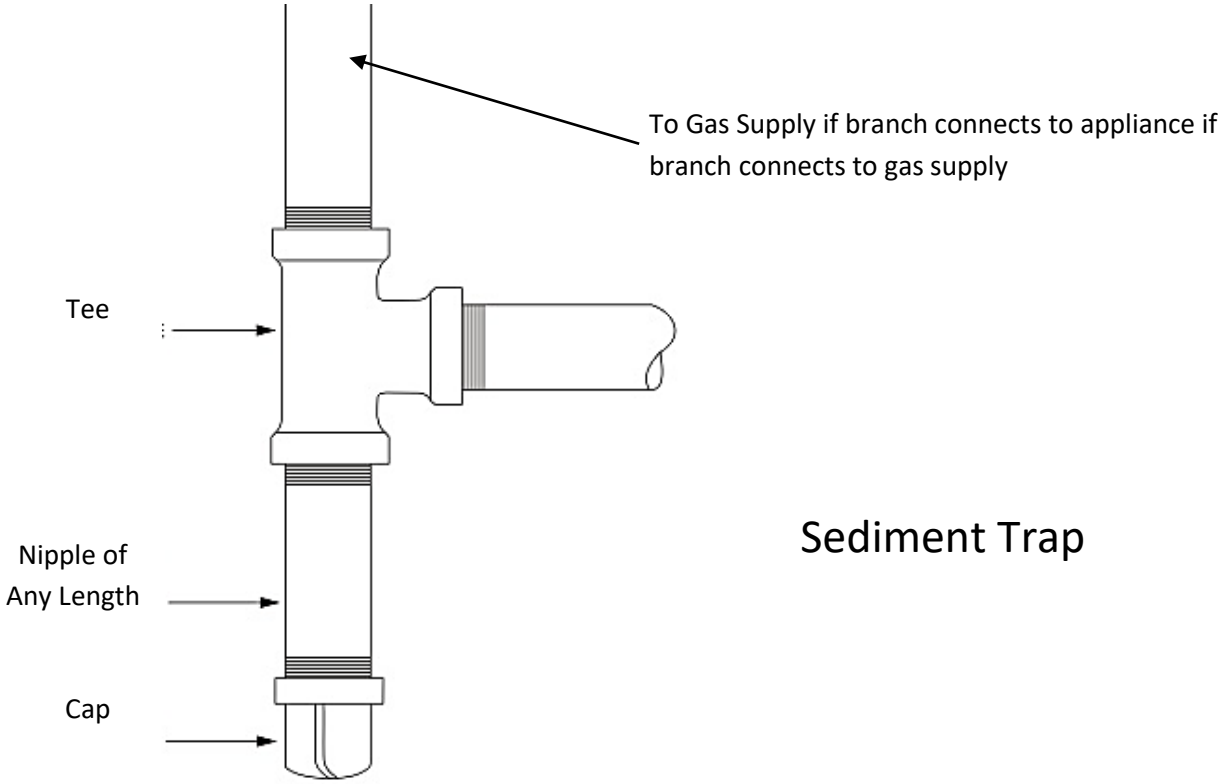
SECTION G2419 (408)
DRIPS AND SLOPED PIPING

G2419.1 (408.1) Slopes.
Piping for other than dry gas conditions shall be sloped not less than 0.25 inch in 15 feet (6.4 mm in 4572 mm) to prevent traps.

G2419.2 (408.2) Drips.
Where wet gas exists, a *drip* shall be provided at any point in the line of *pipe* where *condensate* could collect. A *drip* shall also be provided at the outlet of the *meter* and shall be installed so as to constitute a trap wherein an accumulation of *condensate* will shut off the flow of gas before the *condensate* will run back into the *meter*.

G2419.3 (408.3) Location of drips.
Drips shall be provided with *ready access* to permit cleaning or emptying. A *drip* shall not be located where the *condensate* is subject to freezing.

G2419.4 (408.4) Sediment trap.
Where a sediment trap is not incorporated as part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical. The sediment trap shall be either a tee fitting having a capped nipple of any length installed vertically in the bottommost opening of the tee as illustrated in Figure G2419.4 or other device approved as an effective sediment trap. Illuminating appliances, ranges, clothes dryers, decorative vented appliances for installation in vented fireplaces, gas fireplaces, and outdoor grills need not be so equipped.



Sediment Trap

FIGURE G2419.4
METHOD OF INSTALLING A TEE FITTING SEDIMENT TRAP

SECTION G2420 (409)
GAS SHUTOFF VALVES

G2420.1 (409.1) General.
Piping systems shall be provided with shutoff *valves* in accordance with this section.

G2420.1.1 (409.1.1) Valve approval.
Shutoff *valves* shall be of an *approved* type; shall be constructed of materials compatible with the *piping*; and shall comply with the standard that is applicable for the pressure and application, in accordance with Table G2420.1.1.

G2420.1.2 (409.1.2) Prohibited locations.
Shutoff *valves* shall be prohibited in *concealed locations* and *furnace plenums*.

G2420.1.3 (409.1.3) Access to shutoff valves.
Shutoff *valves* shall be located in places so as to provide access for operation and shall be installed so as to be protected from damage.

G2420.2 (409.2) Meter valve.
Every *meter* shall be equipped with a shutoff *valve* located on the supply side of the *meter*.

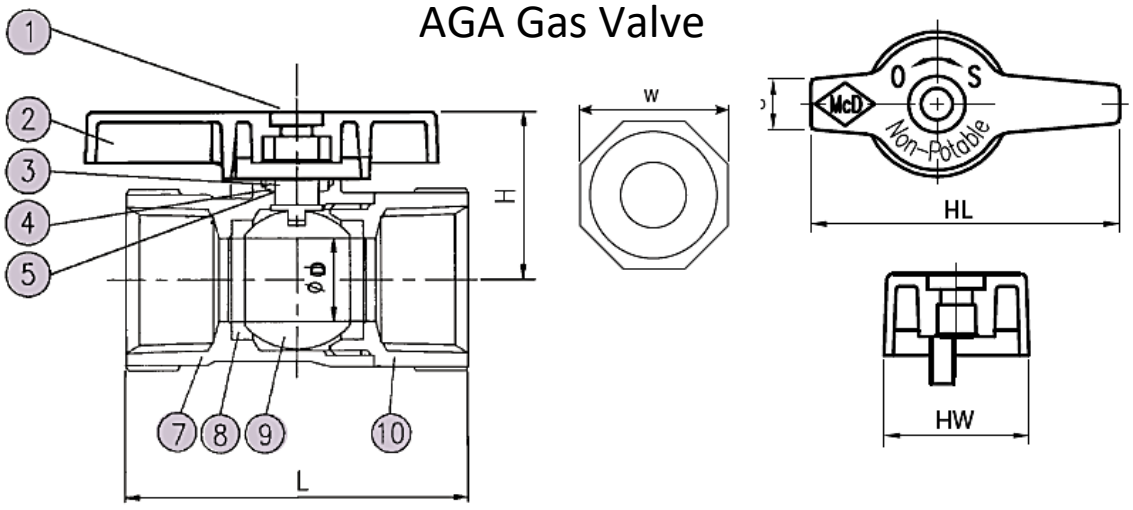
G2420.3 (409.3.2) Individual buildings.
In a common system serving more than one building, shutoff *valves* shall be installed outdoors at each building.

G2420.4 (409.4) MP regulator valves.
A listed shutoff valve shall be installed immediately ahead of each MP *regulator*.

G2420.5 (409.5) Appliance shutoff valve.
Each *appliance* shall be provided with a shutoff *valve* in accordance with Section G2420.5.1, G2420.5.2 or G2420.5.3.

G2420.5.1 (409.5.1) Located within same room.
The shutoff *valve* shall be located in the same room as the *appliance*. The shutoff *valve* shall be within 6 feet (1829 mm) of the *appliance*, and shall be installed upstream of the union, connector or quick disconnect device it serves. Such shutoff *valves* shall be provided with access. *Appliance shutoff valves* located in the firebox of a *fireplace* shall be installed in accordance with the *appliance* manufacturer's instructions.

AGA Gas Valve



Dimensions

Size	L	H	D	W	HW	HL
1/2"	2.17	1.22	.39	1.062	.9	1.92
3/4"	2.44	1.38	.59	1.3125	.9	1.92
1"	2.87	1.66	.79	1.625	1.1	2.6

Materials

No.	Part	Material
1	Screw	Steel
2	Handle	Zinc Alloy
3	Stem	Brass
4	Stem Gland Screw	Brass
5	Gland Packing	Teflon

No.	Part	Material
7	Body	Forged Brass
8	Ball Disc Packing	Teflon
9	Ball	Chrome Plated Brass
10	End Plug	Forged Brass

SECTION G2422 (411)
APPLIANCE CONNECTIONS

G2422.1 (411.1) Connecting appliances.
Appliances shall be connected to the *piping system* by one of the following:

1. Rigid metallic *pipe* and fittings.

2. Corrugated stainless steel *tubing* (CSST) where installed in accordance with the manufacturer's instructions.

3. Listed and labeled *appliance connectors* in compliance with ANSI Z21.24 and installed in accordance with the manufacturer's installation instructions and located entirely in the same room as the *appliance*.

4. Listed and labeled quick-disconnect devices used in conjunction with listed and labeled *appliance connectors*.

5. Listed and labeled convenience outlets used in conjunction with listed and labeled *appliance connectors*.

6. Listed and labeled outdoor *appliance connectors* in compliance with ANSI Z21.75/CSA 6.27 and installed in accordance with the manufacturer's installation instructions.

G2422.1.1 (411.1.2) Protection from damage.
Connectors and *tubing* shall be installed so as to be protected against physical damage.

G2422.1.2 (411.1.3) Connector installation.
Appliance fuel connectors shall be installed in accordance with the manufacturer's instructions and Sections G2422.1.2.1 through G2422.1.2.4.

G2422.1.2.1 (411.1.3.1) Maximum length.
Connectors shall not exceed 6 feet (1829 mm) in overall length. Measurement shall be made along the centerline of the connector. Only one connector shall be used for each *appliance*.

Exception: Rigid metallic *piping* used to connect an *appliance* to the *piping system* shall be permitted to have a total length greater than 6 feet (1829 mm) provided that the connecting *pipe* is sized as part of the *piping system* in accordance with Section G2413 and the location of the *appliance shutoff valve* complies with Section G2420.5.

G2422.1.2.2 (411.1.3.2) Minimum size.
Connectors shall have the capacity for the total *demand* of the connected *appliance*.

G2422.1.2.3 (411.1.3.3) Prohibited locations and penetrations.
Connectors shall not be concealed within, or extended through, walls, floors, partitions, ceilings or *appliance* housings.

Exceptions:

1. Connectors constructed of materials allowed for *piping systems* in accordance with Section G2414 shall be permitted to pass through walls, floors, partitions and ceilings where installed in accordance with Section G2420.5.2 or G2420.5.3.

2. Rigid steel *pipe* connectors shall be permitted to extend through openings in *appliance* housings.

3. *Fireplace* inserts that are factory equipped with grommets, sleeves or other means of protection in accordance with the listing of the *appliance*.

4. Semirigid *tubing* and listed connectors shall be permitted to extend through an opening in an *appliance* housing, cabinet or casing where the tubing or connector is protected against damage.

G2422.1.2.4 (411.1.3.4) Shutoff valve.
A shutoff *valve* not less than the nominal size of the connector shall be installed ahead of the connector in accordance with Section G2420.5.

G2422.1.3 (411.1.5) Connection of gas engine-powered air conditioners.
Internal *combustion* engines shall not be rigidly connected to the gas supply *piping*.

G2422.1.4 (411.1.6) Unions.
A union fitting shall be provided for *appliances* connected by rigid metallic *pipe*. Such unions shall be accessible and located within 6 feet (1829 mm) of the *appliance*.

G2422.1.5 (411.1.4) Movable appliances.
Where *appliances* are equipped with casters or are otherwise subject to periodic movement or relocation for purposes such as routine cleaning and maintenance, such *appliances* shall be connected to the supply system *piping* by means of an *approved* flexible connector designed and labeled for the application. Such flexible connectors shall be installed and protected against physical damage in accordance with the manufacturer's installation instructions.

SECTION G2424 (415)
PIPING SUPPORT INTERVALS

G2424.1 (415.1) Interval of support.
Piping shall be supported at intervals not exceeding the spacing specified in Table G2424.1. Spacing of supports for CSST shall be in accordance with the CSST manufacturer's instructions.

TABLE G2424.1
SUPPORT OF PIPING

STEEL PIPE, NOMINAL SIZE OF PIPE (inches)	SPACING OF SUPPORTS (feet)	NOMINAL SIZE OF TUBING SMOOTH-WALL (inch O.D.)	SPACING OF SUPPORTS (feet)
1/2	6	1/2	4
3/4 or 1	8	5/8 or 3/4	6
1 1/4 or larger (horizontal)	10	7/8 or 1 (horizontal)	8
1 1/4 or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Chapter Notes:

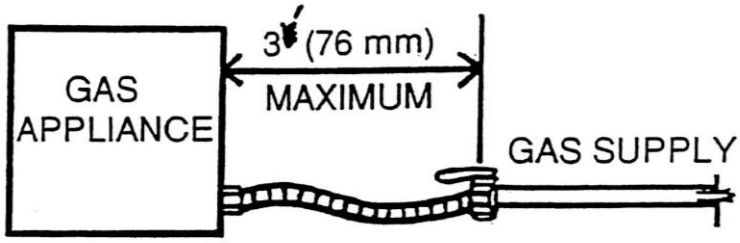
- Gas Piping – Any installation of pipe, valves, or fittings that is used to convey fuel gas installed on any premises or in any building, but shall not include:
    1. Any portion of the service piping
    2. Any approved piping connections 6 feet or less in length between an existing gas outlet and a gas appliance in the same room with the outlet
- No gas piping shall be strained or bent; no appliance shall be supported by or develop any strain or stress on its supply piping. Approved materials for fuel gas piping systems shall be determined by the authority having jurisdiction (AHJ). All such pipe shall be either new, or shall previously have been used for no other purposes than conveying gas. All valves/fittings/piping used in connection with fuel gas piping systems shall be of a type designed and approved for use with fuel gas.
- All licensed plumbers must obtain the correct endorsement or license for the Texas Railroad Commission before installing LP fuel gases.

- No gas piping shall be installed in or under the ground beneath any building or structure unless in a gas-tight conduit and all exposed gas piping shall be kept 6 inches above grade. Building or structures shall include porches, and steps, whether covered or uncovered, breezeways, roofed porte-cocheres, roofed patios, carports, covered walks, covered driveways, and similar structures.
- Where unions are necessary, right and left nipples and couplings shall be used. Ground-joint unions may be used at exposed fixtures, appliances, or equipment connection and in exposed exterior locations immediately on the discharge side of a building shutoff valve.
- All gas outlets located in a barbeque or fireplace shall be controlled by an approved operating valve located in the same room and outside the hearth, but not more than 4 feet from such appliance. When piping on the discharge side of such valve and is standard weight brass or galvanized steel, such piping may be embedded in or surrounded by not less than 2 inches of concrete or masonry.
- An approved accessible valve shall be installed in the fuel supply piping outside each appliance and ahead of the union conenction. Shutoff valves shall be within 3 feet of the appliance and in the same room as the appliance. Shutoff valves may be adjacent to an inside or under an appliance, when such shutoff valve is accessible and the appliance can be removed without removal of the valve.
- An electrically continuous insulated #18 AWG yellow diameter copper tracer wire or other approved materials shall be installed with and attached to an underground non-metallic gas piping and shall terminate above ground. Non-metallic piping shall be buried with a full 18 inches below grade (see manufacturer). When a metallic riser connects underground to plastic gas piping, the underground horizontal metallic portion of the riser shall extend at least 30 inches before connecting to the plastic piping.
- All underground metallic gas piping shall be buried at least 12 inches below grade. Appliance connectors shall, at no time, have a diameter less than the that of the inlet connection of the appliance being served.
- Listed metal appliance connectors shall have an overall length not to exceed 3 feet, except for a range or dryer connection, which may not exceed 6 feet. No part of such connection shall be concealed within or extended through any wall, floor, partition, or appliance housing. All connectors shall be properly sized to serve the appliance being served.
- A listed accessible appliance connector valve not less than the nominal size of the connector shall be provided at the gas piping outlet immediately ahead of the

connector. Outdoor portable appliances may be connected with an approved outdoor hose connector not to exceed 15 feet.

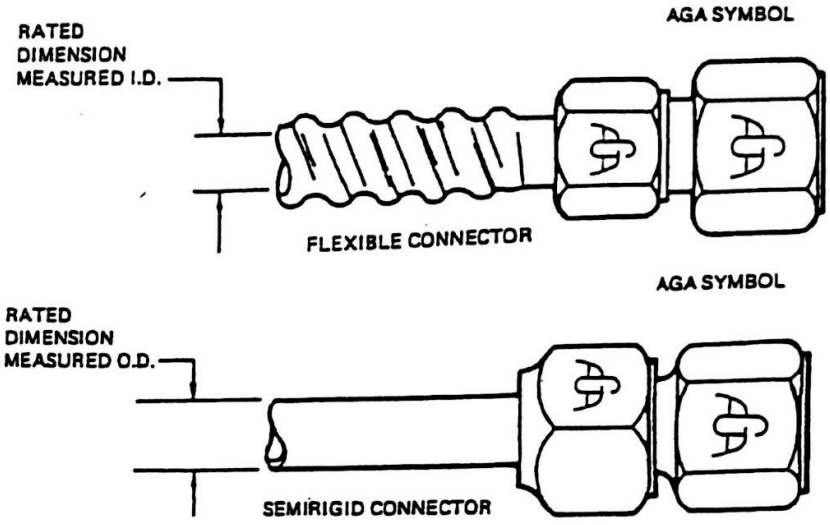
- Leaks in gas piping shall be located by applying soapy water to the exterior of the piping. Fire or acid shall not be used to locate leaks, nor shall any substance other than air, carbon dioxide or nitrogen be introduced into the gas piping.
- Gas flex connectors cannot be tied/connected together
- Gas risers must be a minimum of 30" in length
- Supply lines are for single use only
- All new gas piping and portions of exisiting systems which may be affected by new work, or any changes/modifications shall be inspected by the AHJ. It is the responsibility of the permit holder to:
    1. Ensure that the piping will withstand the prescribed test
    2. That no piping shall be covered, concealed or used until tested and inspected
    3. That all materials must be listed and code-approved
- Rough/Final Inspection will verify that listed and code-approved materials are used and the installation meets all requirements of code: piping, sizing, hangers, anchors, and supports; pressure test satisfied.
- Only the gas supplier (employees) can re-connect/turn-on the gas supply to any premises.
- Any unused outlets whether stops/valves must be plugged or capped.
- Piping must be new, or previously used for conveying gas, free of obstructions, reamed to full-bore and fittings same as piping.
- Exposed piping must be 6" above grade.
- Under slab gas piping shall be installed in gas tight conduits and protected from stresses caused by structural shifting, settlement, or expansion and contraction.
- Non-ferrous is non-metallic
- Underground Ferrous Piping (Iron) must have a minimum of 12' cover with approved coatings or wrapping material (mill-wrap)
- PE – Polyethelene must have a minimum of 18" of cover, back-fill materials must be clean dirt or other approved materials; no rock or other debris that could damage the piping can be used; must use approved risers. Always consult the manufacturer's recommendation.

APPROVED SEMIRIGID OR
FLEXIBLE TUBING CONNECTOR
WITH SHUT-OFF VALVE.

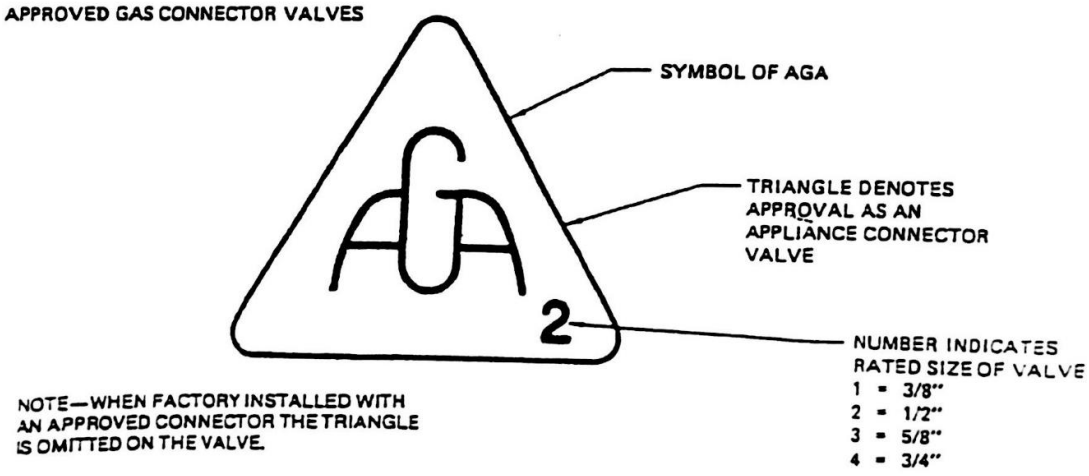


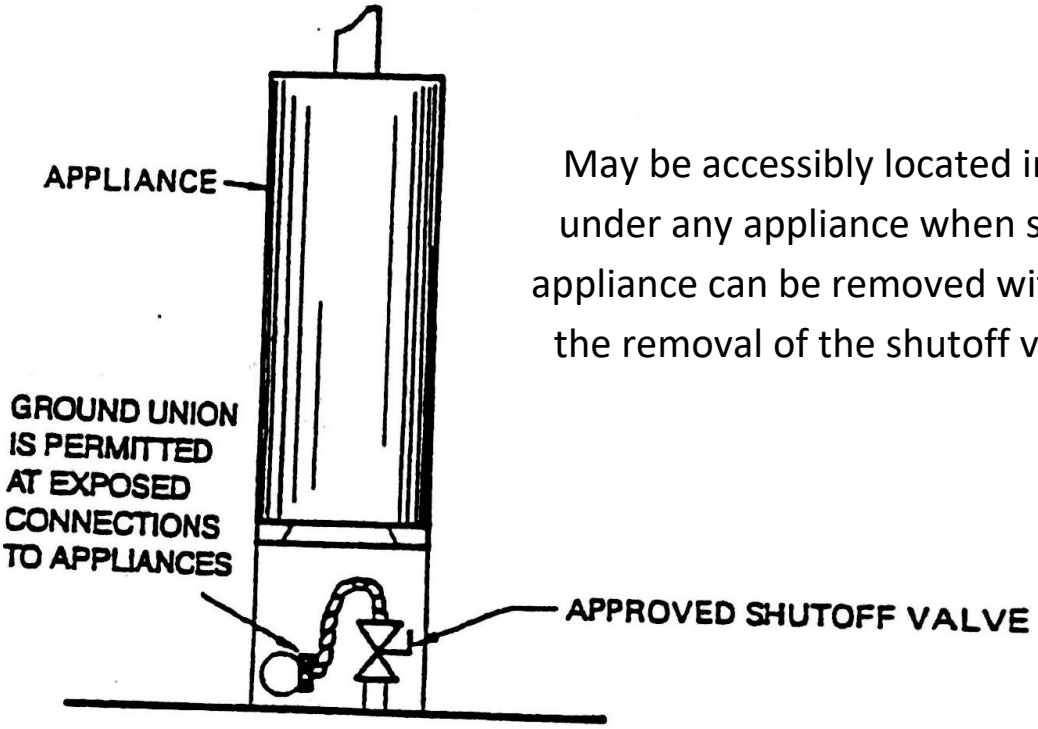
MAXIMUM CONNECTOR LENGTH 3' (914 mm),
EXCEPT RANGE AND CLOTHES
DRYER MAXIMUM LENGTH 6' (1829 mm)

Flexible Connector and Semirigid Connector

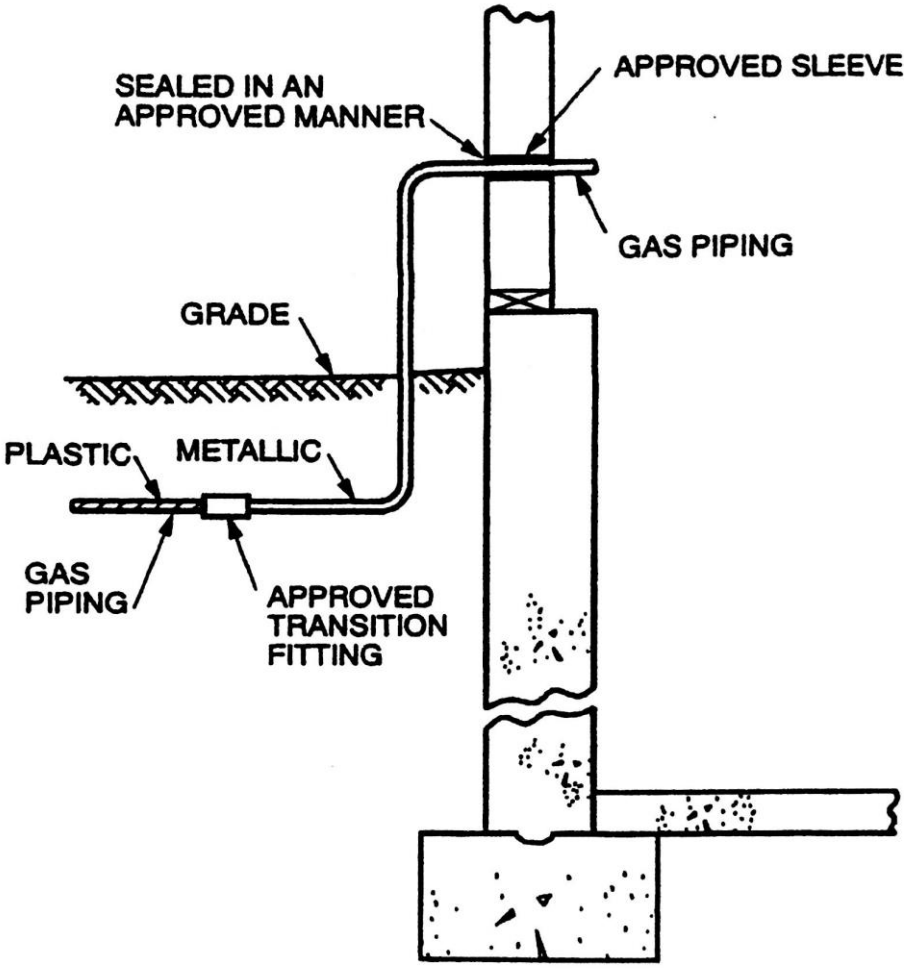


Approved Gas Connector Valves





May be accessibly located in or under any appliance when such appliance can be removed without the removal of the shutoff valve



Chapter 3

IRC

Chapter 26 General Requirements

CONGER
CONSTRUCTION
SERVICES, LLC.

CHAPTER 26
GENERAL PLUMBING REQUIREMENTS

SECTION P2601
GENERAL

P2601.1 Scope.
The provisions of this chapter shall govern the installation of plumbing not specifically covered in other chapters applicable to plumbing systems. The installation of plumbing, *appliances, equipment* and systems not addressed by this code shall comply with the applicable provisions of the *International Plumbing Code*.

P2601.2 Connections to drainage system.
Plumbing fixtures, drains, appurtenances and appliances used to receive or discharge liquid wastes or sewage shall be directly connected to the sanitary drainage system of the building or premises, in accordance with the requirements of this code. This section shall not be construed to prevent indirect waste systems.

Exception: Bathtubs, showers, lavatories, clothes washers and laundry trays shall not be required to discharge to the sanitary drainage system where such fixtures discharge to an approved gray water system for flushing of water closets and urinals or for subsurface landscape irrigation.

P2601.3 Flood hazard areas.
In flood hazard areas as established by Table R301.2(1), plumbing fixtures, drains, and appliances shall be located or installed in accordance with Section R322.1.6.

Section P2602 Individual Water Supply and Sewage Disposal

P2602.1 General.
The water-distribution and drainage system of any building or premises where plumbing fixtures are installed shall be connected to a public water supply or sewer system, respectively, if available. When either a public water-supply or sewer system, or both, are not available, or connection to them is not feasible, an individual water supply or individual (private) sewage-disposal system, or both, shall be provided.

P2602.2 Flood-resistant installation.
In flood hazard areas as established by Table R301.2(1):

1. Water supply systems shall be designed and constructed to prevent infiltration of floodwaters.

2. Pipes for sewage disposal systems shall be designed and constructed to prevent infiltration of floodwaters into the systems and discharges from the systems into floodwaters.

SECTION P2603
STRUCTURAL AND PIPING PROTECTION

P2603.1 General.
In the process of installing or repairing any part of a plumbing and drainage installation, the finished floors, walls, ceilings, tile work or any other part of the building or premises that must be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the building portion of this code.

P2603.2 Drilling and notching.
Wood-framed structural members shall not be drilled, notched or altered in any manner except as provided in Sections R502.8, R602.6, R802.7 and R802.7.1. Holes in load-bearing members of cold-formed steel light-frame construction shall be permitted only in accordance with Sections R505.2.5, R603.2.5 and R804.2.5. In accordance with the provisions in Sections R505.3.5, R603.3.4 and R804.3.4, cutting and notching of flanges and lips of load-bearing members of cold-formed steel light-frame construction shall not be permitted. Structural insulated panels (SIPs) shall be drilled and notched or altered in accordance with the provisions of Section R613.7.

P2603.2.1 Protection against physical damage.
In concealed locations, where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than $1^1/_2$ inches (38 mm) from the nearest edge of the member, the pipe shall be protected by steel shield plates. Such shield plates shall have a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 Gage). Such plates shall cover the area of the pipe where the member is notched or bored, and shall extend not less than 2 inches (51 mm) above sole plates and below top plates.

P2603.3 Breakage and corrosion.
Pipes passing through concrete or cinder walls and floors, cold-formed steel framing or other corrosive material shall be protected against external corrosion by a protective sheathing or wrapping or other means that will withstand any reaction from lime and acid of concrete, cinder or other corrosive material. Sheathing or wrapping shall allow for movement including expansion and contraction of piping. The wall thickness of material shall be not less than 0.025 inch (0.64 mm).

Deleted

P2603.4 Pipes through foundation walls.
A pipe that passes through a foundation wall shall be provided with a relieving arch, or a pipe sleeve shall be built into the foundation wall. The sleeve shall be two pipe sizes greater than the pipe passing through the wall.

P2603.5 Freezing.
In localities having a winter design temperature of 32°F (0°C) or lower as shown in Table R301.2(1) of this code, a water, soil or waste pipe shall not be installed outside of a building, in exterior walls, in *attics* or crawl spaces, or in any other place subjected to freezing temperature unless adequate provision is made to protect it from freezing by insulation or heat or both. Water service pipe shall be installed not less than 12 inches (305 mm) deep and not less than 6 inches (152 mm) below the frost line.

P2603.5.1 Sewer depth.
Building sewers that connect to private sewage disposal systems shall be a not less than **[NUMBER]** inches (mm) below finished *grade* at the point of septic tank connection. *Building sewers* shall be not less than **[NUMBER]** inches (mm) below *grade*.

SECTIONP2604
TRENCHING AND BACKFILLING

P2604.1 Trenching and bedding.
Where trenches are excavated such that the bottom of the trench forms the bed for the pipe, solid and continuous load-bearing support shall be provided between joints. Where over-excavated, the trench shall be backfilled to the proper grade with compacted earth, sand, fine gravel or similar granular material. Piping shall not be supported on rocks or blocks at any point. Rocky or unstable soil shall be over-excavated by two or more pipe diameters and brought to the proper grade with suitable compacted granular material.

P2604.2 Common trench.
See Section P2905.4.2.

P2604.3 Backfilling.
Backfill shall be free from discarded construction material and debris. Backfill shall be free from rocks, broken concrete and frozen chunks until the pipe is covered by not less than 12 inches (305 mm) of tamped earth. Backfill shall be placed evenly on both sides of the pipe and tamped to retain proper alignment. Loose earth shall be carefully placed in the trench in 6-inch (152 mm) layers and tamped in place.

P2604.4 Protection of footings.
Trenching installed parallel to footings shall not extend below the 45-degree (0.79 rad) bearing plane of the bottom edge of a wall or footing (see Figure P2604.4).

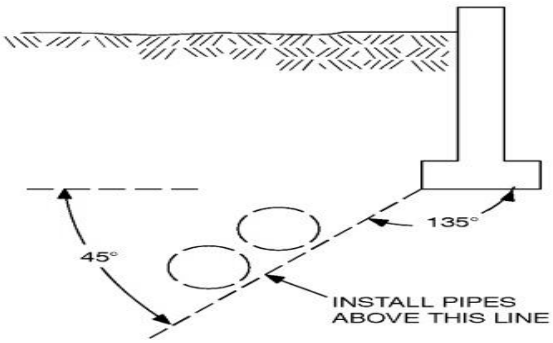


FIGURE P2604.4
PIPE LOCATION WITH RESPECT TO FOOTINGS

SECTION P2605
SUPPORT

P2605.1 General.
Piping shall be supported in accordance with the following:

1. Piping shall be supported to ensure alignment and prevent sagging, and allow movement associated with the expansion and contraction of the piping system.

2. Piping in the ground shall be laid on a firm bed for its entire length, except where support is otherwise provided.

3. Hangers and anchors shall be of sufficient strength to maintain their proportional share of the weight of pipe and contents and of sufficient width to prevent distortion to the pipe. Hangers and strapping shall be of *approved* material that will not promote galvanic action. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees (0.79 rad) for pipe sizes 4 inches (102 mm) and larger.

4. Piping shall be supported at distances not to exceed those indicated in Table P2605.1.

TABLE P2605.1
PIPING SUPPORT

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING
ABS pipe	4	10[b]
Aluminum tubing	10	15
Brass pipe	10	10
Cast-iron pipe	5[a]	15
Copper or copper alloy pipe	12	10
Copper or copper alloy tubing ($1^1/_4$ inches in diameter and smaller)	6	10
Copper or copper alloy tubing ($1^1/_2$ inches in diameter and larger)	10	10
Cross-linked polyethylene (PEX) pipe	2.67 (32 inches)	10[b]
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	2.67 (32 inches)	4[b]
CPVC pipe or tubing (1 inch in diameter and smaller)	3	10[b]
CPVC pipe or tubing ($1^1/_4$ inches in diameter and larger)	4	10[b]
Lead pipe	Continuous	4
PB pipe or tubing	2.67 (32 inches)	4
Polyethylene/aluminum/polyethylene (PE-AL-PE) pipe	2.67 (32 inches)	4[b]
Polyethylene of raised temperature (PE-RT) pipe	2.67 (32 inches)	10[b]
Polypropylene (PP) pipe or tubing (1 inch and smaller)	2.67 (32 inches)	10[b]
Polypropylene (PP) pipe or tubing ($1^1/_4$ inches and larger)	4	10[b]
PVC pipe	4	10[b]
Stainless steel drainage systems	10	10[b]
Steel pipe	12	15

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
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. Midstory guide for sizes 2 inches and smaller.

Rule of thumb, if not covered in IRC, the IPC is the governing code document for reference & manufacturer's recommendation

Chapter 4

IRC

Chapter 27 Fixtures & Chapter 28 Water Heater

CONGER
CONSTRUCTION
SERVICES, LLC.

CHAPTER 27
PLUMBING FIXTURES

SECTION P2701
FIXTURES, FAUCETS AND FIXTURE FITTINGS

P2701.1 Quality of fixtures.
Plumbing fixtures, faucets and fixture fittings shall be constructed of *approved* materials, shall have smooth impervious surfaces, shall be free from defects and concealed fouling surfaces, and shall conform to the standards cited in this code. Plumbing fixtures shall be provided with an adequate supply of potable water to flush and keep the fixtures in a clean and sanitary condition without danger of backflow or cross connection.

FIXTURE ACCESSORIES

P2702.1 Plumbing fixtures.
Plumbing fixtures, other than water closets, shall be provided with *approved* strainers.

Exception: Hub drains and standpipes.

P2702.2 Waste fittings.
Waste fittings shall conform to ASME A112.18.2/CSA B125.2, ASTM F 409 or to one of the standards listed in Table P3002.1(1) for above-ground drainage and vent pipe and fittings.

P2702.3 Plastic tubular fittings.
Plastic tubular fittings shall conform to ASTM F 409 listed in Table P2701.1.

P2702.4 Carriers for wall-hung water closets.
Carriers for wall-hung water closets shall conform to ASME A112.6.1 or ASME A112.6.2.

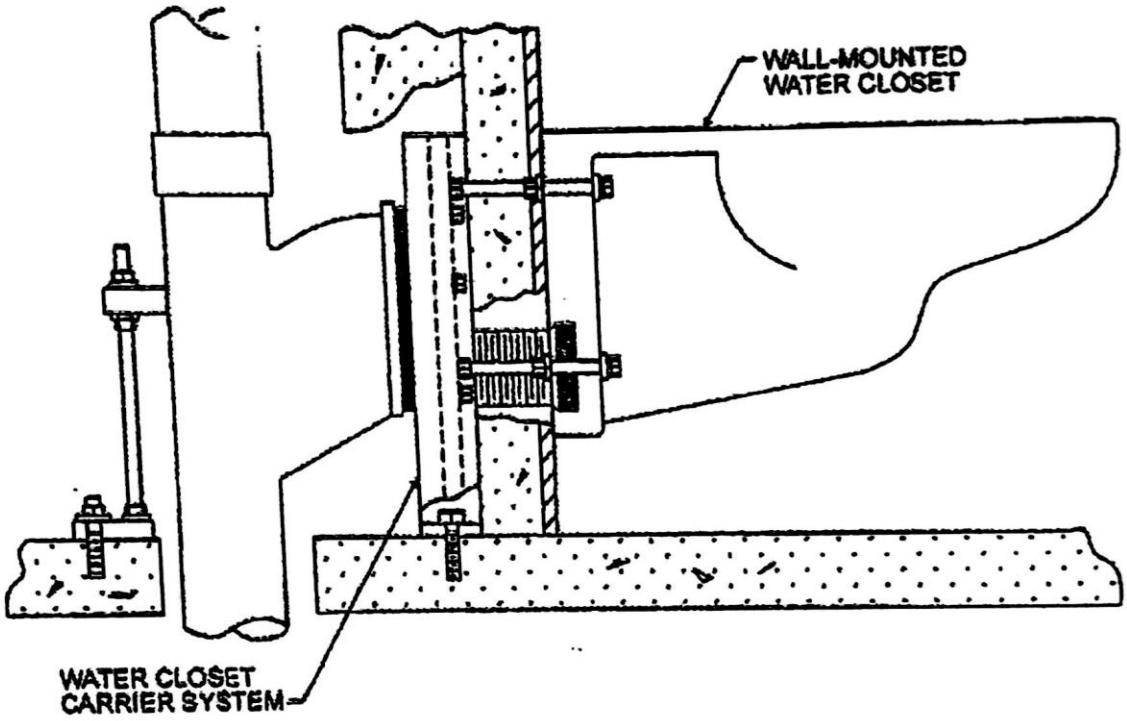


Figure P2702.4
WALL-MOUNTED WATER CLOSET

SECTION P2703
TAIL PIECES

P2703.1 Minimum size.
Fixture tail pieces shall be not less than $1^1/_2$ inches (38 mm) in diameter for sinks, dishwashers, laundry tubs, bathtubs and similar fixtures, and not less than $1^1/_4$ inches (32 mm) in diameter for bidets, lavatories and similar fixtures.

SECTION P2704
ACCESS TO CONNECTIONS

P2704.1 General.
Slip joints shall be made with an *approved* elastomeric gasket and shall be installed only on the trap outlet, trap inlet and within the trap seal. Fixtures with concealed slip-joint connections shall be provided with an access panel or utility space not less than 12 inches (305 mm) in its smallest dimension or other *approved* arrangement so as to provide access to the slip connections for inspection and repair.

SECTION P2705
INSTALLATION

P2705.1 General.
The installation of fixtures shall conform to the following:

1. Floor-outlet or floor-mounted fixtures shall be secured to the drainage connection and to the floor, where so designed, by screws, bolts, washers, nuts and similar fasteners of copper, brass or other corrosion-resistant material.

2. Wall-hung fixtures shall be rigidly supported so that strain is not transmitted to the plumbing system.

3. Where fixtures come in contact with walls and floors, the contact area shall be water tight.

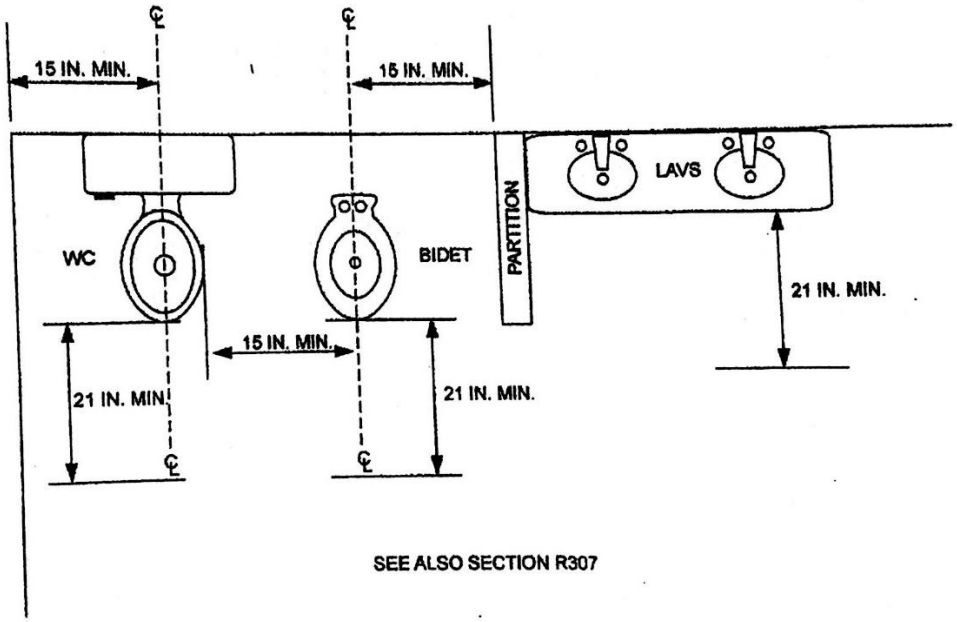
4. Plumbing fixtures shall be usable.

5. Water closets, lavatories and bidets. A water closet, lavatory or bidet shall not be set closer than 15 inches (381 mm) from its center to any side wall, partition or vanity or closer than 30 inches (762 mm) center-to-center between adjacent fixtures. There shall be a clearance of not less than 21 inches (533 mm) in front of a water closet, lavatory or bidet to any wall, fixture or door.

6. The location of piping, fixtures or equipment shall not interfere with the operation of windows or doors.

7. In flood hazard areas as established by Table R301.2(1), plumbing fixtures shall be located or installed in accordance with Section R322.1.7.

8. Integral fixture-fitting mounting surfaces on manufactured plumbing fixtures or plumbing fixtures constructed on site, shall meet the design requirements of ASME A112.19.2/CSA B45.1 or ASME A112.19.3/CSA B45.4.



SEE ALSO SECTION R307

For SI: 1 inch = 25.4 mm.

SECTION P2706
WASTE RECEPTORS

P2706.1 General.
Waste receptors shall be of an *approved* type. Plumbing fixtures or other receptors receiving the discharge of indirect waste pipes shall be shaped and have a capacity to prevent splashing or flooding and shall be readily accessible for inspection and cleaning. Waste receptors and standpipes shall be trapped and vented and shall connect to the building drainage system. A removable strainer or basket shall cover the waste outlet of waste receptors. Waste receptors shall be installed in ventilated spaces. Waste receptors shall not be installed in bathrooms, attics, crawl spaces, interstitial spaces above ceilings and below floors or in any inaccessible or unventilated space such as a closet. Ready access shall be provided to waste receptors.

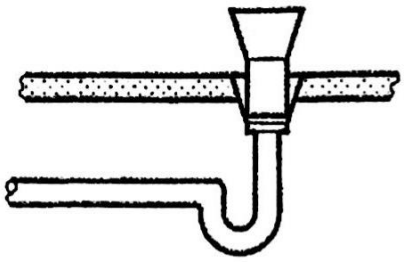
Exceptions:

1. Open hub waste receptors shall be permitted in the form of a hub or pipe extending not less than 1 inch (25 mm) above a water-impervious floor, and are not required to have a strainer.

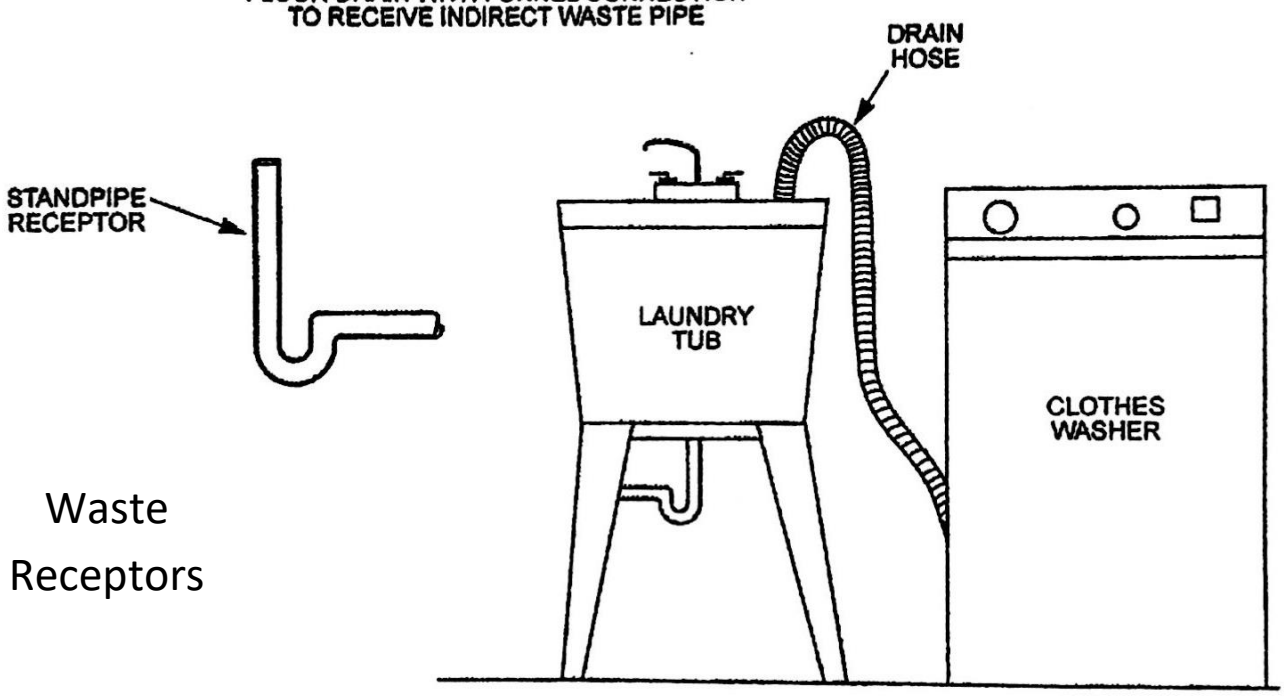
2. Clothes washer standpipes shall not be prohibited in bathrooms.

P2706.2 Standpipes.
Standpipes shall extend not less than of 18 inches (457 mm) but not greater than 42 inches (1067 mm) above the trap weir. Access shall be provided to standpipe traps and drains for rodding.

P2706.2.1 Laundry tray connection.
A laundry tray waste line is permitted to connect into a standpipe for the automatic clothes washer drain. The standpipe shall extend not less than 30 inches (762 mm) above the trap weir and shall extend above the flood level rim of the laundry tray. The outlet of the laundry tray shall not be greater than 30 inches (762 mm) horizontal distance from the standpipe trap.



FLOOR DRAIN WITH FUNNEL CONNECTION
TO RECEIVE INDIRECT WASTE PIPE



Waste Receptors

P2706.3 Prohibited waste receptors.
Plumbing fixtures that are used for washing or bathing shall not be used to receive the discharge of indirect waste piping.

Exceptions:

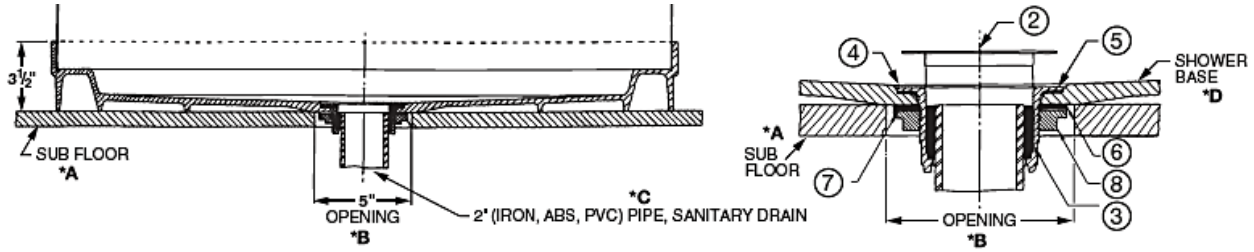
1. A kitchen sink trap is acceptable for use as a receptor for a dishwasher.
2. A laundry tray is acceptable for use as a receptor for a clothes washing machine.

SECTION P2707
DIRECTIONAL FITTINGS

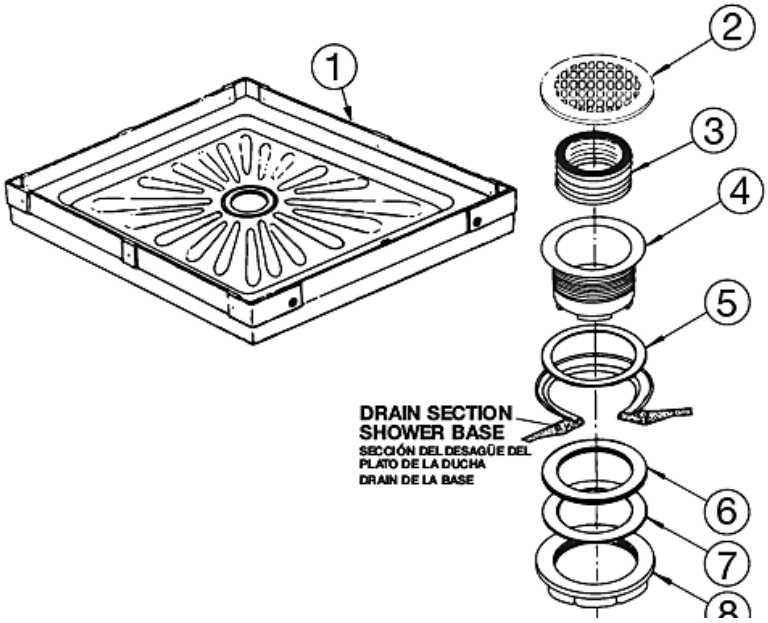
P2707.1 Directional fitting required.
Approved directional-type branch fittings shall be installed in fixture tailpieces receiving the discharge from food waste disposal units or dishwashers.

SECTION P2708
SHOWERS

P2708.1 General.
Shower compartments shall have not less than 900 square inches (0.6 m^2) of interior cross-sectional area. Shower compartments shall be not less than 30 inches (762 mm) in minimum dimension measured from the finished interior dimension of the shower compartment, exclusive of fixture valves, shower heads, soap dishes, and safety grab bars or rails. The minimum required area and dimension shall be measured from the finished interior dimension at a height equal to the top of the threshold and at a point tangent to its centerline and shall be continued to a height of not less than 70 inches (1778 mm) above the shower drain outlet. Hinged shower doors shall open outward. The wall area above built-in tubs having installed shower heads and in shower compartments shall be constructed in accordance with Section R702.4. Such walls shall form a water-tight joint with each other and with either the tub, receptor or shower floor.



SECTIONAL VIEW – STANDARD BASE AND DRAIN
VISTA POR SECCIONES – PLATO DE DUCHA Y DESAGÜE ESTÁNDARD " VUE DE COUPE – BASE STANDARD ET DRAIN



PARTS LIST • LISTA DE PARTES • LISTE DES PIÈCES

KEY No. de llave N°de la pièce	PART NUMBER Número de parte • N°de référence 30	68	DESCRIPTION Descripción Description
1	30.103	68.101	Shower Base Base de la ducha • Base de douche
2–8	80.140AP	80.140AP	COMPLETE DRAIN ASSEMBLY: MONTAJE DE DESAGÜE COMPLETO: DRAIN ASSEMBLÉ :
2	*	*	Strainer Tamiz • Tamis
3	*	*	Drain Seal Sellador para desagüe • Joint de drain
4	*	*	Drain Body Desagüe • Siphon
5	*	*	Sealing Washer – 1/16" Arandelas para sellar – 1/16" (1,59 mm) • Rondelle étanche – 1/16 po (1,59 mm)
6	*	*	Sealing Washer – 1/8" Arandelas para sellar – 1/8" (3,18 mm) • Rondelle étanche – 1/8 po (3,18 mm)
7	*	*	Fiber Washer Arandela de fibra • Rondelle de fibre
8	*	*	Locknut Tuerca de cierre • Écrou bloquant

Exceptions:

1. Fold-down seats shall be permitted in the shower, provided the required 900-square-inch (0.6 m^2) dimension is maintained when the seat is in the folded-up position.

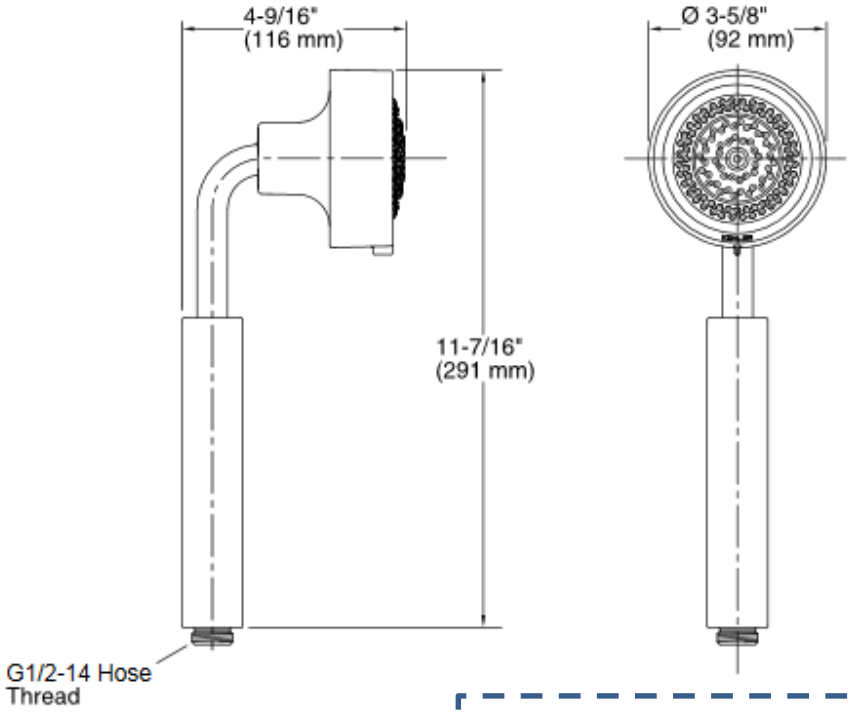
2. Shower compartments having not less than 25 inches (635 mm) in minimum dimension measured from the finished interior dimension of the compartment provided that the shower compartment has a cross-sectional area of not less than 1,300 square inches (0.838 m^2).

P2708.1.1 Access.
The shower compartment access and egress opening shall have a clear and unobstructed finished width of not less than 22 inches (559 mm).

P2708.2 Water supply riser.
Water supply risers from the shower valve to the shower head outlet, whether exposed or concealed, shall be attached to the structure using support devices designed for use with the specific piping material or fittings anchored with screws.

P2708.3 Shower control valves.
Individual shower and tub/shower combination valves shall be equipped with control valves of the pressure-balance, thermostatic-mixing or combination pressure-balance/thermostatic-mixing valve types with a high limit stop in accordance with ASSE 1016 or ASME A112.18.1/CSA B125.1. The high limit stop shall be set to limit the water temperature to not greater than 120°F (49°C). In-line thermostatic valves shall not be used for compliance with this section.

P2708.4 Hand showers.
Hand-held showers shall conform to ASME A112.18.1/CSA B125.1. Hand-held showers shall provide backflow protection in accordance with ASME A112.18.1/CSA B125.1 or shall be protected against backflow by a device complying with ASME A112.18.3.



Technical Information
All product dimensions are nominal.

Handshower:
Rated maximum flow: 1.75 gal/min (6.6 l/min)

Notes
Install this product according to the installation guide.

Plumbing codes require approved backflow prevention devices to be installed in-line to handshowers. Please consult with local plumbing officials.

ADA, OBC, CSA B651 compliant when installed to the specific requirements of these regulations.

SECTION P2709
SHOWER RECEPTORS

P2709.1 Construction.
Where a shower receptor has a finished curb threshold, it shall be not less than 1 inch (25 mm) below the sides and back of the receptor. The curb shall be not less than 2 inches (51 mm) and not more than 9 inches (229 mm) deep when measured from the top of the curb to the top of the drain. The finished floor shall slope uniformly toward the drain not less than $^1/_4$ unit vertical in 12 units horizontal (2-percent slope) nor more than $^1/_2$ unit vertical per 12 units horizontal (4-percent slope) and floor drains shall be flanged to provide a water-tight joint in the floor.

P2709.2 Lining required.
The adjoining walls and floor framing enclosing on-site built-up shower receptors shall be lined with one of the following materials:

1. Sheet lead;
2. Sheet copper;
3. Plastic liner material that complies with ASTM D 4068 or ASTM D 4551;
4. Hot mopping in accordance with Section P2709.2.3; or
5. Sheet-applied load-bearing, bonded waterproof membranes that comply with ANSI A118.10.

The lining material shall extend not less than 2 inches (51 mm) beyond or around the rough jambs and not less than 2 inches (51 mm) above finished thresholds. Sheet-applied load bearing, bonded waterproof membranes shall be applied in accordance with the manufacturer's instructions.

P2709.2.1 PVC sheets.
Plasticized polyvinyl chloride (PVC) sheet shall meet the requirements of ASTM D 4551. Sheets shall be joined by solvent welding in accordance with the manufacturer's instructions.

P2709.2.2 Chlorinated polyethylene (CPE) sheets.
Nonplasticized chlorinated polyethylene sheet shall meet the requirements of ASTM D 4068. The liner shall be joined in accordance with the manufacturer's instructions.

P2709.2.3 Hot-mopping.
Shower receptors lined by hot mopping shall be built-up with not less than three layers of standard grade Type 15 asphalt-impregnated roofing felt. The bottom layer shall be fitted to the formed subbase and each succeeding layer thoroughly hot-mopped to that below. All corners shall be carefully fitted and shall be made strong and water tight by folding or lapping, and each corner shall be reinforced with suitable webbing hot-mopped in place. All folds, laps and reinforcing webbing shall extend not less than 4 inches (102 mm) in all directions from the corner and all webbing shall be of *approved* type and mesh, producing a tensile strength of not less than 50 pounds per inch (893 kg/m) in either direction.

P2709.2.4 Liquid-type, trowel-applied, load-bearing, bonded waterproof materials.
Liquid-type, trowel-applied, load-bearing, bonded waterproof materials shall meet the requirements of ANSI A118.10 and shall be applied in accordance with the manufacturer's instructions.

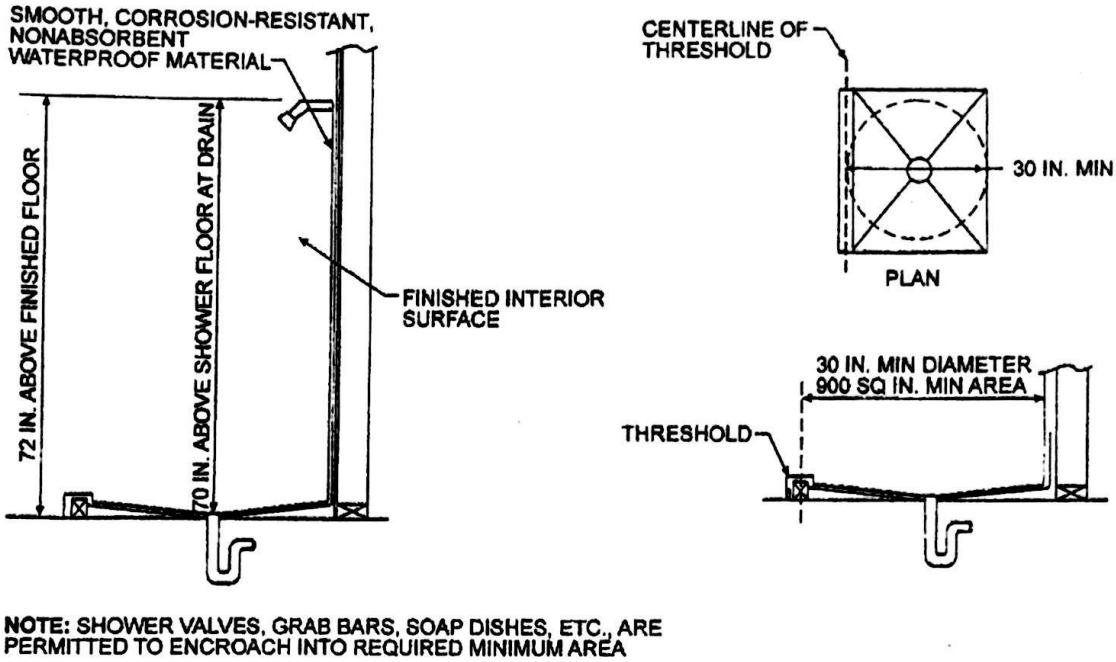
P2709.3 Installation.
Lining materials shall be sloped one-fourth unit vertical in 12 units horizontal (2-percent slope) to weep holes in the subdrain by means of a smooth, solidly formed subbase, shall be properly recessed and fastened to *approved* backing so as not to occupy the space required for the wall covering, and shall not be nailed or perforated at any point less than 1 inch (25.4 mm) above the finished threshold.

P2709.3.1 Materials.
Lead and copper linings shall be insulated from conducting substances other than the connecting drain by 15-pound (6.80 kg) asphalt felt or its equivalent. Sheet lead liners shall weigh not less than 4 pounds per square foot (19.5 kg/m^2). Sheet copper liners shall weigh not less than 12 ounces per square foot (3.7 kg/m^2). Joints in lead and copper pans or liners shall be burned or silver brazed, respectively. Joints in plastic liner materials shall be jointed per the manufacturer's instructions.

P2709.4 Receptor drains.
An *approved* flanged drain shall be installed with shower subpans or linings. The flange shall be placed flush with the subbase and be equipped with a clamping ring or other device to make a water-tight connection between the lining and the drain. The flange shall have weep holes into the drain.

SECTION P2710
SHOWER WALLS

P2710.1 Bathtub and shower spaces.
Shower walls shall be finished in accordance with Section R307.2.



NOTE: SHOWER VALVES, GRAB BARS, SOAP DISHES, ETC., ARE PERMITTED TO ENCROACH INTO REQUIRED MINIMUM AREA

For SI: 1 inch = 25.4 mm.

Figure P2708.1
SHOWER COMPARTMENT

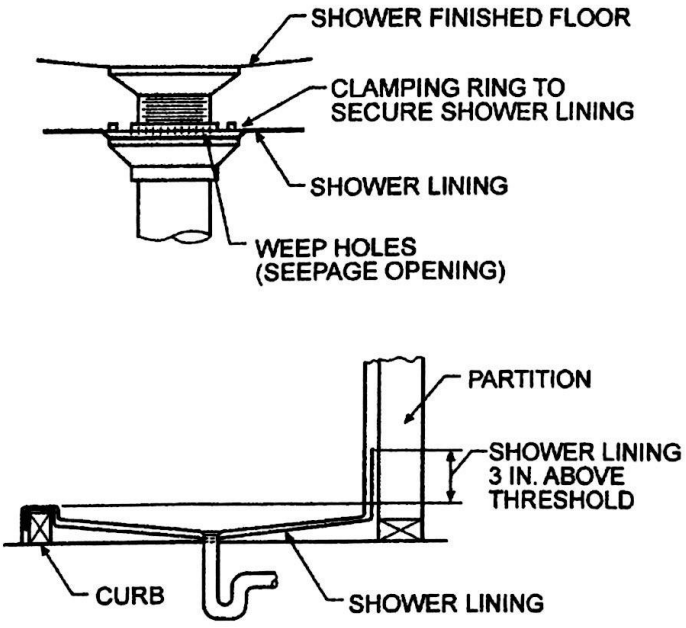


Figure P2709.1
SHOWER DRAIN AND PAN CONNECTION

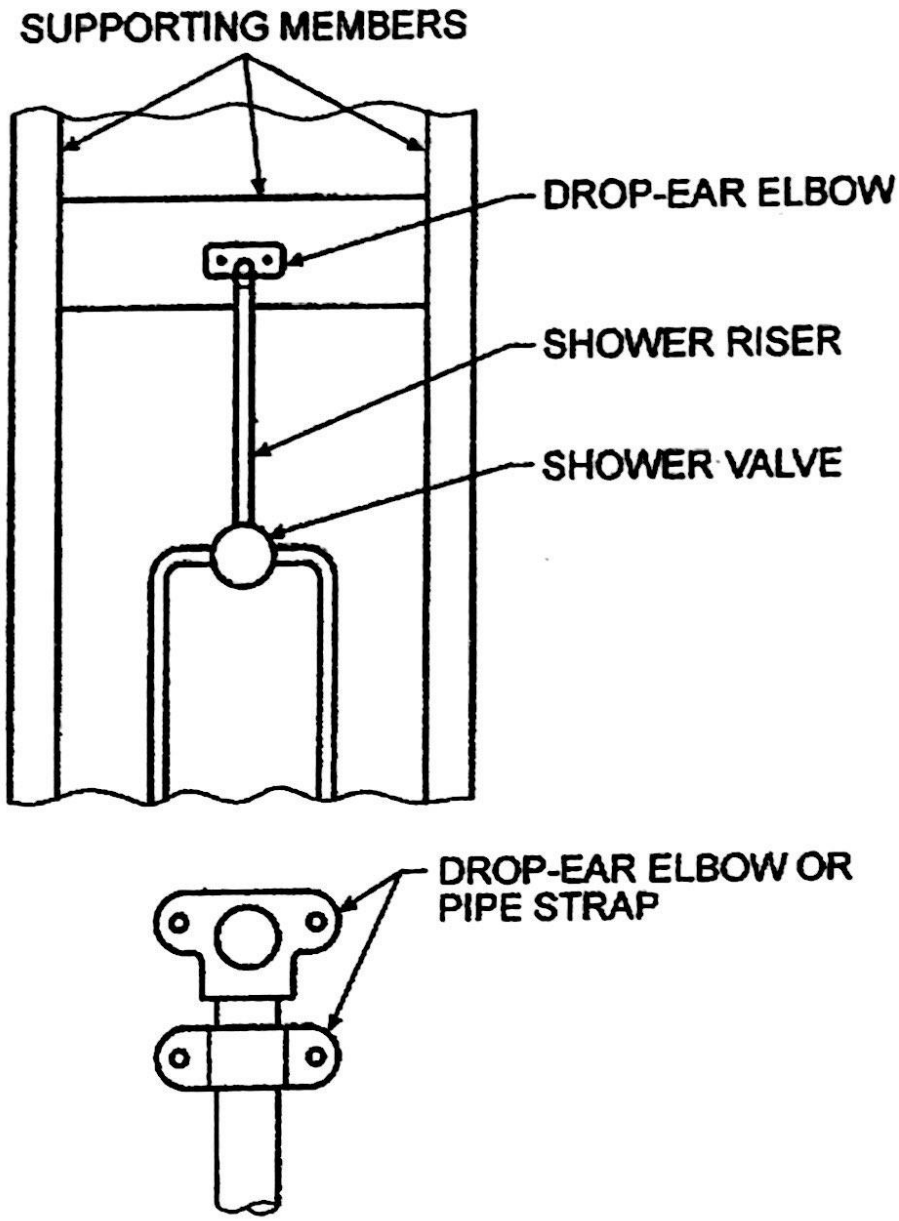


Figure P2708.2
SECURING SHOWER RISER

SECTION P2711
LAVATORIES

P2711.1 Approval.
Lavatories shall conform to ANSI Z124.3, ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1 or ASME A112.19.3/CSA B45.4.

P2711.2 Cultured marble lavatories.
Cultured marble vanity tops with an integral lavatory shall conform to ANSI Z124.3 or CSA B45.5.

P2711.3 Lavatory waste outlets.
Lavatories shall have waste outlets not less than $1^1/_4$ inch (32 mm) in diameter. A strainer, pop-up stopper, crossbar or other device shall be provided to restrict the clear opening of the waste outlet.

P2711.4 Movable lavatory systems.
Movable lavatory systems shall comply with ASME A112.19.12.

SECTION P2712
WATER CLOSETS

P2712.1 Approval.
Water closets shall conform to the water consumption requirements of Section P2903.2 and shall conform to ANSI Z124.4, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4 or CSA B45.5. Water closets shall conform to the hydraulic performance requirements of ASME A112.19.2/CSA B45.1. Water closet tanks shall conform to ANSI Z124.4, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4 or CSA B45.5. Water closets that have an invisible seal and unventilated space or walls that are not thoroughly washed at each discharge shall be prohibited. Water closets that permit backflow of the contents of the bowl into the flush tank shall be prohibited.

P2712.7 Water closet seats.
Water closets shall be equipped with seats of smooth, nonabsorbent material and shall be properly sized for the water closet bowl type.

SECTION P2713
BATHTUBS

P2713.1 Bathtub waste outlets and overflows.
Bathtubs shall be equipped with a waste outlet and an overflow outlet. The outlets shall be connected to waste tubing or piping not less than $1^1/_2$ inches (38 mm) in diameter. The waste outlet shall be equipped with a water-tight stopper.

P2713.2 Bathtub enclosures.
Doors within a bathtub enclosure shall conform to ASME A112.19.15.

P2713.3 Bathtub and whirlpool bathtub valves.
Hot water supplied to bathtubs and whirlpool bathtubs shall be limited to a temperature of not greater than 120°F (49°C) by a water-temperature limiting device that conforms to ASSE 1070 or CSA B125.3, except where such protection is otherwise provided by a combination tub/shower valve in accordance with Section P2708.3.

SECTION P2714
SINKS

P2714.1 Sink waste outlets.
Sinks shall be provided with waste outlets not less than $1^1/_2$ inches (38 mm) in diameter. A strainer, crossbar or other device shall be provided to restrict the clear opening of the waste outlet.

P2714.2 Movable sink systems.
Movable sink systems shall comply with ASME A112.19.12.

SECTION P2715
LAUNDRY TUBS

P2715.1 Laundry tub waste outlet.
Each compartment of a laundry tub shall be provided with a waste outlet not less than $1^1/_2$ inches (38 mm) in diameter and a strainer or crossbar to restrict the clear opening of the waste outlet.

SECTION P2716
FOOD WASTE GRINDER

P2716.1 Food waste grinder waste outlets.
Food waste grinders shall be connected to a drain of not less than $1^1/_2$ inches (38 mm) in diameter.

P2716.2 Water supply required.
Food waste grinders shall be provided with an adequate supply of water at a sufficient flow rate to ensure proper functioning of the unit.

SECTION P2717
DISHWASHING MACHINES

P2717.1 Protection of water supply.
The water supply for dishwashers shall be protected by an air gap or integral backflow preventer.

P2717.2 Sink and dishwasher.
A sink and dishwasher are permitted to discharge through a single $1^1/_2$-inch (38 mm) trap. The discharge pipe from the dishwasher shall be increased to not less than $^3/_4$ inch (19 mm) in diameter and shall be connected with a wye fitting to the sink tailpiece. The dishwasher waste line shall rise and be securely fastened to the underside of the counter before connecting to the sink tailpiece.

P2717.3 Sink, dishwasher and food grinder.
The combined discharge from a sink, dishwasher, and waste grinder is permitted to discharge through a single $1^1/_2$-inch (38 mm) trap. The discharge pipe from the dishwasher shall be increased to not less than $^3/_4$ inch (19 mm) in diameter and shall connect with a wye fitting between the discharge of the food-waste grinder and the trap inlet or to the head of the food grinder. The dishwasher waste line shall rise and be securely fastened to the underside of the counter before connecting to the sink tail piece or the food grinder.

SECTION P2718
CLOTHES WASHING MACHINE

P2718.1 Waste connection.
The discharge from a clothes washing machine shall be through an *air break*.

SECTION P2719
FLOOR DRAINS

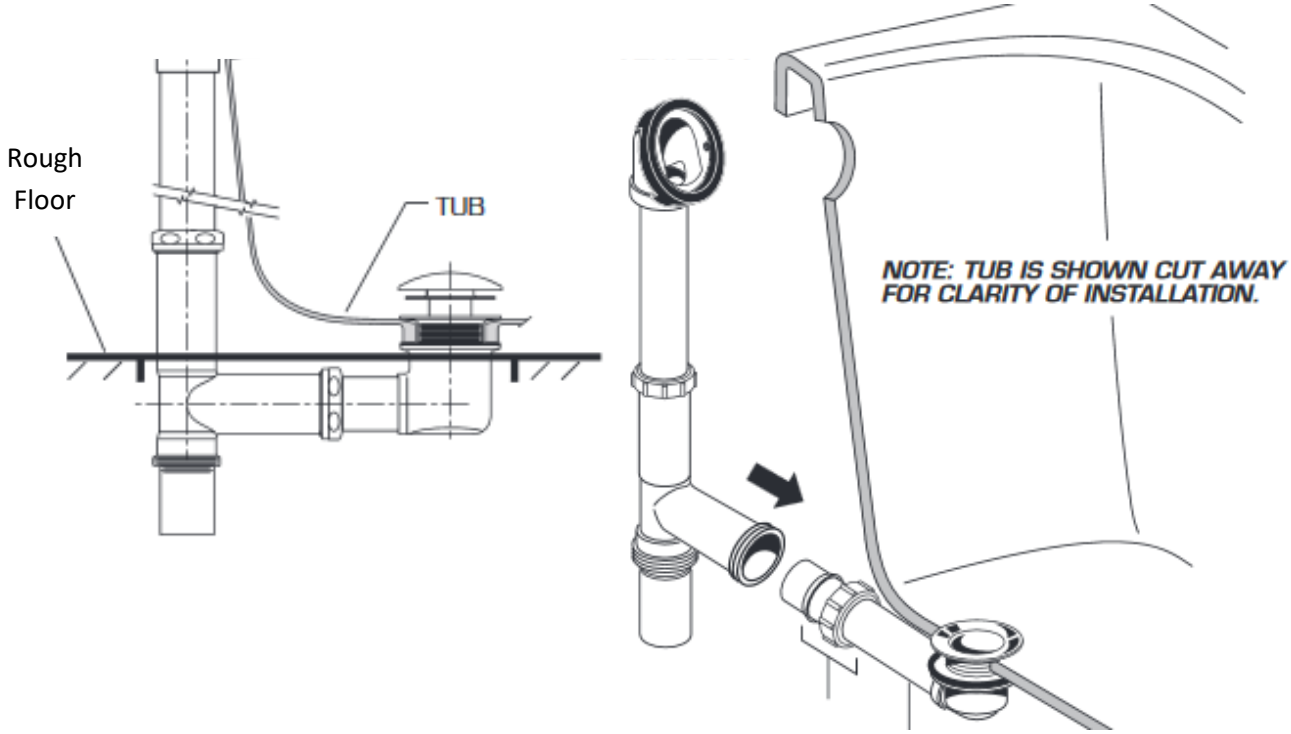
P2719.1 Floor drains.
Floor drains shall have waste outlets not less than 2 inches (51 mm) in diameter and a removable strainer. The floor drain shall be constructed so that the drain can be cleaned. Access shall be provided to the drain inlet. Floor drains shall not be located under or have their access restricted by permanently installed appliances.

SECTION P2720
WHIRLPOOL BATHTUBS

P2720.1 Access to pump.
Access shall be provided to circulation pumps in accordance with the fixture or pump manufacturer's installation instructions. Where the manufacturer's instructions do not specify the location and minimum size of field-fabricated access openings, an opening of not less than 12-inches by 12-inches (305 mm by 305 mm) shall be installed for access to the circulation pump. Where pumps are located more than 2 feet (610 mm) from the access opening, an opening of not less than 18 inches by 18 inches (457 mm by 457 mm) shall be installed. A door or panel shall be permitted to close the opening. In all cases, the access opening shall be unobstructed and be of the size necessary to permit the removal and replacement of the circulation pump.

P2720.2 Piping drainage.
The circulation pump shall be accessibly located above the crown weir of the trap. The pump drain line shall be properly graded to ensure minimum water retention in the volute after fixture use. The circulation piping shall be installed to be self-draining.

Below Floor Installations



SECTION P2721
BIDET INSTALLATIONS

P2721.1 Water supply.
The bidet shall be equipped with either an air-gap-type or vacuum-breaker-type fixture supply fitting.

P2721.2 Bidet water temperature.
The discharge water temperature from a bidet fitting shall be limited to not greater than 110°F (43°C) by a water-temperature-limiting device conforming to ASSE 1070 or CSA B125.3.

SECTION P2722
FIXTURE FITTING

P2722.1 General.
Fixture supply valves and faucets shall comply with ASME A112.18.1/CSA B125.1 as listed in Table P2701.1. Faucets and fixture fittings that supply drinking water for human ingestion shall conform to the requirements of NSF 61, Section 9. Flexible water connectors shall conform to the requirements of Section P2905.7.

P2722.2 Hot water.
Fixture fittings and faucets that are supplied with both hot and cold water shall be installed and adjusted so that the left-hand side of the water temperature control represents the flow of hot water when facing the outlet.

Exception: Shower and tub/shower mixing valves conforming to ASSE 1016 or ASME A112.18.1/CSA B125.1, where the water temperature control corresponds to the markings on the device.

P2722.3 Hose-connected outlets.
Faucets and fixture fittings with hose-connected outlets shall conform to ASME A112.18.3 or ASME A112.18.1/CSA B125.1.

P2722.4 Individual pressure-balancing in-line valves for individual fixture fittings.
Where individual pressure-balancing in-line valves for individual fixture fittings are installed, the valves shall comply with ASSE 1066. Such valves shall be installed in an accessible location and shall not be used alone as a substitute for the balanced pressure, thermostatic or combination shower valves required in Section P2708.3.

P2722.5 Water closet personal hygiene devices.
Personal hygiene devices integral to water closets or water closet seats shall conform to the requirements of ASME A112.4.2.

SECTION P2723
MACERATING TOILET SYSTEMS

P2723.1 General.
Macerating toilet systems shall be installed in accordance with manufacturer's instructions.

P2723.2 Drain.
The size of the drain from the macerating toilet system shall be not less than $^{3}/_{4}$ inch (19 mm) in diameter.

SECTION P2724
SPECIALTY TEMPERATURE CONTROL DEVICES
AND VALVES

P2724.1 Temperature-actuated mixing valves.
Temperature-actuated mixing valves, which are installed to reduce water temperatures to defined limits, shall comply with ASSE 1017. Such valves shall be installed at the hot water source.

P2724.2 Temperature-actuated, flow-reduction devices for individual fixtures.
Temperature-actuated, flow-reduction devices, where installed for individual fixture fittings, shall conform to ASSE 1062. Such valves shall not be used alone as a substitute for the balanced pressure, thermostatic or combination shower valves required for showers in Section P2708.3.

Chapter 28 Water Heaters

P2801.1 Required.
Each *dwelling* shall have an *approved* automatic water heater or other type of domestic water-heating system sufficient to supply hot water to plumbing fixtures and appliances intended for bathing, washing or culinary purposes. Storage tanks shall be constructed of noncorrosive metal or shall be lined with noncorrosive material.

P2801.2 Installation.
Water heaters shall be installed in accordance with this chapter and Chapters 20 and 24.

P2801.3 Location.
Water heaters and storage tanks shall be installed in accordance with Section M1305 and shall be located and connected to provide access for observation, maintenance, servicing and replacement.

P2801.4 Prohibited locations.
Water heaters shall be located in accordance with Chapter 20.

Exceptions:

1. Direct-vent water heaters
2. Appliances installed in a dedicated enclosure in which all combustible air is taken directly from the outdoors, in accordance with Section R703. Access to such enclosure shall be through a solid door, weatherstripped in accordance with the exterior door air leakage requirements of the International Energy Conservation Code and equipped with an approved self-closing device.

P2801.5 Required pan.
Where a storage tank-type water heater or a hot water storage tank is installed in a location where water leakage from the tank will cause damage, the tank shall be installed in a galvanized steel pan having a material thickness of not less than 0.0236 inch (0.6010 mm) (No. 24 gage), or other pans approved for such use. Listed pans shall comply with CSA LC3.

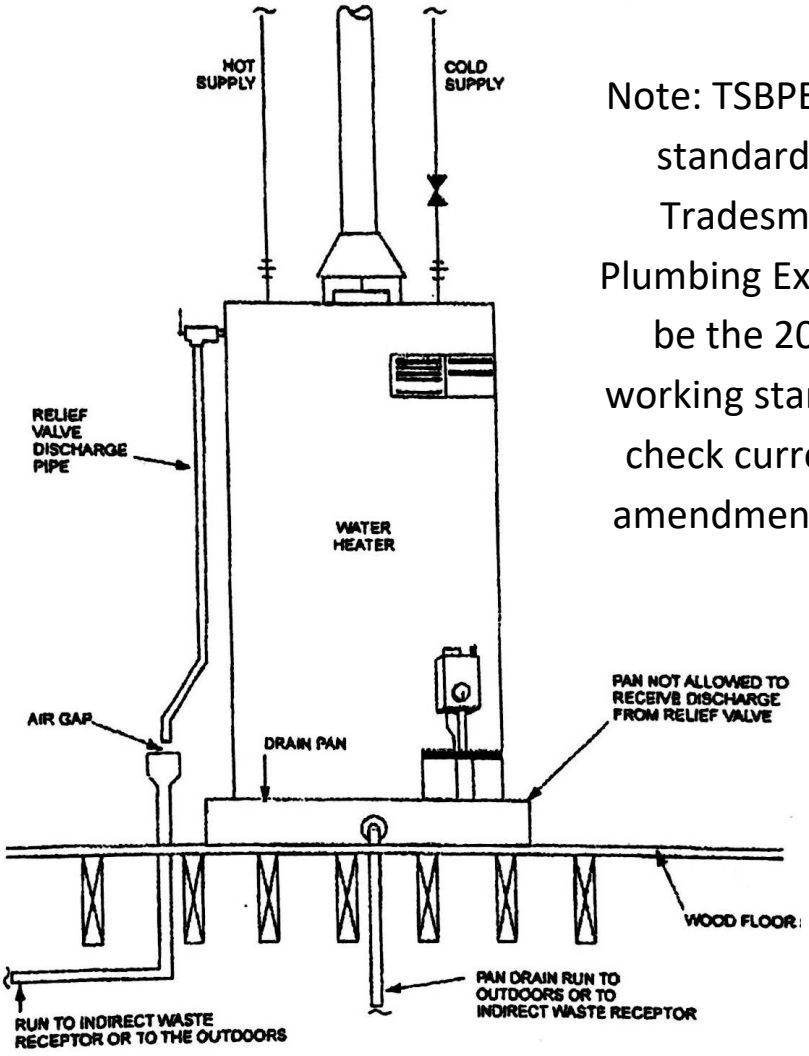
P2801.5.1 Pan size and drain.
The pan shall be not less than $1^1/_2$ inches (38 mm) deep and shall be of sufficient size and shape to receive all dripping or condensate from the tank or water heater. The pan shall be drained by an indirect waste pipe of not less than $^3/_4$ inch (19 mm) diameter. Piping for safety pan drains shall be of those materials listed in Table P2905.5.

P2801.5.2 Pan drain termination.
The pan drain shall extend full-size and terminate over a suitably located indirect waste receptor or shall extend to the exterior of the building and terminate not less than 6 inches (152 mm) and not more than 24 inches (610 mm) above the adjacent ground surface.

P2801.6 Water heaters installed in garages.
Water heaters having an *ignition source* shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the garage floor.

Exception: Elevation of the ignition source is not required for appliances that are listed as flammable vapor ignition-resistant.

P2801.7 Water heater seismic bracing.
In Seismic Design Categories D_0, D_1 and D_2 and townhouses in Seismic Design Category C, water heaters shall be anchored or strapped in the upper one-third and in the lower one-third of the appliance to resist a horizontal force equal to one-third of the operating weight of the water heater, acting in any horizontal direction, or in accordance with the appliance manufacturer's recommendations.



Note: TSBPE current code standard for testing Tradesman-Limited Plumbing Examination will be the 2012 IRC. For working standards always check current code and amendments for the AHJ

SECTION P2802
WATER HEATERS USED FOR SPACE HEATING

P2802.1 Protection of potable water.
Piping and components connected to a water heater for space heating applications shall be suitable for use with potable water in accordance with Chapter 29. Water heaters that will be used to supply potable water shall not be connected to a heating system or components previously used with nonpotable-water heating *appliances*. Chemicals for boiler treatment shall not be introduced into the water heater.

P2802.2 Temperature control.
Where a combination water heater-space heating system requires water for space heating at temperatures exceeding 140°F (60°C), a master thermostatic mixing valve complying with ASSE 1017 shall be installed to temper the water to a temperature of not greater than 140°F (60°C) for domestic uses.

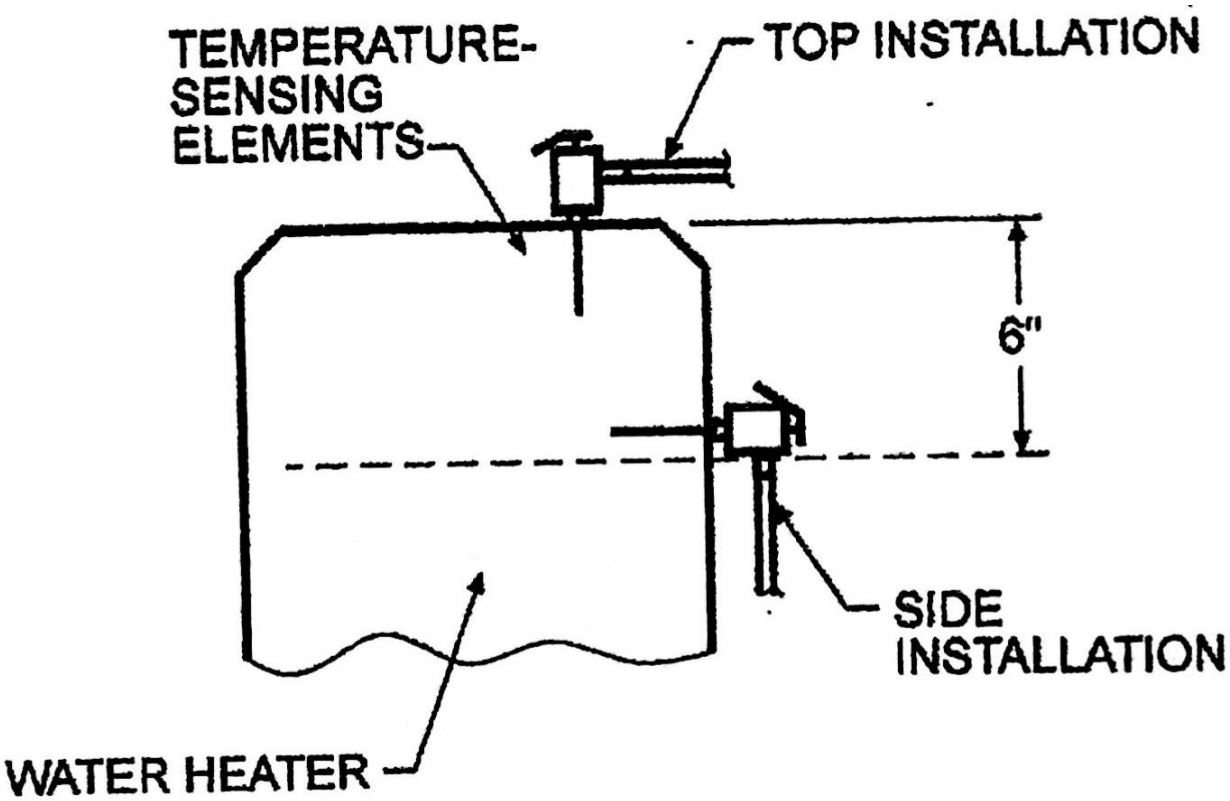
SECTION P2803
RELIEF VALVES

P2803.1 Relief valves required.
Appliances and equipment used for heating water or storing hot water shall be protected by:

1. A separate pressure-relief valve and a separate temperature-relief valve; or
2. A combination pressure- and temperature-relief valve.

P2803.2 Rating.
Relief valves shall have a minimum rated capacity for the equipment served and shall conform to ANSI Z21.22.

P2803.3 Pressure-relief valves.
Pressure-relief valves shall have a relief rating adequate to meet the pressure conditions for the appliances or equipment protected. In tanks, they shall be installed directly into a tank tapping or in a water line close to the tank. They shall be set to open at not less than 25 psi (172 kPa) above the system pressure but not over 150 psi (1034 kPa). The relief-valve setting shall not exceed the tanks rated working pressure.



P2803.4 Temperature-relief valves.
Temperature-relief valves shall have a relief rating compatible with the temperature conditions of the appliances or equipment protected. The valves shall be installed such that the temperature-sensing element monitors the water within the top 6 inches (152 mm) of the tank. The valve shall be set to open at a temperature of not greater than 210°F (99°C).

P2803.5 Combination pressure-/temperature-relief valves.
Combination pressure-/temperature-relief valves shall comply with all the requirements for separate pressure- and temperature-relief valves.

P2803.6 Installation of relief valves.
A check or shutoff valve shall not be installed in the following locations:

1. Between a relief valve and the termination point of the relief valve discharge pipe;
2. Between a relief valve and a tank; or
3. Between a relief valve and heating appliances or equipment.

P2803.6.1 Requirements for discharge pipe.
The discharge piping serving a pressure-relief valve, temperature-relief valve or combination valve 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.
8. Not be trapped.
9. Be installed to flow by gravity.
10. Not terminate more than 6 inches (152 mm) above the floor or waste receptor.
11. Not have a threaded connection at the end of the piping.
12. Not have valves or tee fittings.
13. Be constructed of those materials listed in Section P2905.5 or materials tested, rated and *approved* for such use in accordance with ASME A112.4.1.

P2803.7 Vacuum-relief valve.
Bottom fed tank-type water heaters and bottom fed tanks connected to water heaters shall have a vacuum-relief valve installed that complies with ANSI Z21.22.

Chapter Notes:

- With regards to gas water heaters, for fuels to burn properly and safely there must be a sufficient amount of fresh available at the appliance location to support:
    1. Combustion Air
    2. Dilution of the Draft Hood
    3. Equalize pressure throughout the appliance location

- A reletively standard proportion of oxygen molecules to gas modelcules is required in order to assure a complete burn (oxidation) of the gas molecules. Ais is approximately 80% Nitrogen, 19% Oxygen & 1% Trace Gases (Argon, Helium, Hydrogen & etc.)
- Ten cubic feet of air is required to furnish two cubic feet of oxygen at the termperature and pressure of standard atmosphere (pressure 29.92 inches of mercury at 59 Degrees F).
- Undersized combustion air will result in deficiency of air that is critical to safely and efficiently operate a fuel-burning appliance.
- A properly sized venting system and combustion air system should be installed for each gas fired appliance to insure the following proper functions of the appliance and the safety fo the building'c occupents as well as the structure's safety:
    1. Convey all fo the combustion products to the outside atmosphere.
    2. Prevent damage to the gas equipment, vent building, and furnishings from water vapor condensation in the flue gases.
    3. Prevent overheating of walls, building structure, and other combustible materials that are installed with requried clearance to the appliance and venting system.
    4. Provide fas priming fo the natural draft venting systems to minimize spillage of combustion products into the building.
- T&P: Temperature sensing element must be immersed in the water within the top 6" of the tank

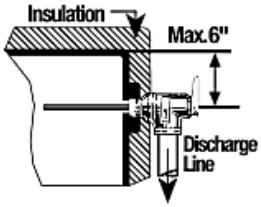
Direct Side Tapping

For External Flue Heaters

Use extra length extension thermostat to extend into water storage tank.

For Internal Flue Heaters

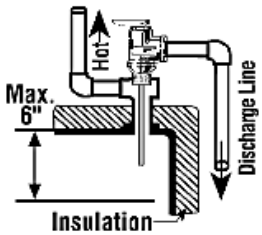
Use short or standard length thermostat. Vertical discharge line must be installed with its direction downward.



Alternate

Only when the tappings are not provided

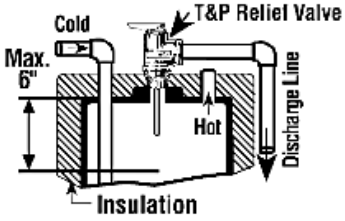
Use standard or extra length extension thermostat.

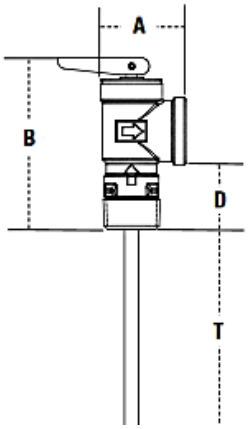


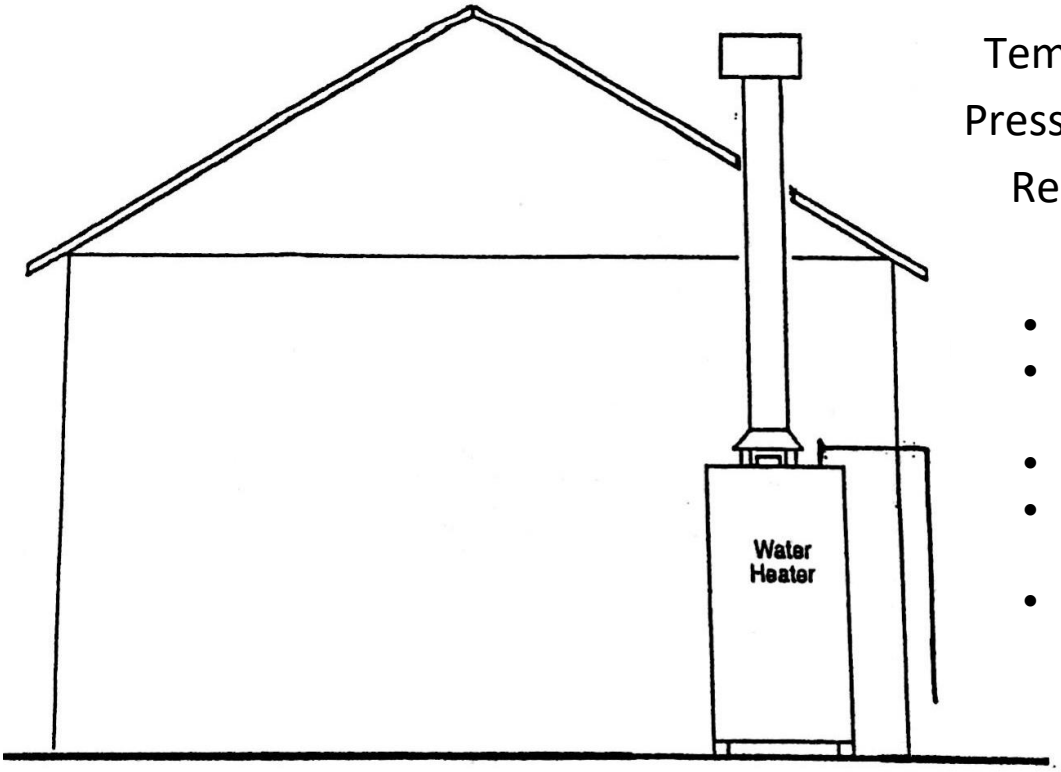
Direct Top Tapping

For Heaters

Use standard or extra length extension thermostat.

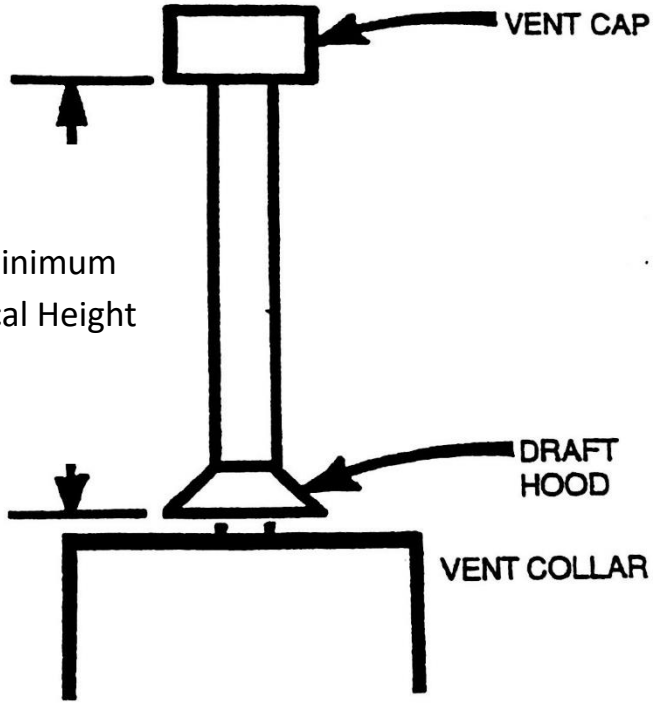






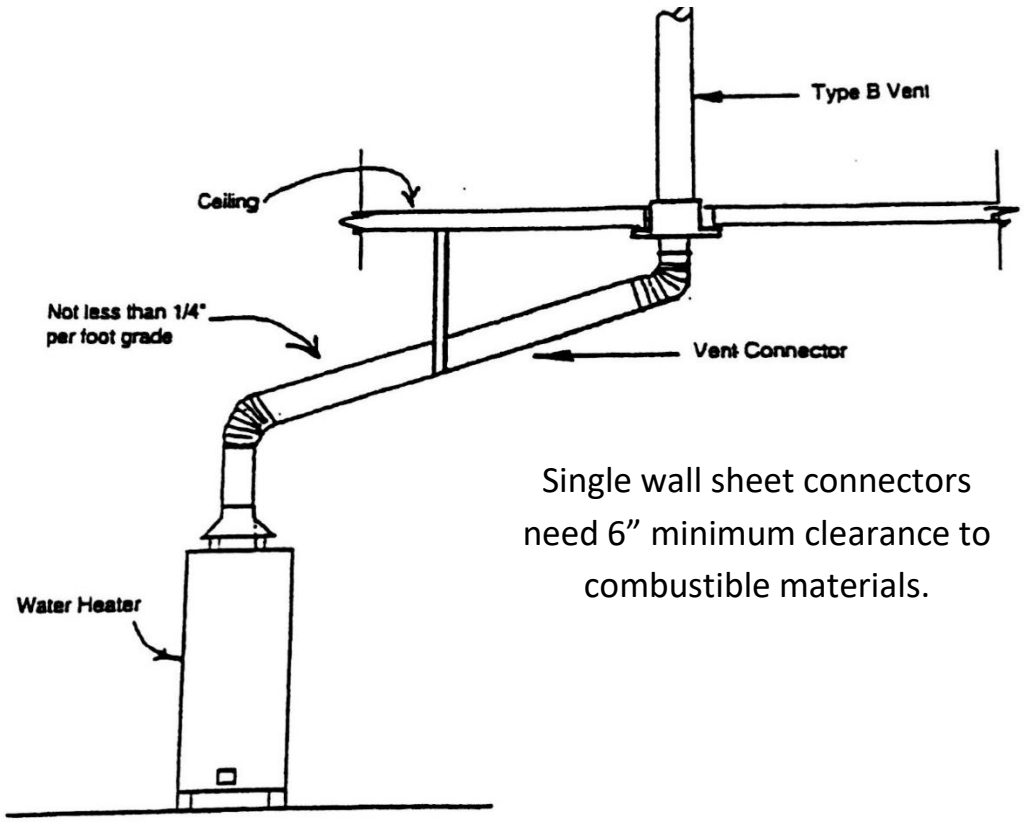
Temperature and Pressure Relief Line Requirements:

- ¾” Hard Drawn
- Cannot reduce in pipe size; or diminish size
- Must Slope to outside
- Must terminate not less than 6” above grade
- Material must be approved for exterior exposure

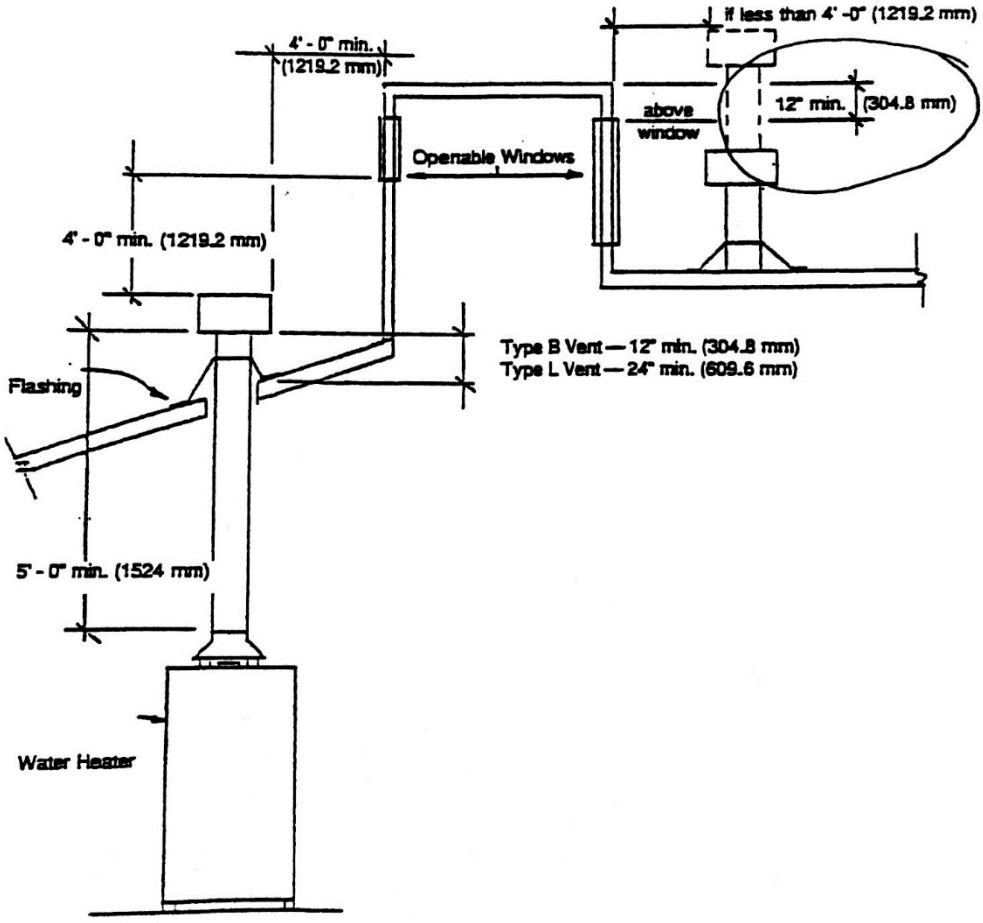


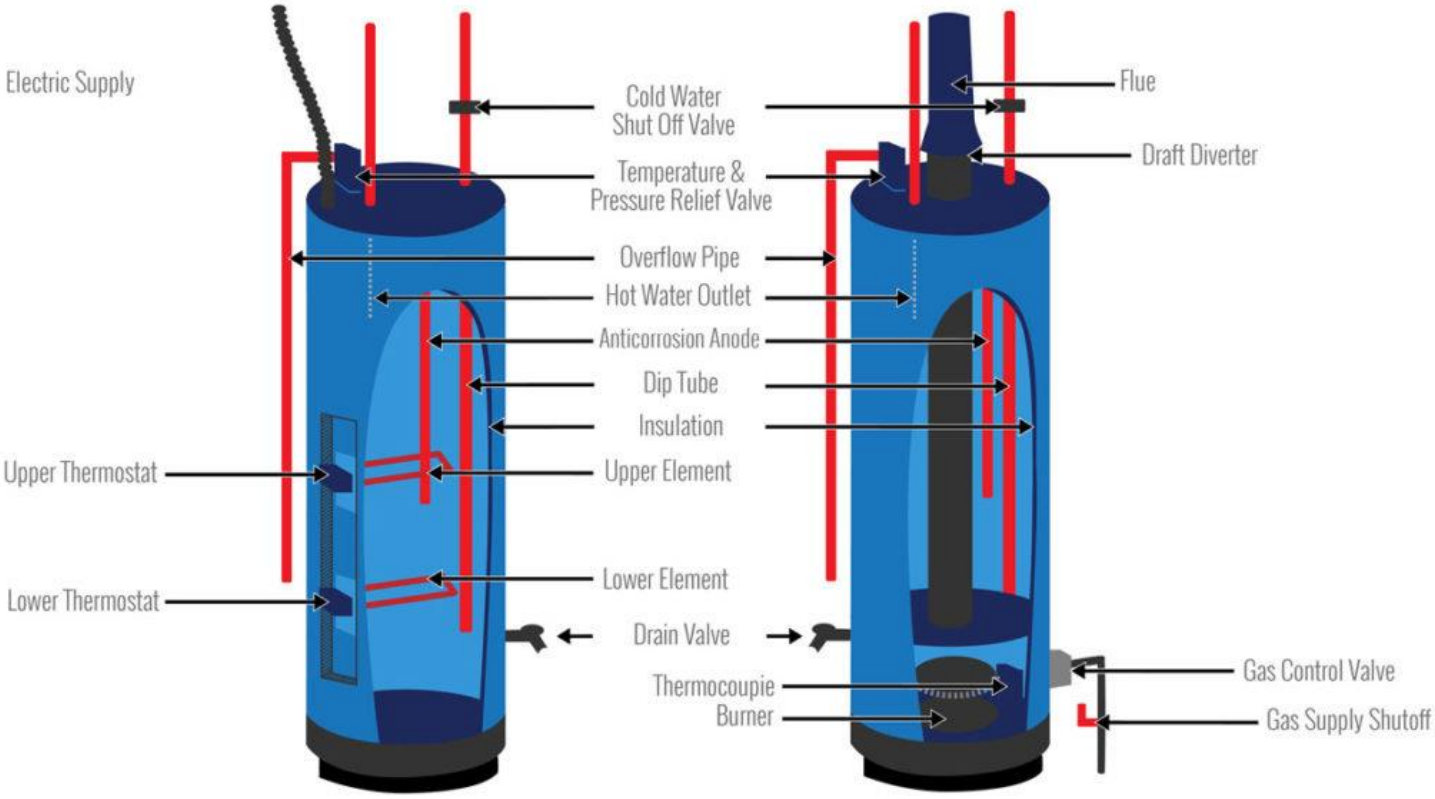
MINIMUM VENT HEIGHT

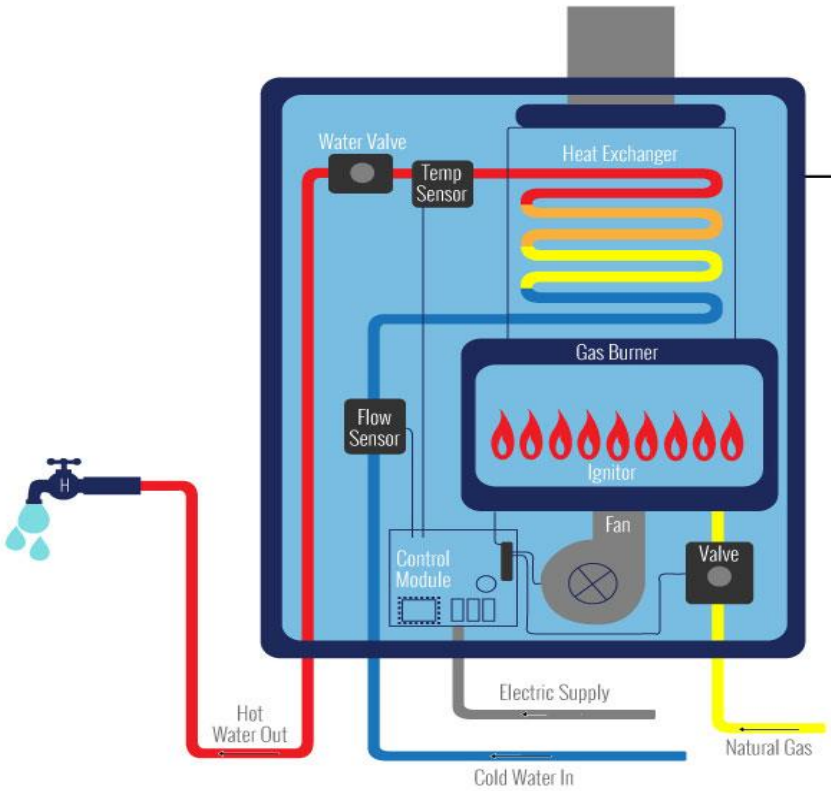
The 5’ minimum vertical height prevents accumulation of moisture which will restrict tank corrosion



Single wall sheet connectors need 6” minimum clearance to combustible materials.







How it Works:

1. A hot water valve is opened.
2. Cold water enters the heater through the flow sensor, alerting control module that hot water is needed.
3. The control module turns on the fan, opens the gas valve, and ignites the burner.
4. Water is circulated through the heat exchanger and is heated by the gas burner.
5. The temperature sensor alerts the control module as the water temperature begins to rise.
6. The control module may reduce the valve's gas input as the desired water temperature is reached or cycle the gas valve off upon reaching the desired temperature.
7. When the hot water valve is sloced, the flow sensor signals the control module to turn off the unit.

Chapter 5

IRC

Chapter 29 Water Supply & Distribution

CONGER
CONSTRUCTION
SERVICES, LLC.

CHAPTER 29
WATER SUPPLY AND DISTRIBUTION

SECTION P2901
GENERAL

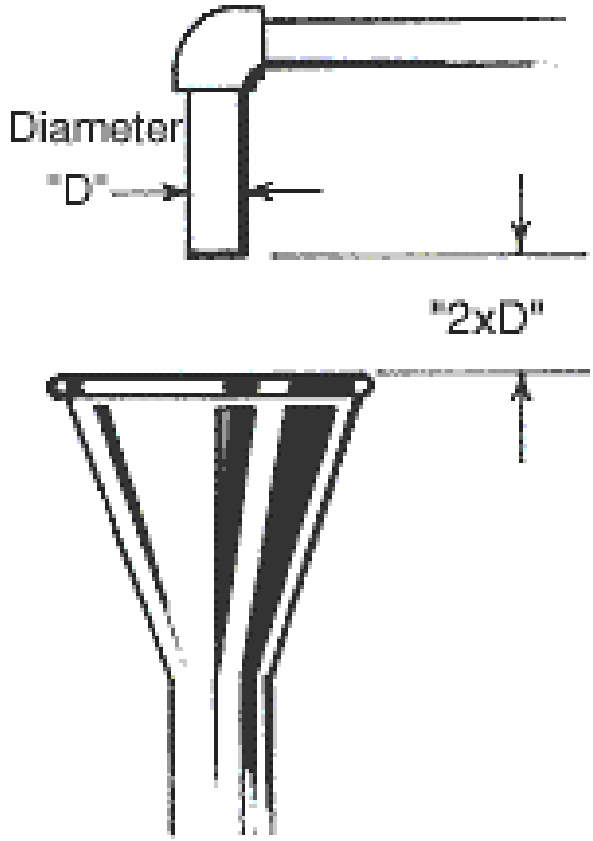
P2901.1 Potable water required.
Dwelling units shall be supplied with potable water in the amounts and pressures specified in this chapter. Where a nonpotable water-distribution system is installed, the nonpotable system shall be identified by color marking, metal tags or other appropriate method. Where color is used for marking, purple shall be used to identify municipally reclaimed water, rainwater and graywater distribution systems. Nonpotable outlets that could inadvertently be used for drinking or domestic purposes shall be posted.

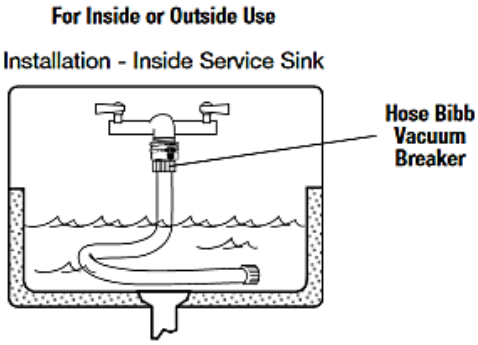
SECTION P2902
PROTECTION OF POTABLE WATER SUPPLY

P2902.1 General.
A potable water supply system shall be designed and installed as to prevent contamination from nonpotable liquids, solids or gases being introduced into the potable water supply. Connections shall not be made to a potable water supply in a manner that could contaminate the water supply or provide a cross-connection between the supply and a source of contamination except where approved methods are installed to protect the potable water supply. Cross-connections between an individual water supply and a potable public water supply shall be prohibited.

P2902.2 Plumbing fixtures.
The supply lines and fittings for every plumbing fixture shall be installed so as to prevent backflow. Plumbing fixture fittings shall provide backflow protection in accordance with ASME A112.18.1/CSA B125.1.

P2902.3 Backflow protection.
A means of protection against backflow shall be provided in accordance with Sections P2902.3.1 through P2902.3.6. Backflow prevention applications shall conform to Table P2902.3, except as specifically stated in Sections P2902.4 through P2902.5.5.





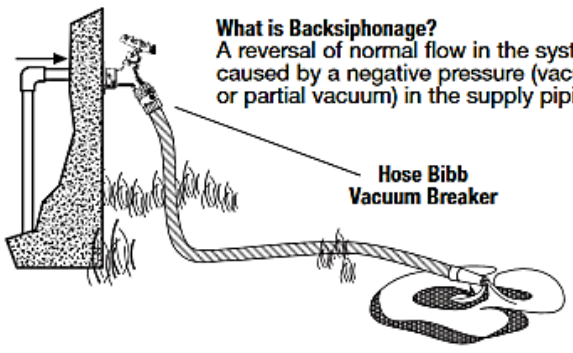


TABLE P2902.3
APPLICATION FOR BACKFLOW PREVENTERS

DEVICE	DEGREE OF HAZARD[a]	APPLICATION[b]	APPLICABLE STANDARDS
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
Antisiphon-type fill valves for gravity water closet flush tanks	High hazard	Backsiphonage only	ASSE 1002, CSA B125.3
Backflow preventer with intermediate atmospheric vents	Low hazard	Backpressure or backsiphonage Sizes $^1/_4$" – $^3/_4$"	ASSE 1012, CSA B64.3
Double check backflow prevention assembly and double check fire protection backflow prevention assembly	Low hazard	Backpressure or backsiphonage Sizes $^3/_8$" – 16"	ASSE 1015, AWWA C510, CSA B64.5, CSA B64.5.1
Double check detector fire protection backflow prevention assemblies	Low hazard	Backpressure or backsiphonage (Fire sprinkler systems) Sizes 2" – 16"	ASSE 1048
Dual-check-valve-type backflow preventer	Low hazard	Backpressure or backsiphonage Sizes $^1/_4$" – 1"	ASSE 1024, CSA B64.6
Hose-connection backflow preventer	High or low hazard	Low head backpressure, rated working pressure backpressure or backsiphonage Sizes $^1/_2$" – 1"	ASSE 1052, CSA B64.2.1.1
Hose-connection vacuum breaker	High or low hazard	Low head backpressure or backsiphonage Sizes $^1/_2$", $^3/_4$", 1"	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 $^1/_4$" – 4"	ASSE 1001, CSA B64.1.1
Pressure vacuum breaker assembly	High or low hazard	Backsiphonage only Sizes $^1/_2$" – 2"	ASSE 1020, CSA B64.1.2
Reduced pressure detector fire protection backflow prevention assemblies	High or low hazard	Backsiphonage or backpressure (Fire sprinkler systems)	ASSE 1047
Reduced pressure principle backflow prevention assembly and reduced pressure principle fire protection backflow prevention assembly	High or low hazard	Backpressure or backsiphonage Sizes $^3/_8$" – 16"	ASSE 1013, AWWA C511, CSA B64.4, CSA B64.4.1
Spill-resistant pressure vacuum breaker	High or low hazard	Backsiphonage only Sizes $^1/_4$" – 2″	ASSE 1056, CSA B64.1.3
Vacuum breaker wall hydrants, frost-resistant, automatic-draining type	High or low hazard	Low head backpressure or backsiphonage Sizes $^3/_4$" – 1"	ASSE 1019, CSA B64.2.2

For SI: 1 inch = 25.4 mm.

a. Low hazard—See Pollution (Section R202). High hazard—See Contamination (Section R202).

b. See Backpressure (Section R202). See Backpressure, Low Head (Section R202). See Backsiphonage (Section R202).

P2902.3.1 Air gaps.
Air gaps shall comply with ASME A112.1.2 and air gap fittings shall comply with ASME A112.1.3. The minimum air gap shall be measured vertically from the lowest end of a water supply outlet to the flood level rim of the fixture or receptor into which such potable water outlets discharge. The minimum required air gap shall be twice the diameter of the effective opening of the outlet, but in no case less than the values specified in Table P2902.3.1. An air gap is required at the discharge point of a relief valve or piping. Air gap devices shall be incorporated in dishwashing and clothes washing *appliances*.

TABLE P2902.3.1
MINIMUM AIR GAPS

FIXTURE	MINIMUM AIR GAP	
	Away from a wall[a] (inches)	Close to a wall (inches)
Effective openings greater than 1 inch	Two times the diameter of the effective opening	Three times the diameter of the effective opening
Lavatories and other fixtures with effective opening not greater than $^1/_2$ inch in diameter	1	1.5
Over-rim bath fillers and other fixtures with effective openings not greater than 1 inch in diameter	2	3
Sink, laundry trays, gooseneck back faucets and other fixtures with effective openings not greater than $^3/_4$ inch in diameter	1.5	2.5

For SI: 1 inch = 25.4 mm.
a. Applicable where walls or obstructions are spaced from the nearest inside edge of the spout opening a distance greater than three times the diameter of the effective opening for a single wall, or a distance greater than four times the diameter of the effective opening for two intersecting walls.

P2902.3.2 Atmospheric-type vacuum breakers.
Pipe-applied atmospheric-type vacuum breakers shall conform to ASSE 1001 or CSA B64.1.1. Hose-connection vacuum breakers shall conform to ASSE 1011, ASSE 1019, ASSE 1035, ASSE 1052, CSA B64.2, CSA B64.2.1, CSA B64.2.1.1, CSA B64.2.2 or CSA B64.7. These devices shall operate under normal atmospheric pressure when the critical level is installed at the required height.

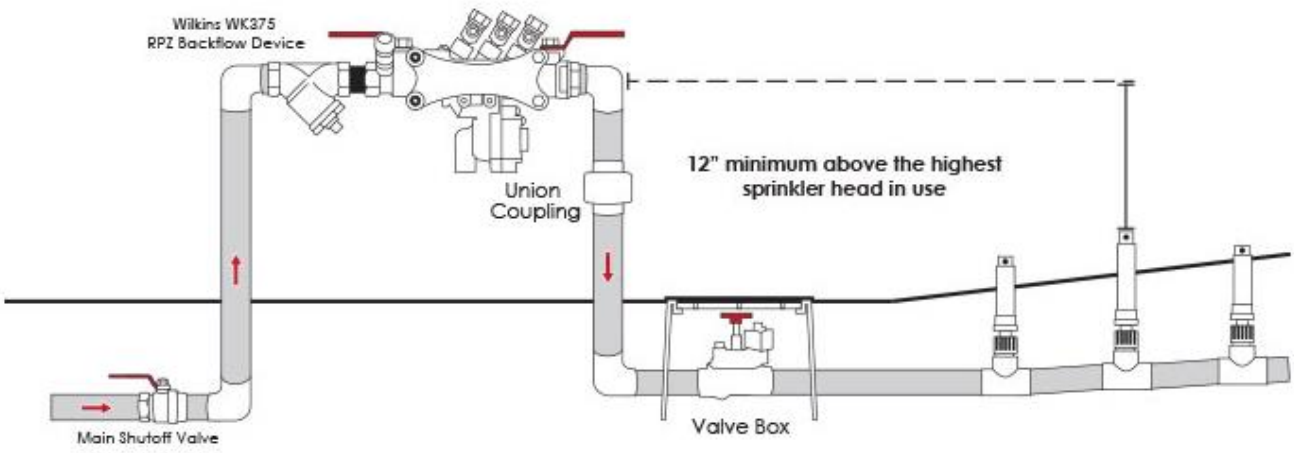
P2902.3.3 Backflow preventer with intermediate atmospheric vent.
Backflow preventers with intermediate atmospheric vents shall conform to ASSE 1012 or CAN/CSA B64.3. These devices shall be permitted to be installed where subject to continuous pressure conditions. The relief opening shall discharge by air gap and shall be prevented from being submerged.

P2902.3.4 Pressure vacuum breaker assemblies.
Pressure vacuum breaker assemblies shall conform to ASSE 1020 or CSA B64.1.2. Spill-resistant vacuum breaker assemblies shall comply with ASSE 1056. These assemblies are designed for installation under continuous pressure conditions where the critical level is installed at the required height. Pressure vacuum breaker assemblies shall not be installed in locations where spillage could cause damage to the structure.

P2902.3.5 Reduced pressure principle backflow prevention assemblies.
Reduced pressure principle backflow prevention assemblies and reduced pressure principle fire protection backflow prevention assemblies shall conform to ASSE 1013, AWWA C511, CSA B64.4 or CSA B64.4.1. Reduced pressure detector fire protection backflow prevention assemblies shall conform to ASSE 1047. These devices shall be permitted to be installed where subject to continuous pressure conditions. The relief opening shall discharge by air gap and shall be prevented from being submerged.

P2902.3.6 Double check-valve assemblies.
Double check-valve assemblies shall conform to ASSE 1015, CSA B64.5, CSA B64.5.1 or AWWA C510. Double-detector check-valve assemblies shall conform to ASSE 1048. These devices shall be capable of operating under continuous pressure conditions.

P2902.4 Protection of potable water outlets.
Potable water openings and outlets shall be protected by an air gap, reduced pressure principle backflow preventer with atmospheric vent, atmospheric-type vacuum breaker, pressure-type vacuum breaker or hose connection backflow preventer.



P2902.4.1 Fill valves.
Flush tanks shall be equipped with an antisiphon fill valve conforming to ASSE 1002 or CSA B125.3. The fill valve backflow preventer shall be located not less than 1 inch (25 mm) above the full opening of the overflow pipe.

P2902.4.2 Deck-mounted and integral vacuum breakers.
Approved deck-mounted or equipment-mounted vacuum breakers and faucets with integral atmospheric vacuum breakers or spill–resistant vacuum breaker assemblies shall be installed in accordance with the manufacturer's instructions and the requirements for labeling. The critical level of the breakers and assemblies shall be located at not less than 1 inch (25 mm) above the *flood level rim*.

P2902.4.3 Hose connection.
Sillcocks, hose bibbs, wall hydrants and other openings with a hose connection shall be protected by an atmospheric-type or pressure-type vacuum breaker or a permanently attached hose connection vacuum breaker.

Exceptions:

1. This section shall not apply to water heater and boiler drain valves that are provided with hose connection threads and that are intended only for tank or vessel draining.

2. This section shall not apply to water supply valves intended for connection of clothes washing machines where backflow prevention is otherwise provided or is integral with the machine.

P2902.5 Protection of potable water connections.
Connections to the potable water shall conform to Sections P2902.5.1 through P2902.5.5.

P2902.5.1 Connections to boilers.
The potable supply to the boiler shall be equipped with a backflow preventer with an intermediate atmospheric vent complying with ASSE 1012 or CSA B64.3. Where conditioning chemicals are introduced into the system, the potable water connection shall be protected by an air gap or a reduced pressure principle backflow preventer complying with ASSE 1013, CSA B64.4 or AWWA C511.

Air Gap Basket

RPZ: Reduced Pressure Zone Assemblies

P2902.5.2 Heat exchangers.
Heat exchangers using an essentially toxic transfer fluid shall be separated from the potable water by double-wall construction. An air gap open to the atmosphere shall be provided between the two walls. Heat exchangers utilizing an essentially nontoxic transfer fluid shall be permitted to be of single-wall construction.

P2902.5.3 Lawn irrigation systems.
The potable water supply to lawn irrigation systems shall be protected against backflow by an atmospheric vacuum breaker, a pressure vacuum breaker assembly or a reduced pressure principle backflow prevention assembly. Valves shall not be installed downstream from an atmospheric vacuum breaker. Where chemicals are introduced into the system, the potable water supply shall be protected against backflow by a reduced pressure principle backflow prevention assembly.

P2902.5.4 Connections to automatic fire sprinkler systems.
The potable water supply to automatic fire sprinkler shall be protected against backflow by a double check backflow prevention assembly, a double check fire protection backflow prevention assembly, a reduced pressure principle backflow prevention assembly or a reduced pressure principle fire protection backflow prevention assembly.

Exception: Where systems are installed as a portion of the water distribution system in accordance with the requirements of this code and are not provided with a fire department connection, backflow protection for the water supply system shall not be required.

P2902.5.4.1 Additives or nonpotable source.
Where systems contain chemical additives or antifreeze, or where systems are connected to a nonpotable secondary water supply, the potable water supply shall be protected against backflow by a reduced pressure principle backflow prevention assembly or a reduced pressure principle fire protection backflow prevention assembly. Where chemical additives or antifreeze is added to only a portion of an automatic fire sprinkler or standpipe system, the reduced pressure principle fire protection backflow preventer shall be permitted to be located so as to isolate that portion of the system.

P2902.5.2 Heat exchangers.
Heat exchangers using an essentially toxic transfer fluid shall be separated from the potable water by double-wall construction. An air gap open to the atmosphere shall be provided between the two walls. Heat exchangers utilizing an essentially nontoxic transfer fluid shall be permitted to be of single-wall construction.

P2902.5.3 Lawn irrigation systems.
The potable water supply to lawn irrigation systems shall be protected against backflow by an atmospheric vacuum breaker, a pressure vacuum breaker assembly or a reduced pressure principle backflow prevention assembly. Valves shall not be installed downstream from an atmospheric vacuum breaker. Where chemicals are introduced into the system, the potable water supply shall be protected against backflow by a reduced pressure principle backflow prevention assembly.

P2902.5.4 Connections to automatic fire sprinkler systems.
The potable water supply to automatic fire sprinkler shall be protected against backflow by a double check backflow prevention assembly, a double check fire protection backflow prevention assembly, a reduced pressure principle backflow prevention assembly or a reduced pressure principle fire protection backflow prevention assembly.

Exception: Where systems are installed as a portion of the water distribution system in accordance with the requirements of this code and are not provided with a fire department connection, backflow protection for the water supply system shall not be required.

P2902.5.4.1 Additives or nonpotable source.
Where systems contain chemical additives or antifreeze, or where systems are connected to a nonpotable secondary water supply, the potable water supply shall be protected against backflow by a reduced pressure principle backflow prevention assembly or a reduced pressure principle fire protection backflow prevention assembly. Where chemical additives or antifreeze is added to only a portion of an automatic fire sprinkler or standpipe system, the reduced pressure principle fire protection backflow preventer shall be permitted to be located so as to isolate that portion of the system.

P2902.5.5 Solar systems.
The potable water supply to a solar system shall be equipped with a backflow preventer with intermediate atmospheric vent complying with ASSE 1012 or a reduced pressure principle backflow preventer complying with ASSE 1013. Where chemicals are used, the potable water supply shall be protected by a reduced pressure principle backflow preventer.

Exception: Where all solar system piping is a part of the potable water distribution system, in accordance with the requirements of the *International Plumbing Code*, and all components of the piping system are listed for potable water use, cross-connection protection measures shall not be required.

P2902.6 Location of backflow preventers.
Access shall be provided to backflow preventers as specified by the manufacturer's installation instructions.

P2902.6.1 Outdoor enclosures for backflow prevention devices.
Outdoor enclosures for backflow prevention devices shall comply with ASSE 1060.

P2902.6.2 Protection of backflow preventers.
Backflow preventers shall not be located in areas subject to freezing except where they can be removed by means of unions, or are protected by heat, insulation or both.

P2902.6.3 Relief port piping.
The termination of the piping from the relief port or air gap fitting of the backflow preventer shall discharge to an *approved* indirect waste receptor or to the outdoors where it will not cause damage or create a nuisance.

SECTION P2903
WATER-SUPPLY SYSTEM

P2903.1 Water supply system design criteria.
The water service and water distribution systems shall be designed and pipe sizes shall be selected such that under conditions of peak demand, the capacities at the point of outlet discharge shall not be less than shown in Table P2903.1.

TABLE P2903.1
REQUIRED CAPACITIES AT POINT OF OUTLET DISCHARGE

FIXTURE AT POINT OF OUTLET	FLOW RATE (gpm)	FLOW PRESSURE (psi)
Bathtub, pressure-balanced or thermostatic mixing valve	4	20
Bidet, thermostatic mixing	2	20
Dishwasher	2.75	8
Laundry tub	4	8
Lavatory	2	8
Shower, pressure-balancing or thermostatic mixing valve	3	20
Sillcock, hose bibb	5	8
Sink	2.5	8
Water closet, flushometer tank	1.6	20
Water closet, tank, close coupled	3	20
Water closet, tank, one-piece	6	20

For SI: 1 gallon per minute = 3.785 L/m,
1 pound per square inch = 6.895 kPa.

P2903.2 Maximum flow and water consumption.
The maximum water consumption flow rates and quantities for all plumbing fixtures and fixture fittings shall be in accordance with Table P2903.2.

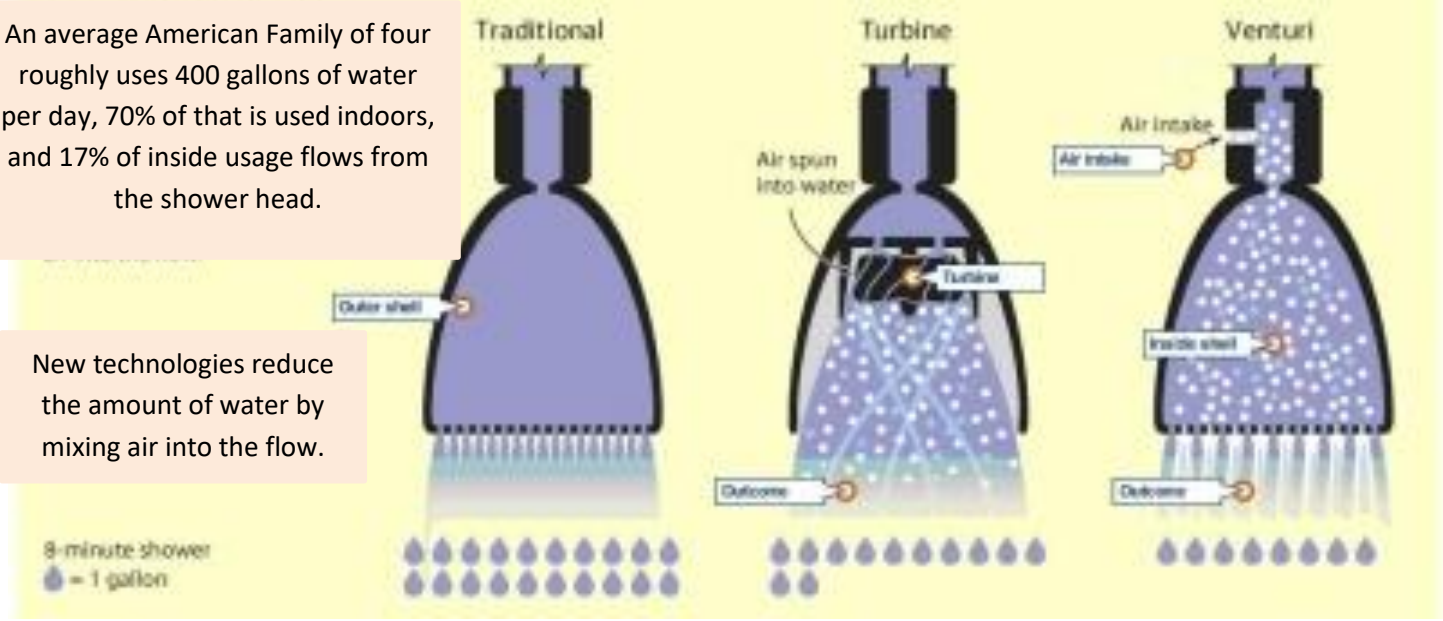
TABLE P2903.2
MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS[b]

PLUMBING FIXTURE OR FIXTURE FITTING	PLUMBING FIXTURE OR FIXTURE FITTING
Lavatory faucet	2.2 gpm at 60 psi
Shower head[a]	2.5 gpm at 80 psi
Sink faucet	2.2 gpm at 60 psi
Water closet	1.6 gallons per flushing cycle

For SI: 1 gallon per minute = 3.785 L/m,
1 pound per square inch = 6.895 kPa.
a. A handheld shower spray is also a shower head.
b. Consumption tolerances shall be determined from referenced standards.

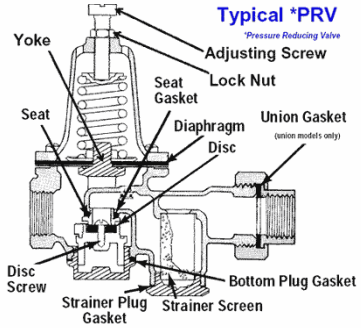
An average American Family of four roughly uses 400 gallons of water per day, 70% of that is used indoors, and 17% of inside usage flows from the shower head.

New technologies reduce the amount of water by mixing air into the flow.



P2903.3 Minimum pressure.
The static water pressure (as determined by the local water authority) at the building entrance for either public or private water service shall be not less than 40 psi (276 kPa).

P2903.3.1 Maximum pressure.
The static water pressure shall be not greater than 80 psi (551 kPa). When main pressure exceeds 80 psi (551 kPa), an approved pressure-reducing valve conforming to ASSE 1003 or CSA B356 shall be installed on the domestic water branch main or riser at the connection to the water-service pipe.



P2903.4 Thermal expansion control.
A means for controlling increased pressure caused by thermal expansion shall be installed where required in accordance with Sections P2903.4.1 and P2903.4.2.

P2903.4.1 Pressure-reducing valve.
For water service system sizes up to and including 2 inches (51 mm), a device for controlling pressure shall be installed where, because of thermal expansion, the pressure on the downstream side of a pressure-reducing valve exceeds the pressure-reducing valve setting.

P2903.4.2 Backflow prevention device or check valve.
Where a backflow prevention device, check valve or other device is installed on a water supply system using storage water heating equipment such that thermal expansion causes an increase in pressure, a device for controlling pressure shall be installed.

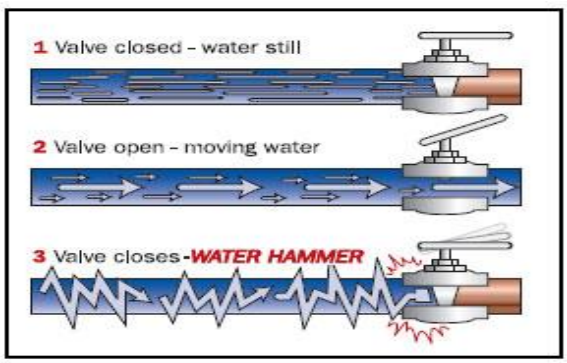
P2903.5 Water hammer.
The flow velocity of the water distribution system shall be controlled to reduce the possibility of water hammer. Water-hammer arrestors shall be installed in accordance with the manufacturer's installation instructions. Water hammer arrestors shall conform to ASSE 1010.

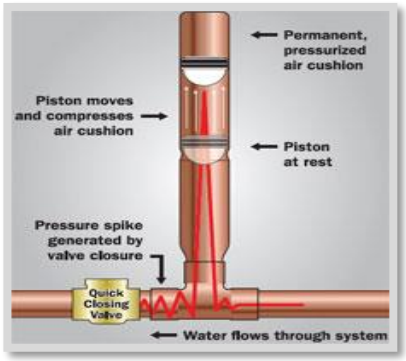
P2903.6 Determining water-supply fixture units.
Supply loads in the building water-distribution system shall be determined by total load on the pipe being sized, in terms of water-supply fixture units (w.s.f.u.), as shown in Table P2903.6, and gallon per minute (gpm) flow rates [see Table P2903.6(1)]. For fixtures not listed, choose a w.s.f.u. value of a fixture with similar flow characteristics.

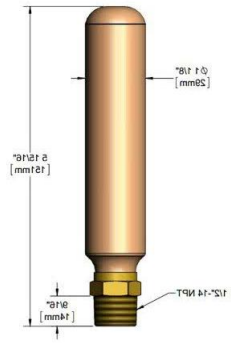
TABLE P2903.6
WATER-SUPPLY FIXTURE-UNIT VALUES FOR VARIOUS PLUMBING FIXTURES AND FIXTURE GROUPS

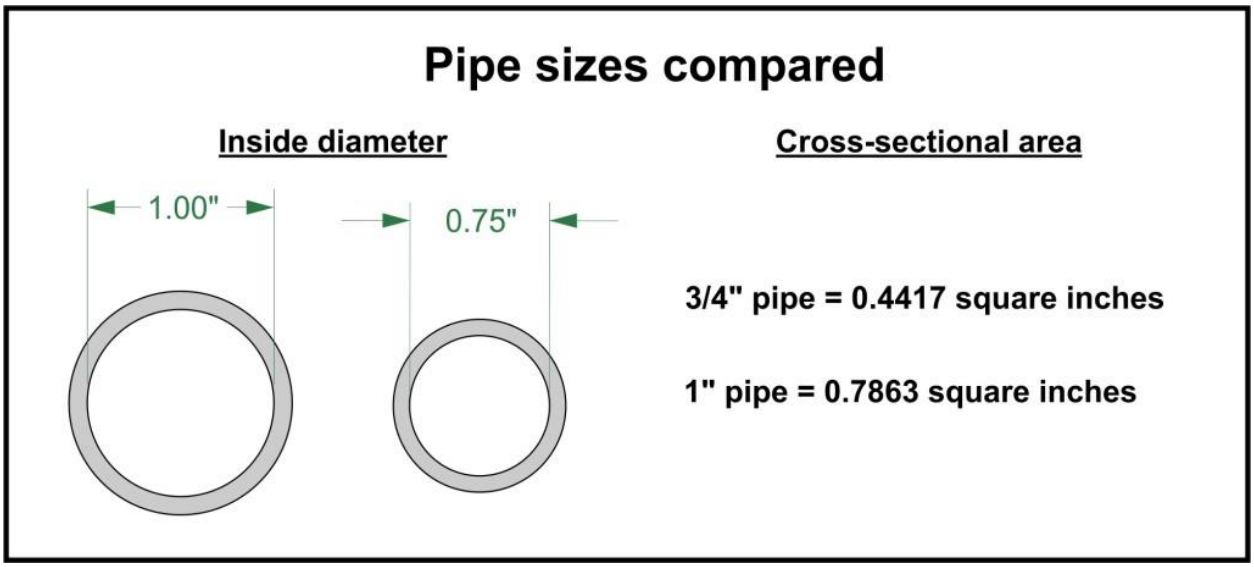
TYPE OF FIXTURES OR GROUP OF FIXTURES	WATER-SUPPLY FIXTURE-UNIT VALUE (w.s.f.u.)		
	Hot	Cold	Combined
Bathtub (with/without overhead shower head)	1.0	1.0	1.4
Clothes washer	1.0	1.0	1.4
Dishwasher	1.4	—	1.4
Full-bath group with bathtub (with/without shower head) or shower stall	1.5	2.7	3.6
Half-bath group (water closet and lavatory)	0.5	2.5	2.6
Hose bibb (sillcock)[a]	—	2.5	2.5
Kitchen group (dishwasher and sink with/without garbage grinder)	1.9	1.0	2.5
Kitchen sink	1.0	1.0	1.4
Laundry group (clothes washer standpipe and laundry tub)	1.8	1.8	2.5
Laundry tub	1.0	1.0	1.4
Lavatory	0.5	0.5	0.7
Shower stall	1.0	1.0	1.4
Water closet (tank type)	—	2.2	2.2

For SI: 1 gallon per minute = 3.785 L/m.
a. The fixture unit value 2.5 assumes a flow demand of 2.5 gpm, such as for an individual lawn sprinkler device. If a hose bibb/sill cock will be required to furnish a greater flow, the equivalent fixture-unit value may be obtained from this table or Table P2903.6(1).









P2903.7 Size of water-service mains, branch mains and risers.
The size of the water service pipe shall be not less than $^3/_4$ inch (19 mm) diameter. The size of water service mains, branch mains and risers shall be determined according to water supply demand [gpm (L/m)], available water pressure [psi (kPa)] and friction loss caused by the water meter and *developed length* of pipe [feet (m)], including *equivalent length* of fittings. The size of each water distribution system shall be determined according to design methods conforming to acceptable engineering practice, such as those methods in Appendix P and shall be *approved* by the code official.

P2903.8 Gridded and parallel water distribution system manifolds.
Hot water and cold water manifolds installed with gridded or parallel-connected individual distribution lines to each fixture or fixture fittings shall be designed in accordance with Sections P2903.8.1 through P2903.8.6.

P2903.8.1 Sizing of manifolds.
Manifolds shall be sized in accordance with Table P2903.8.1. Total gallons per minute is the demand for all outlets.

TABLE P2903.8.1
MANIFOLD SIZING

PLASTIC		METALLIC	
Nominal Size ID (inches)	Maximum[a] gpm	Nominal Size ID (inches)	Maximum[a] gpm
$^3/_4$	17	$^3/_4$	11
1	29	1	20
$1^1/_4$	46	$1^1/_4$	31
$1^1/_2$	66	$1^1/_2$	44

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m,
1 foot per second = 0.3048 m/s.
Note: See Table P2903.6(1) for w.s.f.u and Table 2903.6(1) for gallon-per-minute (gpm) flow rates.
a. Based on velocity limitation: plastic-12 fps; metal-8 fps.

P2903.8.2 Minimum size.
Where the *developed length* of the distribution line is 60 feet (18 288 mm) or less, and the available pressure at the meter is not less than 40 pounds per square inch (276 kPa), the size of individual distribution lines shall be not less than $^3/_8$ inch (10 mm) diameter. Certain fixtures such as one-piece water closets and whirlpool bathtubs shall require a larger size where specified by the manufacturer. If a water heater is fed from the end of a cold water manifold, the manifold shall be one size larger than the water heater feed.

P2903.8.3 Orientation.
Manifolds shall be permitted to be installed in a horizontal or vertical position.

P2903.8.4 Support and protection.
Plastic piping bundles shall be secured in accordance with the manufacturer's instructions and supported in accordance with Section P2605. Bundles that have a change in direction equal to or greater than 45 degrees (0.79 rad) shall be protected from chafing at the point of contact with framing members by sleeving or wrapping.

P2903.8.5 Valving.
Fixture valves, when installed, shall be located either at the fixture or at the manifold. If valves are installed at the manifold, they shall be labeled indicating the fixture served.

P2903.8.6 Hose bibb bleed.
A *readily accessible* air bleed shall be installed in hose bibb supplies at the manifold or at the hose bibb exit point.

P2903.9 Valves.
Valves shall be installed in accordance with Sections P2903.9.1 through P2903.9.5.

P2903.9.1 Service valve.
Each *dwelling unit* shall be provided with an accessible main shutoff valve near the entrance of the water service. The valve shall be of a full-open type having nominal restriction to flow, with provision for drainage such as a bleed orifice or installation of a separate drain valve. Additionally, the water service shall be valved at the curb or lot line in accordance with local requirements.

P2903.9.2 Water heater valve.
A *readily accessible* full-open valve shall be installed in the cold-water supply pipe to each water heater at or near the water heater.

P2903.9.3 Fixture valves and access.
Valves serving individual fixtures, *appliances*, risers and branches shall be provided with access. An individual shutoff valve shall be required on the fixture supply pipe to each plumbing fixture other than bathtubs and showers.

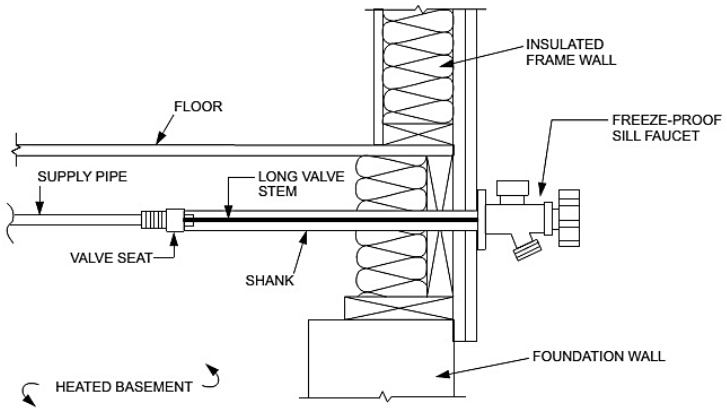
P2903.9.4 Valve requirements.
Valves shall be of an *approved* type and compatible with the type of piping material installed in the system. Ball valves, gate valves, globe valves and plug valves intended to supply drinking water shall meet the requirements of NSF 61.

P2903.9.5 Valves and outlets prohibited below grade.
Potable water outlets and combination stop-and-waste valves shall not be installed underground or below grade. Freezeproof yard hydrants that drain the riser into the ground are considered to be stop-and-waste valves.

Exception: Installation of freezeproof yard hydrants that drain the riser into the ground shall be permitted if the potable water supply to such hydrants is protected upstream of the hydrants in accordance with Section P2902 and the hydrants are permanently identified as nonpotable outlets by *approved* signage that reads as follows: "Caution, Nonpotable Water. Do Not Drink."

P2903.10 Hose bibb.
Hose bibbs subject to freezing, including the "frostproof" type, shall be equipped with an accessible stop-and-waste-type valve inside the building so that they can be controlled and drained during cold periods.

Exception: Frostproof hose bibbs installed such that the stem extends through the building insulation into an open heated or semi*conditioned space* need not be separately valved (see Figure P2903.10).



SECTION P2905
MATERIALS, JOINTS AND CONNECTIONS

P2905.1 Soil and groundwater.
The installation of water service pipe, water distribution pipe, fittings, valves, appurtenances and gaskets shall be prohibited in soil and groundwater that is contaminated with solvents, fuels, organic compounds or other detrimental materials that cause permeation, corrosion, degradation or structural failure of the water service or water distribution piping material.

P2905.1.1 Investigation required.
Where detrimental conditions are suspected by or brought to the attention of the *building official*, a chemical analysis of the soil and groundwater conditions shall be required to ascertain the acceptability of the water service material for the specific installation.

P2905.1.2 Detrimental condition.
When a detrimental condition exists, *approved* alternate materials or alternate routing shall be required.

P2905.2 Lead content.
Pipe and fittings used in the water-supply system shall have lead content of not greater than 8 percent lead.

P2905.3 Polyethylene plastic piping installation.
Polyethylene pipe shall be cut square using a cutter designed for plastic pipe. Except where joined by heat fusion, pipe ends shall be chamfered to remove sharp edges. Pipe that has been kinked shall not be installed. For bends, the installed radius of pipe curvature shall be greater than 30 pipe diameters or the coil radius when bending with the coil. Coiled pipe shall not be bent beyond straight. Bends shall not be permitted within 10 pipe diameters of any fitting or valve. Joints between polyethylene plastic pipe and fittings shall comply with Sections P2905.3.1 and P2905.3.2.

P2905.3.1 Heat-fusion joints.
Joint surfaces shall be clean and free from moisture. Joint surfaces shall be heated to melting temperature and joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657.

P2905.3.2 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions.

P2905.4 Water service pipe.
Water service pipe shall conform to NSF 61 and shall conform to one of the standards listed in Table P2905.4. Water service pipe or tubing, installed underground and outside of the structure, shall have a working pressure rating of not less than 160 pounds per square inch at 73°F (1103 kPa at 23°C). Where the water pressure exceeds 160 pounds per square inch (1103 kPa), piping material shall have a rated working pressure equal to or greater than the highest available pressure. Water service piping materials not third-party certified for water distribution shall terminate at or before the full open valve located at the entrance to the structure. Ductile iron water service piping shall be cement mortar lined in accordance with AWWA C104.

TABLE P2905.4
WATER SERVICE PIPE

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 1527; ASTM D 2282
Asbestos-cement pipe	ASTM C 296
Brass pipe	ASTM B 43
Chlorinated polyvinyl chloride (CPVC) plastic pipe	ASTM D 2846; ASTM F 441; ASTM F 442; CSA B137.6
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, WK, L, WL, M or WM)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 447
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	ASTM F 1281; ASTM F 2262; CSA B137.10M
Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE)	ASTM F 1986
Cross-linked polyethylene (PEX) plastic tubing	ASTM F 876; ASTM F 877; CSA B137.5

Ductile iron water pipe	AWWA C151; AWWA C115
Galvanized steel pipe	ASTM A 53
Polyethylene/aluminum/polyethylene (PE-AL-PE) pipe	ASTM F 1282; CSA B137.9
Polyethylene (PE) plastic pipe	ASTM D 2104; ASTM D 2239; AWWA C901; CSA B137.1
Polyethylene (PE) plastic tubing	ASTM D 2737; AWWA C901; CSA B137.1
Polyethylene of raised temperature (PE-RT) plastic tubing	ASTM F 2769
Polyvinyl chloride (PVC) plastic pipe	ASTM D 1785; ASTM D 2241; ASTM D 2672; CSA B137.3
Stainless steel (Type 304/304L) pipe	ASTM A 312; ASTM A 778
Stainless steel (Type 316/316L) pipe	ASTM A 312; ASTM A 778

P2905.4.1 Dual check-valve-type backflow preventer.
Where a dual check-valve backflow preventer is installed on the water supply system, it shall comply with ASSE 1024 or CSA B64.6.

P2905.4.2 Water service installation.
Trenching, pipe installation and backfilling shall be in accordance with Section P2604. Water-service pipe is permitted to be located in the same trench with a *building sewer* provided such sewer is constructed of materials listed for underground use within a building in Section P3002.1. If the *building sewer* is not constructed of materials listed in Section P3002.1, the water-service pipe shall be separated from the *building sewer* by not less than 5 feet (1524 mm), measured horizontally, of undisturbed or compacted earth or placed on a solid ledge not less than 12 inches (305 mm) above and to one side of the highest point in the sewer line.

Exception: The required separation distance shall not apply where a water service pipe crosses a sewer pipe, provided that the water service pipe is sleeved not less than 5 feet (1524 mm), horizontally from the sewer pipe centerline, on both sides of the crossing with pipe materials listed in Table P2905.4, P3002.1(1), P3002.1(2) or P3002.2.

P2905.5 Water-distribution pipe.
Water-distribution piping within *dwelling units* shall conform to NSF 61 and shall conform to one of the standards listed in Table P2905.5. All hot-water-distribution pipe and tubing shall have a pressure rating of not less than 100 psi at 180°F (689 kPa at 82°C).

TABLE P2905.5
WATER DISTRIBUTION PIPE

MATERIAL	STANDARD
Brass pipe	ASTM B 43
Chlorinated polyvinyl chloride (CPVC) plastic pipe and tubing	ASTM D 2846; ASTM F 441; ASTM F 442; CSA B137.6
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, WK, L, WL, M or WM)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 447
Cross-linked polyethylene (PEX) plastic tubing	ASTM F 876; ASTM F 877; CSA B137.5
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	ASTM F 1281; ASTM F 2262; CSA B137.10M
Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE)	ASTM F 1986
Galvanized steel pipe	ASTM A 53
Polyethylene/aluminum/polyethylene (PE-AL-PE) composite pipe	ASTM F 1282
Polyethylene of raised temperature (PE-RT) plastic tubing	ASTM F 2769
Polypropylene (PP) plastic pipe or tubing	ASTM F 2389; CSA B137.11
Stainless steel (Type 304/304L) pipe	ASTM A 312; ASTM A 778

P2905.6 Fittings.
Pipe fittings shall be *approved* for installation with the piping material installed and shall comply with the applicable standards listed in Table P2905.6. All pipe fittings used in water supply systems shall also comply with NSF 61.

TABLE P2905.6
PIPE FITTINGS

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D 2468
Brass	ASTM F1974
Cast-iron	ASME B16.4; ASME B16.12
Chlorinated polyvinyl chloride (CPVC) plastic	ASSE 1061; ASTM D 2846; ASTM F 437; ASTM F 438; ASTM F 439; CSA B137.6
Copper or copper alloy	ASSE 1061; ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.23; ASME B16.26; ASME B16.29
Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE)	ASTM F 1986
Fittings for cross-linked polyethylene (PEX) plastic tubing	ASSE 1061; ASTM F 877; ASTM F 1807; ASTM F 1960; ASTM F 2080; ASTM F 2098; ASTM F 2159; ASTM F 2434; ASTM F 2735; CSA B137.5
Gray iron and ductile iron	AWWA C110; AWWA C153
Malleable iron	ASME B16.3
Insert fittings for Polyethylene/aluminum/polyethylene (PE-AL-PE) and cross-linked polyethylene/aluminum/polyethylene (PEX-AL-PEX)	ASTM F 1974; ASTM F 1281; ASTM F 1282; CSA B137.9; CSA B137.10
Polyethylene (PE) plastic	ASTM D 2609; CSA B137.1
Fittings for polyethylene of raised temperature (PE-RT) plastic tubing	ASTM F 1807; ASTM F2098; ASTM F 2159; ASTM F 2735
Polypropylene (PP) plastic pipe or tubing	ASTM F 2389; CSA B137.11
Polyvinyl chloride (PVC) plastic	ASTM D 2464; ASTM D 2466; ASTM D 2467; CSA B137.2; CSA B137.3
Stainless steel (Type 304/304L) pipe	ASTM A 312; ASTM A 778
Stainless steel (Type 316/316L) pipe	ASTM A 312; ASTM A 778
Steel	ASME B16.9; ASME B16.11; ASME B16.28

P2905.7 Flexible water connectors.
Flexible water connectors, exposed to continuous pressure, shall conform to ASME A112.18.6/CSA B125.6. Access shall be provided to all flexible water connectors.

P2905.8 Joint and connection tightness.
Joints and connections in the plumbing system shall be gas tight and water tight for the intended use or required test pressure.

P2905.9 Plastic pipe joints.
Joints in plastic piping shall be made with *approved* fittings by solvent cementing, heat fusion, corrosion-resistant metal clamps with insert fittings or compression connections. Flared joints for polyethylene pipe shall be permitted in accordance with Section P2905.3.

P2905.9.1 Solvent cementing.
Solvent-cemented joints shall comply with Sections P2905.9.1.1 through P2905.9.1.3.

P2905.9.1.1 ABS plastic pipe.
Solvent cement for ABS plastic pipe conforming to ASTM D 2235 shall be applied to all joint surfaces.

WELD-ON®

SOLVENT CEMENTS SET/CURE TIMES AND APPLICATOR GUIDE

Average Initial Set Schedule For WELD-ON® PVC/CPVC Solvent Cements**

Temperature Range	Pipe Sizes				
	½" to 1¼" (20mm to 40mm)	1½" to 2" (50mm to 63mm)	2½" to 8" (75mm to 200mm)	10" to 15" (250mm to 380mm)	15"+ (380mm +)
60°-100°F/16°-38°C	2 minutes	5 minutes	30 minutes	2 hours	4 hours
40°-60°F/5°-16°C	5 minutes	10 minutes	2 hours	8 hours	16 hours
0°-40°F/-18°-5°C	10 minutes	15 minutes	12 hours	24 hours	48 hours

Note - Initial set schedule is the necessary time to allow before the joint can be carefully handled. In damp or humid weather allow 50% more set time.

P2905.9.1.1 ABS plastic pipe.
Solvent cement for ABS plastic pipe conforming to ASTM D 2235 shall be applied to all joint surfaces.

P2905.9.1.2 CPVC plastic pipe.
Joint surfaces shall be clean and free from moisture and an *approved* primer shall be applied. Solvent cement for CPVC plastic pipe, orange in color and conforming to ASTM F 493, shall be applied to all joint surfaces. The parts shall be joined while the cement is wet and in accordance with ASTM D 2846 or ASTM F 493. Solvent-cement joints shall be permitted above or below ground.

Exception: A primer shall not be required where all of the following conditions apply:

1. The solvent cement used is third-party certified as conforming to ASTM F 493.
2. The solvent cement used is yellow in color.
3. The solvent cement is used only for joining $^1/_2$ inch (13 mm) through 2 inch (51 mm) diameter CPVC pipe and fittings.
4. The CPVC pipe and fittings are manufactured in accordance with ASTM D 2846.

P2905.9.1.3 PVC plastic pipe.
A purple primer that conforms to ASTM F 656 shall be applied to PVC solvent-cemented joints. Solvent cement for PVC plastic pipe conforming to ASTM D 2564 shall be applied to all joint surfaces.

P2905.9.1.4 Cross-linked polyethylene plastic (PEX).
Joints between cross-linked polyethylene plastic tubing or fittings shall comply with Section P2905.9.1.4.1 or Section P2905.9.1.4.

P2905.9.1.4.1 Flared joints.
Flared pipe ends shall be made by a tool designed for that operation.

P2905.9.1.4.2 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for cross-linked polyethylene (PEX) plastic tubing shall comply with the applicable standards listed in Table P2905.6 and shall be installed in accordance with the manufacturer's instructions. PEX tubing shall be factory marked with the applicable standards for the fittings that the PEX manufacturer specifies for use with the tubing.

P2905.10 Polypropylene (PP) plastic.
Joints between polypropylene plastic pipe and fittings shall comply with Section P2905.10.1 or P2905.10.2.

P2905.10.1 Heat-fusion joints.
Heat fusion joints for polypropylene pipe and tubing joints shall be installed with socket-type heat-fused polypropylene fittings, butt-fusion polypropylene fittings or electrofusion polypropylene fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 2389.

P2905.10.2 Mechanical and compression sleeve joints.
Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's instructions.

P2905.11 Cross-linked polyethylene/aluminum/cross-linked polyethylene.
Joints between polyethylene/aluminum/polyethylene (PE-AL-PE) and cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe and fittings shall comply with Section P2905.11.1.

P2905.11.1 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for PE-AL-PE and PEX-AL-PEX as described in ASTM F 1974, ASTM F 1281, ASTM F 1282, CSA B137.9 and CSA B137.10 shall be installed in accordance with the manufacturer's instructions.

P2905.12 Stainless steel.
Joints between stainless steel pipe and fittings shall comply with Sections P2905.12.1 and P2905.12.2.

P2905.12.1 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions.

P2905.12.2 Welded joints.
Joint surfaces shall be cleaned. The joint shall be welded autogenously or with an *approved* filler metal in accordance with ASTM A 312.

P2905.13 Threaded pipe joints.
Threaded joints shall conform to American National Taper Pipe Thread specifications. Pipe ends shall be deburred and chips removed. Pipe joint compound shall be used only on male threads.

P2905.14 Soldered joints.
Soldered joints in tubing shall be made with fittings *approved* for water piping and shall conform to ASTM B 828. Surfaces to be soldered shall be cleaned bright. The joints shall be properly fluxed and made with *approved* solder. Solders and fluxes used in potable water-supply systems shall have a lead content of not greater than 0.2 percent. Fluxes shall conform to ASTM B 813.

P2905.15 Flared joints.
Flared joints in water tubing shall be made with *approved* fittings. The tubing shall be reamed and then expanded with a flaring tool.

P2905.16 Above-ground joints.
Joints within the building between copper pipe or CPVC tubing, in any combination with compatible outside diameters, shall be permitted to be made with the use of *approved* push-in mechanical fittings of a pressure-lock design.

P2905.17 Joints between different materials.
Joints between different piping materials shall be made in accordance with Sections P2905.17.1, P2905.17.2 and P2905.17.3 or with a mechanical joint of the compression or mechanical sealing type having an elastomeric seal conforming to ASTM D 1869 or ASTM F 477. Joints shall be installed in accordance with the manufacturer's instructions.

P2905.17.1 Copper or copper-alloy tubing to galvanized steel pipe.
Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass fitting or dielectric fitting. The copper tubing shall be joined to the fitting in an *approved* manner, and the fitting shall be screwed to the threaded pipe.

P2904.17.2 Plastic pipe or tubing to other piping material.
Joints between different types of plastic pipe or between plastic pipe and other piping material shall be made with an approved adapter fitting.

P2905.17.3 Stainless steel.
Joints between stainless steel and different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type or a dielectric fitting.

P2905.18 Press joints.
Press-type mechanical joints in copper tubing shall be made in accordance with the manufacturer's instructions using *approved* tools which affix the copper fitting with integral O-ring to the tubing.

P2905.19 Polyethylene of raised temperature plastic.
Joints between polyethylene of raised temperature plastic tubing and fittings shall be in accordance with Section P2905.19.1 and Section P2905.19.2

P2905.19.1 Flared joints.
Flared pipe ends shall be made by a tool designed for that operation.

P2905.19.2 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for polyethylene of raised temperature plastic tubing shall comply with the applicable standards listed in Table P2905.6 and shall be installed in accordance with the manufacturer's instructions. Polyethylene of raised temperature plastic tubing shall be factory marked with the applicable standards for the fittings that the manufacturer of the tubing specifies for use with the tubing.

SECTION P2906
CHANGES IN DIRECTION

P2906.1 Bends.
Changes in direction in copper tubing are permitted to be made with bends having a radius of not less than four diameters of the tube, providing such bends are made by use of forming equipment that does not deform or create loss in cross-sectional area of the tube.

SECTION P2907
SUPPORT

P2907.1 General.
Pipe and tubing support shall conform to Section P2605.

SECTION P2908
DRINKING WATER TREATMENT UNITS

P2908.1 Design.
Drinking water treatment units shall meet the requirements of NSF42, NSF 44, NSF 53, NSF 60 or CSA B483.1.

P2908.2 Reverse osmosis drinking water treatment units.
Point-of-use reverse osmosis drinking water treatment units, designed for residential use, shall meet the requirements of NSF 58 or CSA B483.1. Waste or discharge from reverse osmosis drinking water treatment units shall enter the drainage system through an air gap or an air gap device that meets the requirements of NSF 58.

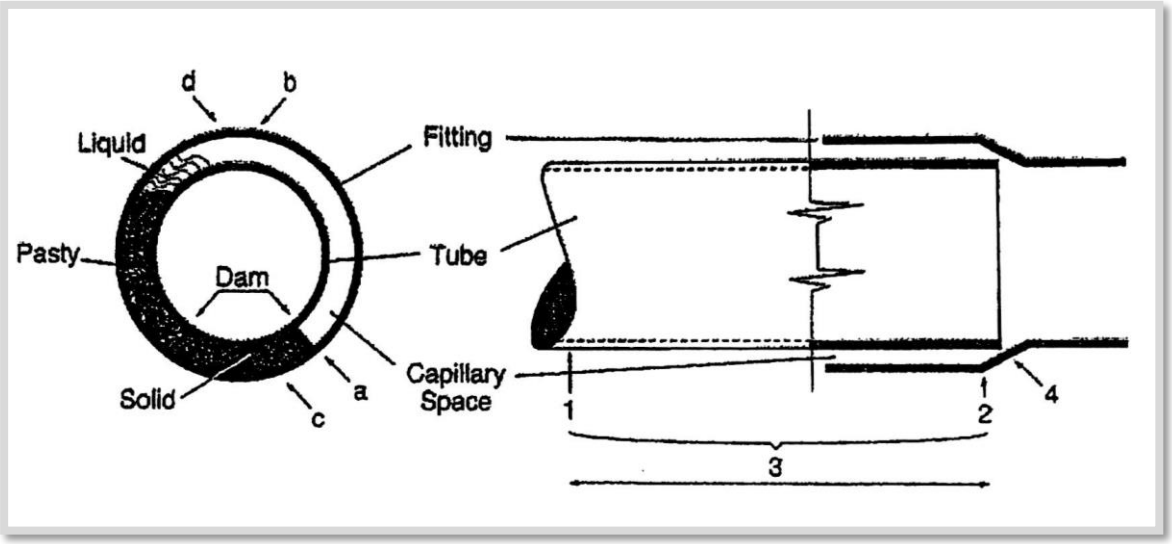
P2908.3 Connection tubing.
The tubing to and from drinking water treatment units shall be of a size and material as recommended by the manufacturer. The tubing shall comply with NSF 14, NSF 42, NSF 44, NSF 53, NSF 58 or NSF 61.

Chapter Notes:

The Copper Tube Handbook, CDA reminds plumbers to consistently make satisfactory joints, the following steps of joint-preparation and operations (based upon ASTM Standard B828), should be followed:

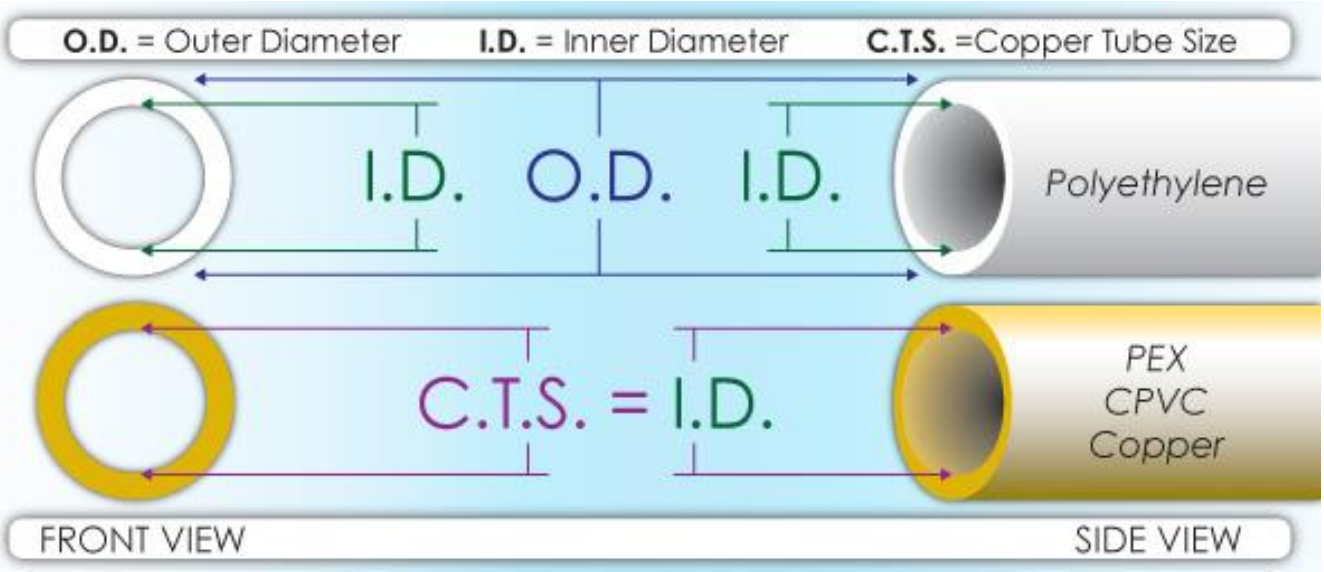
1. Measuring and cutting
2. Reaming
3. Cleaning
4. Fluxing
5. Assembly & support
6. Heating
7. Applying the solder
8. Cooling and cleaning

The techniques described produce leak-tight solder joints between copper and copper alloy tube fittings, either in shop operations or in the field. Skill and knowledge are required to produce a satisfactory solder joint.



- No installation of potable water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted or contaminated water, mixtures or substances to enter any portion of such piping from any tank, receptor, equipment, or plumbing fixture is flooded, or subject to pressure in excess of operating pressure in the hot and cold water piping.
- No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by a public or private water service system, and any pipes, conduits, or fixtures containing or carrying from any other source or containing or carrying water which has been used for any purpose whatsoever, unless there is provided a backflow prevention device approved for potential hazard and maintained in accordance with the code.
- No plumbing fixture, device, or construction shall be installed or maintained or shall be connected to any domestic water supply when such installation or connection may provide a possibility of such water supply or may provide a cross-connection between a distributing system of water for drinking and domestic purposes and water which may become contaminated by such plumbing fixture, device or construction unless there is provided an approved backflow prevention device.

- No water piping supplied by any private water supply system shall be connected to any other source of supply without the approval of Administrative Authority, Health Department, or Authority Having Jurisdiction (AHJ).
- Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow prevention.
- Water Supply & Distribution materials shall not be used for any other purpose than that of potable water.

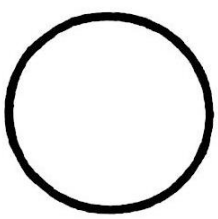


- Malleable Iron shall be galvanized.
- PVC (Pressure) can only be used for potable water on the outside of the building for services; PVC (Pressure) cannot be brought inside the footprint of the building. CPVC can be used inside/outside of the the building's footprint.
- These are the color codes for Copper and its installation requirements:
    - Type K (Green): Installed above/below ground & inside/out
    - Type L (Blue): Installed above/below ground & inside/out
    - Type M (Red): Installed above ground & inside only
    - Type DWV (Yellow): Installed above/below ground & inside/out

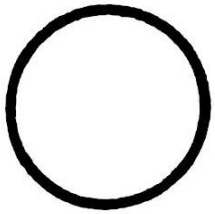
Plumbing Tube Color Code

Type K = GREEN	Type M = RED
Type L = BLUE	Type DWV = YELLOW

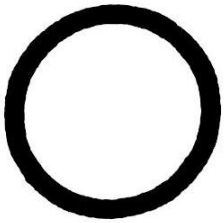
Information Chart on Copper Tubing



Type M Copper



Type L Copper



Type K Copper

Above is the approximate wall thickness of the various types of copper pipe.

Information on Copper	Type M	Type L	Type K
Where Used	In Homes Above Ground	In Homes Above and Below Ground Level	Below Ground And Above
Pressure Rated Approximate	415 PSI	525 PSI	625 PSI
Color Coded	Red Stripe on Side	Blue Stripe on Side	Green Stripe on Side
½ " Outside Diameter	.625	.625	.625
½ " Inside Diameter	.569	.545	.527
¾" Outside Diameter	.875	.875	.875
¾" Inside Diameter	.811	.785	.745

Using a piece of string, wrap it around the tube and use chart to determine the size of copper you need.

½ inch _____

¾ inch _____

Full Way Valves

Require Locations:

1. Discharge Side of the Meter
2. Each Building
3. Immediately ahead of each slip joint or non-metallic fixture supply or appliance supply
4. Multi- Dwellings units shall have separating valves

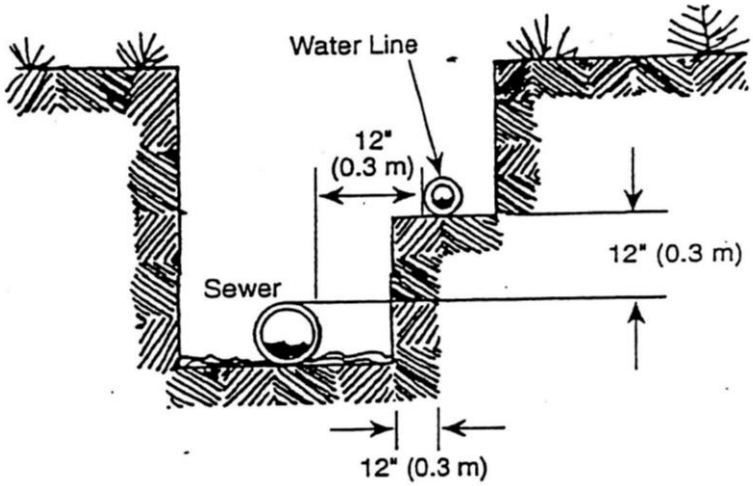
Full Way valves shall be accessible

TESTING

- **Upon completion of a section or entire hot and cold water supply system, it shall be tested and proved tight under a water pressure not less than the working pressure**

50 PSI air test

No less than 15 minutes



12” Minimum Separation when certain Sewer Piping materials are used with Water Piping:

CHECK WITH EACH MATERIAL’S MANUFACTURER’S SPECIFICATION!!

- Valves: Accessible shutoff or control valves shall be installed at the following locations:
    1. Discharge side of water meters
    2. At each building or dwelling unit at the beginning of a water service (Duplex must have one for each unit)
    3. On discharge piping at or near a water supply tank
    4. On the cold water supply at or near a water heater
- Control valves shall be installed ahead of:
    1. Water-supplied appliances
    2. Slip-joint appliance supply or fixture
    3. Non-metallic fixture or appliance supply
    4. Automatic metering valve supplying a battery of fixtures
- Mandated Water Pressure Parameters:
    1. Inadequate Pressure: Less than 15 pounds (A tank or pump or other means which will provide at least 15 pounds of pressure shall be installed.
    2. Excessive Pressure: More than 80 pounds (Pressure regulator [PRV – Pressure Reducing Valve] required to reduce pressure to 80 pounds or less. Regulators shall be accessible)
- The size of the water piping system shall be determined by the following conditions:
    1. Total number of fixtures
    2. Total length of the system from the meter to the most remote outlet (longest length method)
    3. Difference in elevation between the highest fixture and the meter
    4. Minimum pressure in the street main or other source of supply
    5. NO BUILDING SUPPLY SHALL BE LESS THAN ¾" IN DIAMETER

Chapter 6

IRC

Chapter 30 Sanitary Drainage

CONGER
CONSTRUCTION
SERVICES, LLC.

SECTION P3001
GENERAL

P3001.1 Scope.
The provisions of this chapter shall govern the materials, design, construction and installation of sanitary drainage systems. Plumbing materials shall conform to the requirements of this chapter. The drainage, waste and vent (DWV) system shall consist of all piping for conveying wastes from plumbing fixtures, appliances and appurtenances, including fixture traps; above-grade drainage piping; below-grade drains within the building (*building drain*); below- and above-grade venting systems; and piping to the public sewer or private septic system.

P3001.2 Protection from freezing.
No portion of the above grade DWV system other than vent terminals shall be located outside of a building, in *attics* or crawl spaces, concealed in outside walls, or in any other place subjected to freezing temperatures unless adequate provision is made to protect them from freezing by insulation or heat or both, except in localities having a winter design temperature above 32°F (0°C) (ASHRAE 97.5 percent column, winter, see Chapter 3).

P3001.3 Flood-resistant installation.
In flood hazard areas as established by Table R301.2(1), drainage, waste and vent systems shall be located and installed to prevent infiltration of floodwaters into the systems and discharges from the systems into floodwaters.

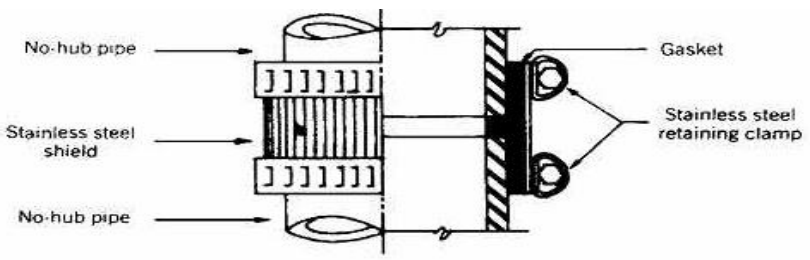
SECTION P3002
MATERIALS

P3002.1 Piping within buildings.
Drain, waste and vent (DWV) piping in buildings shall be as shown in Tables P3002.1(1) and P3002.1(2) except that galvanized wrought-iron or galvanized steel pipe shall not be used underground and shall be maintained not less than 6 inches (152 mm) above ground. Allowance shall be made for the thermal expansion and contraction of plastic piping.

TABLE P3002.1(1)
ABOVE-GROUND DRAINAGE AND VENT PIPE

PIPE	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1
Brass pipe	ASTM B 43
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, L, M or DWV)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306
Galvanized steel pipe	ASTM A 53
Polyolefin pipe	CSA B181.3
Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2665; ASTM F 891; CSA B181.2; ASTM F 1488
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D. and a solid, cellular core or composite wall	ASTM D 2949; ASTM F 1488
Stainless steel drainage systems, Types 304 and 316L	ASME A 112.3.1

For SI: 1 inch = 25.4 mm.



(*c*) **No-hub joint**

TABLE P3002.1(2)
UNDERGROUND BUILDING DRAINAGE AND VENT PIPE

PIPE	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Copper or copper alloy tubing (Type K, L, M or DWV)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306
Polyolefin pipe	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D. and a solid, cellular core or composite wall	ASTM D 2949; ASTM F 1488
Stainless steel drainage systems, Type 316L	ASME A 112.3.1

For SI: 1 inch = 25.4 mm.

P3002.2 Building sewer.

Building sewer piping shall be as shown in Table P3002.2. Forced main sewer piping shall conform to one of the standards for ABS plastic pipe, copper or copper-alloy tubing, PVC plastic pipe or pressure-rated pipe listed in Table P3002.2.

Building Sewer Pipe – Table 3002.2

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; ASTM A 888; CISPI 301
Acrylonitrile butadiene styrene (ABS) plastic pipe in sewer and drain diameters, including SDR 42 (PS 20), PS35, SDR 35 (PS 45), PS50, PS100, PS140, SDR 23.5 (PS 150) and PS200; with a solid, cellular core or composite wall	ASTM F 1488; ASTM D 2751
Polyvinyl chloride (PVC) plastic pipe in sewer and drain diameters, including PS 25, SDR 41 (PS 28), PS 35, SDR 35 (PS 46), PS 50, PS 100, SDR 26 (PS 115), PS140 and PS 200; with a solid, cellular core or composite wall	ASTM F 891; ASTM F 1488; ASTM D 3034; CSA B182.2;CSA B182.4
Concrete pipe	ASTM C 14; ASTM C 76; CSA A257.1M; CSA A257.2M
Copper or copper-alloy tubing (Type K or L)	ASTM B 75; ASTM B 88; ASTM B 251
Polyethylene (PE) plastic pipe (SDR-PR)	ASTM F 714
Polyolefin pipe	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with solid, cellular core or composite wall	ASTM D 2665; ASTM D 2949; ASTM D 3034; ASTM F 1412; CSA B182.2; CSA B182.4
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D. and a solid, cellular core or composite wall	ASTM D 2949, ASTM F 1488
Stainless steel drainage systems, Types 304 and 316L	ASME A 112.3.1
Vitrified clay pipe	ASTM C 425; ASTM C 700

P3002.3 Fittings.

Pipe fittings shall be *approved* for installation with the piping material installed and shall comply with the applicable standards listed in Table P3002.3.

TABLE P3002.3
PIPE FITTINGS

PIPE MATERIAL	FITTING STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters	ASTM D 2661; ASTM D 3311; ASTM F 628; CSA B181.1
Asbestos cement	ASTM C 428
Cast-iron	ASME B 16.4; ASME B 16.12; ASTM A 74; ASTM A 888; CISPI 301
Acrylonotrile butadiene styrene (ABS) plastic pipe in sewer and drain diameters	ASTM D 2751
Polyvinyl chloride (PVC) plastic pipe in sewer and drain diameters	ASTM D 3034
Copper or copper alloy	ASME B 16.15; ASME B 16.18; ASME B 16.22; ASME B 16.23; ASME B 16.26; ASME B 16.29
Gray iron and ductile iron	AWWA C 110
Polyolefin	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic in IPS diameters	ASTM D 2665; ASTM D 3311; ASTM F 1866
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D.	ASTM D 2949
PVC fabricated fittings	ASTM F 1866
Stainless steel drainage systems, Types 304 and 316L	ASME A 112.3.1
Vitrified clay	ASTM C 700

For SI: 1 inch = 25.4 mm.

P3002.3.1 Drainage.
Drainage fittings shall have a smooth interior waterway of the same diameter as the piping served. All fittings shall conform to the type of pipe used. Drainage fittings shall have no ledges, shoulders or reductions which can retard or obstruct drainage flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type, black or galvanized. Drainage fittings shall be designed to maintain one-fourth unit vertical in 12 units horizontal (2-percent slope) grade. This section shall not be applicable to tubular waste fittings used to convey vertical flow upstream of the trap seal liquid level of a fixture trap.

P3002.4 Other materials.
Sheet lead, lead bends, lead traps and sheet copper shall comply with Sections P3002.4.1 through P3002.4.3.

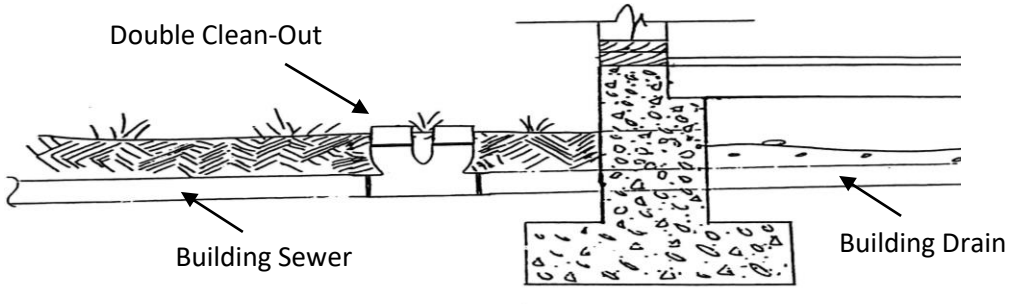
P3002.4.1 Sheet lead.
Sheet lead for the following uses shall weigh not less than indicated below:

1. Flashing of vent terminals, 3 psf (15 kg/m^2).
2. Prefabricated flashing for vent pipes, $2^1/_2$ psf (12 kg/m^2).

P3002.4.2 Lead bends and traps.
Lead bends and lead traps shall not be less than $^1/_8$-inch (3 mm) wall thickness.

P3002.4.3 Sheet copper.
Sheet copper for the following uses shall weigh not less than indicated below:

1. General use, 12 ounces per square feet (4 kg/m^2).
2. Flashing for vent pipes, 8 ounces per square feet (2.5 kg/m^2).



SECTION P3003
JOINTS AND CONNECTIONS

P3003.1 Tightness.
Joints and connections in the DWV system shall be gas tight and water tight for the intended use or pressure required by test.

P3003.1.1 Threaded joints, general.
Pipe and fitting threads shall be tapered.

P3003.2 Prohibited joints.
Running threads and bands shall not be used in the drainage system. Drainage and vent piping shall not be drilled, tapped, burned or welded.

The following types of joints and connections shall be prohibited:

1. Cement or concrete.
2. Mastic or hot-pour bituminous joints.
3. Joints made with fittings not *approved* for the specific installation.
4. Joints between different diameter pipes made with elastomeric rolling O-rings.
5. Solvent-cement joints between different types of plastic pipe.
6. Saddle-type fittings.

P3003.3 ABS plastic.
Joints between ABS plastic pipe or fittings shall comply with Sections P3003.3.1 through P3003.3.3.

P3003.3.1 Mechanical joints.
Mechanical joints on drainage pipes shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed only in underground systems unless otherwise *approved*. Joints shall be installed in accordance with the manufacturer's instructions.

P3003.3.2 Solvent cementing.
Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 or CSA B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235, ASTM D 2661, ASTM F 628 or CSA B181.1. Solvent-cement joints shall be permitted above or below ground.

P3003.3.3 Threaded joints.
Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. *Approved* thread lubricant or tape shall be applied on the male threads only.

P3003.4 Asbestos-cement.
Joints between asbestos-cement pipe or fittings shall be made with a sleeve coupling of the same composition as the pipe, sealed with an elastomeric ring conforming to ASTM D 1869.

P3003.5 Brass.
Joints between brass pipe or fittings shall comply with Sections P3003.5.1 through P3003.5.3.

P3003.5.1 Brazed joints.
All joint surfaces shall be cleaned. An *approved* flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

P3003.5.2 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions.

P3003.5.3 Threaded joints.
Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

P3003.6 Cast iron.
Joints between cast-iron pipe or fittings shall comply with Sections P3003.6.1 through P3003.6.3.

P3003.6.1 Caulked joints.
Joints for hub and spigot pipe shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation to a depth of not less than 1 inch (25 mm). The lead shall not recede more than $^{1}/_{8}$ inch (3 mm) below the rim of the hub and shall be caulked tight. Paint, varnish or other coatings shall not be permitted on the jointing material until after the joint has been tested and *approved*. Lead shall be run in one pouring and shall be caulked tight. Acid-resistant rope and acidproof cement shall be permitted.

P3003.6.2 Compression gasket joints.
Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C 564. Gaskets shall be compressed when the pipe is fully inserted.

P3003.6.3 Mechanical joint coupling.
Mechanical joint couplings for hubless pipe and fittings shall comply with CISPI 310 or ASTM C 1277. The elastomeric sealing sleeve shall conform to ASTM C 564 or CSA B602 and shall have a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer's installation instructions.

P3003.7 Concrete joints.
Joints between concrete pipe and fittings shall be made with an elastomeric seal conforming to ASTM C 443, ASTM C 1173, CSA A257.3M or CSA B602.

P3003.8 Coextruded composite ABS pipe.
Joints between coextruded composite pipe with an ABS outer layer or ABS fittings shall comply with Sections P3003.8.1 and P3003.8.2.

P3003.8.1 Mechanical joints.
Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise *approved*. Joints shall be installed in accordance with the manufacturer's instructions.

P3003.8.2 Solvent cementing.
Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 or CSA B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235, ASTM D 2661, ASTM F 628 or CSA B181.1. Solvent-cement joints shall be permitted above or below ground.

P3003.9 Coextruded composite PVC pipe.
Joints between coextruded composite pipe with a PVC outer layer or PVC fittings shall comply with Sections P3003.9.1 and P3003.9.2.

P3003.9.1 Mechanical joints.
Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM D 3212. Mechanical joints shall not be installed in above-ground systems, unless otherwise *approved*. Joints shall be installed in accordance with the manufacturer's instructions.

P3003.9.2 Solvent cementing.
Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not purple in color and conforming to ASTM D 2564, CSA B137.3 or CSA B181.2 shall be applied to all joint surfaces. The joint shall be made while the cement is wet, and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground.

P3003.10 Copper pipe.
Joints between copper or copper-alloy pipe or fittings shall comply with Sections P3003.10.1 through P3003.10.4.

P3003.10.1 Brazed joints.
All joint surfaces shall be cleaned. An *approved* flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

P3003.10.2 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions.

P3003.10.3 Soldered joints.
Solder joints shall be made in accordance with the methods of ASTM B 828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32.

P3003.10.4 Threaded joints.
Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

P3003.11 Copper tubing.
Joints between copper or copper-alloy tubing or fittings shall comply with Sections P3003.11.1 through P3003.11.3.

P3003.11.1 Brazed joints.
All joint surfaces shall be cleaned. An *approved* flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

P3003.11.2 Mechanical joints.
Mechanical joints shall be installed in accordance with the manufacturer's instructions.

P3003.11.3 Soldered joints.
Solder joints shall be made in accordance with the methods of ASTM B 828. Cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32.

P3003.12 Steel.
Joints between galvanized steel pipe or fittings shall comply with Sections P3003.12.1 and P3003.12.2.

P3003.12.1 Threaded joints.
Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

P3003.12.2 Mechanical joints.
Joints shall be made with an *approved* elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

P3003.13 Lead.
Joints between lead pipe or fittings shall comply with Sections P3003.13.1 and P3003.13.2.

P3003.13.1 Burned.
Burned joints shall be uniformly fused together into one continuous piece. The thickness of the joint shall be at least as thick as the lead being joined. The filler metal shall be of the same material as the pipe.

P3003.13.2 Wiped.
Joints shall be fully wiped, with an exposed surface on each side of the joint not less than $^{3}/_{4}$ inch (19 mm). The joint shall be at least $^{3}/_{8}$ inch (9.5 mm) thick at the thickest point.

P3003.14 PVC plastic.
Joints between PVC plastic pipe or fittings shall comply with Sections P3003.14.1 through P3003.14.3.

P3003.14.1 Mechanical joints.
Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise *approved*. Joints shall be installed in accordance with the manufacturer's instructions.

P3003.14.2 Solvent cementing.
Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not purple in color and conforming to ASTM D 2564, CSA B137.3 or CSA B181.2 shall be applied to all joint surfaces. The joint shall be made while the cement is wet, and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground.

P3003.14.3 Threaded joints.
Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. *Approved* thread lubricant or tape shall be applied on the male threads only.

P3003.15 Vitrified clay.
Joints between vitrified clay pipe or fittings shall be made with an elastomeric seal conforming to ASTM C 425, ASTM C 1173 or CSA B602.

P3003.16 Polyolefin plastic.
Joints between polyolefin plastic pipe and fittings shall comply with Sections P3003.16.1 and P3003.16.2.

P3003.16.1 Heat-fusion joints.
Heat-fusion joints for polyolefin pipe and tubing joints shall be installed with socket-type heat-fused polyolefin fittings or electrofusion polyolefin fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 1412 or CSA B181.3.

P3003.16.2 Mechanical and compression sleeve joints.
Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's instructions.

P3003.17 Polyethylene plastic pipe.
Joints between polyethylene plastic pipe and fittings shall be underground and shall comply with Section P3003.17.1 or P3003.17.2.

P3003.17.1 Heat fusion joints.
Joint surfaces shall be clean and free from moisture. All joint surfaces shall be cut, heated to melting temperature and joined using tools specifically designed for the operation. Joints shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657 and the manufacturer's instructions.

P3003.17.2 Mechanical joints.
Mechanical joints in drainage piping shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

P3003.18 Joints between different materials.
Joints between different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type conforming to ASTM C 1173, ASTM C 1460 or ASTM C 1461. Connectors and adapters shall be *approved* for the application and such joints shall have an elastomeric seal conforming to ASTM C 425, ASTM C 443, ASTM C 564, ASTM C 1440, ASTM D 1869, ASTM F 477, CSA A257.3M or CSA B602, or as required in Sections P3003.18.1 through P3003.18.6. Joints between glass pipe and other types of materials shall be made with adapters having a TFE seal. Joints shall be installed in accordance with the manufacturer's instructions.

P3003.18.1 Copper or copper-alloy tubing to cast-iron hub pipe.
Joints between copper or copper-alloy tubing and cast-iron hub pipe shall be made with a brass ferrule or compression joint. The copper or copper-alloy tubing shall be soldered to the ferrule in an *approved* manner, and the ferrule shall be joined to the cast-iron hub by a caulked joint or a mechanical compression joint.

P3003.18.2 Copper or copper-alloy tubing to galvanized steel pipe.
Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass converter fitting or dielectric fitting. The copper tubing shall be soldered to the fitting in an *approved* manner, and the fitting shall be screwed to the threaded pipe.

P3003.18.3 Cast-iron pipe to galvanized steel or brass pipe.
Joints between cast-iron and galvanized steel or brass pipe shall be made by either caulked or threaded joints or with an *approved* adapter fitting.

P3003.18.4 Plastic pipe or tubing to other piping material.
Joints between different types of plastic pipe or between plastic pipe and other piping material shall be made with an *approved* adapter fitting. Joints between plastic pipe and cast-iron hub pipe shall be made by a caulked joint or a mechanical compression joint.

P3003.18.5 Lead pipe to other piping material.
Joints between lead pipe and other piping material shall be made by a wiped joint to a caulking ferrule, soldering nipple, or bushing or shall be made with an *approved* adapter fitting.

P3003.18.6 Stainless steel drainage systems to other materials.
Joints between stainless steel drainage systems and other piping materials shall be made with *approved* mechanical couplings.

P3003.19 Joints between drainage piping and water closets.
Joints between drainage piping and water closets or similar fixtures shall be made by means of a closet flange or a waste connector and sealing gasket compatible with the drainage system material, securely fastened to a structurally firm base. The inside diameter of the drainage pipe shall not be used as a socket fitting for a 4-inch by 3-inch (102 mm by 76 mm) closet flange. The joint shall be bolted, with an approved gasket flange to fixture connection complying with ASME A112.4.3 or setting compound between the fixture and the closet flange or waste connector and sealing gasket. The waste connector and sealing gasket joint shall comply with the joint-tightness test of ASME A112.4.3 and shall be installed in accordance with the manufacturer's installation instructions.

SECTION P3004
DETERMINING DRAINAGE FIXTURE UNITS

P3004.1 DWV system load.
The load on DWV-system piping shall be computed in terms of drainage fixture unit (d.f.u.) values in accordance with Table P3004.1.

TABLE P3004.1
DRAINAGE FIXTURE UNIT (d.f.u.) VALUES FOR VARIOUS PLUMBING FIXTURES

TYPE OF FIXTURE OR GROUP OF FIXTURES	DRAINAGE FIXTURE UNIT VALUE (d.f.u.)[a]
Bar sink	1
Bathtub (with or without shower head and/or whirlpool attachments)	2
Bidet	1
Clothes washer standpipe	2
Dishwasher	2
Floor drain[b]	0
Kitchen sink	2
Lavatory	1
Laundry tub	2
Shower stall	2
Water closet (1.6 gallons per flush)	3
Water closet (greater than 1.6 gallons per flush)	4
Full-bath group with bathtub (with 1.6 gallon per flush water closet, and with or without shower head and/or whirlpool attachment on the bathtub or shower stall)	5
Full-bath group with bathtub (water closet greater than 1.6 gallon per flush, and with or without shower head and/or whirlpool attachment on the bathtub or shower stall)	6

Half-bath group (1.6 gallon per flush water closet plus lavatory)	4
Half-bath group (water closet greater than 1.6 gallon per flush plus lavatory)	5
Kitchen group (dishwasher and sink with or without garbage grinder)	2
Laundry group (clothes washer standpipe and laundry tub)	3
Multiple-bath groups[c]: 1.5 baths 2 baths 2.5 baths 3 baths 3.5 baths	 7 8 9 10 11

For SI: 1 gallon = 3.785 L.

a. For a continuous or semicontinuous flow into a drainage system, such as from a pump or similar device, 1.5 fixture units shall be allowed per gpm of flow. For a fixture not listed, use the highest d.f.u. value for a similar listed fixture.

b. A floor drain itself adds no hydraulic load. However, where used as a receptor, the fixture unit value of the fixture discharging into the receptor shall be applicable.

c. Add 2 d.f.u. for each additional full bath.

SECTION P3005
DRAINAGE SYSTEM

P3005.1 Drainage fittings and connections.

Changes in direction in drainage piping shall be made by the appropriate use of sanitary tees, wyes, sweeps, bends or by a combination of these drainage fittings in accordance with Table P3005.1. Change in direction by combination fittings, heel or side inlets or increasers shall be installed in accordance with Table P3005.1 and Sections P3005.1.1 through P3005.1.4. based on the pattern of flow created by the fitting.

TABLE P3005.1
FITTINGS FOR CHANGE IN DIRECTION

TYPE OF FITTING PATTERN	CHANGE IN DIRECTION		
	Horizontal to vertical[c]	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

For SI: 1 inch = 25.4 mm.

a. The fittings shall only be permitted for a 2-inch or smaller fixture drain.

b. Three inches and larger.

c. For a limitation on multiple connection fittings, see Section P3005.1.1.

P3005.1.1 Horizontal to vertical (multiple connection fittings).

Double fittings such as double sanitary tees and tee-wyes or *approved* multiple connection fittings and back-to-back fixture arrangements that connect two or more branches at the same level shall be permitted as long as directly opposing connections are the same size and the discharge into directly opposing connections is from similar fixture types or fixture groups. Double sanitary tee patterns shall not receive the discharge of back-to-back water closets and fixtures or appliances with pumping action discharge.

Exception: Back-to-back water closet connections to double sanitary tee patterns shall be permitted where the horizontal *developed length* between the outlet of the water closet and the connection to the double sanitary tee is 18 inches (457 mm) or greater.

P3005.1.2 Heel- or side-inlet quarter bends, drainage.
Heel-inlet quarter bends shall be an acceptable means of connection, except where the quarter bends serves a water closet. A low-heel inlet shall not be used as a wet-vented connection. Side-inlet quarter bends shall be an acceptable means of connection for both drainage, wet venting and stack venting arrangements.

P3005.1.3 Heel- or side-inlet quarter bends, venting.
Heel-inlet or side-inlet quarter bends, or any arrangement of pipe and fittings producing a similar effect, shall be acceptable as a dry vent where the inlet is placed in a vertical position. The inlet is permitted to be placed in a horizontal position only where the entire fitting is part of a dry vent arrangement.

P3005.1.4 Water closet connection between flange and pipe.
One-quarter bends 3 inches (76 mm) in diameter shall be acceptable for water closet or similar connections, provided a 4-inch by 3-inch (102 mm by 76 mm) flange is installed to receive the closet fixture horn. Alternately, a 4-inch by 3-inch (102 mm by 76 mm) elbow shall be acceptable with a 4-inch (102 mm) flange.

P3005.1.5 Dead ends.
Dead ends shall be prohibited except where necessary to extend a cleanout or as an *approved* part of a rough-in more than 2 feet (610 mm) in length.

P3005.1.6 Provisions for future fixtures.
Where drainage has been roughed-in for future fixtures, the drainage unit values of the future fixtures shall be considered in determining the required drain sizes. Such future installations shall be terminated with an accessible permanent plug or cap fitting.

P3005.1.7 Change in size.
The size of the drainage piping shall not be reduced in size in the direction of the flow. A 4-inch by 3-inch (102 mm by 76 mm) water closet connection shall not be considered as a reduction in size.

P3005.2 Drainage pipe cleanouts.
Drainage pipe cleanouts shall comply with Sections P3005.2.1 through P3005.2.11.

Exception: These provisions shall not apply to pressurized *building drains* and *building sewers* that convey the discharge of automatic pumping equipment to a gravity drainage system.

P3005.2.1 Materials.
Cleanouts shall be liquid and gas tight. Cleanout plugs shall be brass or plastic.

P3005.2.2 Spacing.
Cleanouts shall be installed not more than 100 feet (30 480 mm) apart in horizontal drainage lines measured from the upstream entrance of the cleanout.

P3005.2.3 Underground drainage cleanouts.
When installed in underground drains, cleanouts shall be extended vertically to or above finished grade either inside or outside the building.

P3005.2.4 Change of direction.
Cleanouts shall be installed at each fitting with a change of direction more than 45 degrees (0.79 rad) in the *building sewer, building drain* and horizontal waste or soil lines. Where more than one change of direction occurs in a run of piping, only one cleanout shall be required in each 40 feet (12 192 mm) of *developed length* of the drainage piping.

P3005.2.5 Accessibility.
Cleanouts shall be accessible. The clearance in front of cleanouts shall be not less than 18 inches (457 mm) on 3-inch (76 mm) and larger pipes, and not less than 12 inches (305 mm) on smaller pipes. Concealed cleanouts shall be provided with access of sufficient size to permit removal of the cleanout plug and rodding of the system. Cleanout plugs shall not be concealed by permanent finishing material.

P3005.2.6 Base of stacks.
A cleanout shall be provided at the base of each waste or soil stack.

P3005.2.7 Building drain and building sewer junction.
There shall be a cleanout near the junction of the *building drain* and *building sewer*. This cleanout shall be either inside or outside the building wall, provided that it is brought up to finish grade or to the lowest floor level. An *approved* two-way cleanout shall be permitted to serve as the required cleanout for both the *building drain* and the *building sewer*. The cleanout at the junction of the *building drain* and *building sewer* shall not be required where a cleanout on a 3-inch (76 mm) or larger diameter soil stack is located within a *developed length* of 10 feet (3048 mm) of the *building drain* and *building sewer* junction.

P3005.2.8 Direction of flow.
Cleanouts shall be installed so that the cleanout opens to allow cleaning in the direction of the flow of the drainage line.

P3005.2.9 Cleanout size.
Cleanouts shall be the same nominal size as the pipe they serve up to 4 inches (102 mm). For pipes larger than 4 inches (102 mm) nominal size, the size of the cleanout shall be not less than 4 inches (102 mm).

Exceptions:

1. "P" trap connections with slip joints or ground joint connections, or stack cleanouts that are not more than one pipe diameter smaller than the drain served, shall be permitted.

2. Cast-iron cleanouts sized in accordance with the referenced standards in Table P3002.3, ASTM A 74 for hub and spigot fittings or ASTM A 888 or CISPI 301 for hubless fittings.

P3005.2.10 Cleanout equivalent.
A fixture trap or a fixture with integral trap, readily removable without disturbing concealed piping shall be acceptable as a cleanout equivalent.

P3005.2.11 Connections to cleanouts prohibited.
Clean-out openings shall not be used for the installation of new fixtures except where *approved* and an acceptable alternate cleanout is provided.

P3005.3 Horizontal drainage piping slope.
Horizontal drainage piping shall be installed in uniform alignment at uniform slopes not less than $^1/_4$ unit vertical in 12 units horizontal (2-percent slope) for $2^1/_2$ inch (64 mm) diameter and less, and not less than $^1/_8$ unit vertical in 12 units horizontal (1-percent slope) for diameters of 3 inches (76 mm) or more.

P3005.4 Drain pipe sizing.
Drain pipes shall be sized according to drainage fixture unit (d.f.u.) loads. The size of the drainage piping shall not be reduced in size in the direction of flow. The following general procedure is permitted to be used:

1. Draw an isometric layout or riser diagram denoting fixtures on the layout.

2. Assign d.f.u. values to each fixture group plus individual fixtures using Table P3004.1.

3. Starting with the top floor or most remote fixtures, work downstream toward the *building drain* accumulating d.f.u. values for fixture groups plus individual fixtures for each branch. Where multiple bath groups are being added, use the reduced d.f.u. values in Table P3004.1, which take into account probability factors of simultaneous use.

4. Size branches and stacks by equating the assigned d.f.u. values to pipe sizes shown in Table P3005.4.1.

5. Determine the pipe diameter and slope of the *building drain* and *building sewer* based on the accumulated d.f.u. values, using Table P3005.4.2.

P3005.4.1 Branch and stack sizing.
Branches and stacks shall be sized in accordance with Table P3005.4.1. Below grade drain pipes shall be not less than $1^1/_2$ inches (38 mm) in diameter. Drain stacks shall be not smaller than the largest horizontal branch connected.

Exceptions:

1. A 4-inch by 3-inch (102 mm by 76 mm) closet bend or flange.

2. A 4-inch (102 mm) closet bend connected to a 3-inch (76 mm) stack tee shall not be prohibited.

TABLE P3005.4.1
MAXIMUM FIXTURE UNITS ALLOWED TO BE CONNECTED TO BRANCHES AND STACKS

NOMINAL PIPE SIZE (inches)	ANY HORIZONTAL FIXTURE BRANCH	ANY ONE VERTICAL STACK OR DRAIN
$1^1/_4$[a]	—	—
$1^1/_2$[b]	3	4
2[b]	6	10
$2^1/_2$[b]	12	20
3	20	48
4	160	240

For SI: 1 inch = 25.4 mm.
a. $1^1/_4$-inch pipe size limited to a single-fixture drain or trap arm. See Table P3201.7.
b. No water closets.

P3005.4.2 Building drain and sewer size and slope.
Pipe sizes and slope shall be determined from Table P3005.4.2 on the basis of drainage load in fixture units (d.f.u.) computed from Table P3004.1.

TABLE P3005.4.2
MAXIMUM NUMBER OF FIXTURE UNITS ALLOWED TO BE CONNECTED TO THE BUILDING DRAIN, BUILDING DRAIN BRANCHES OR THE BUILDING SEWER

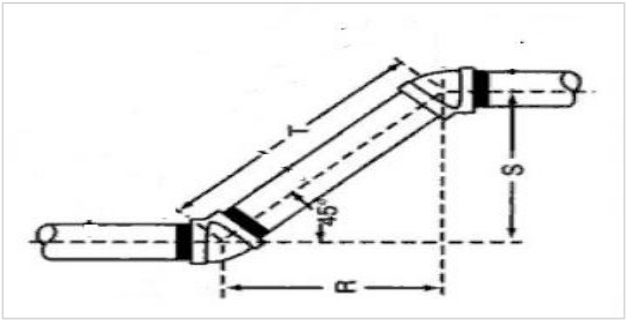
DIAMETER OF PIPE (inches)	SLOPE PER FOOT		
	$^1/_8$ inch	$^1/_4$ inch	$^1/_2$ inch
$1^1/_2$[a, b]	—	Note a	Note a
2[b]	—	21	27
$2^1/_2$[b]	—	24	31
3	36	42	50
4	180	216	250

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
a. $1^1/_2$-inch pipe size limited to a building drain branch serving not more than two waste fixtures, or not more than one waste fixture if serving a pumped discharge fixture or garbage grinder discharge.
b. No water closets.

P3005.5 Connections to offsets and bases of stacks.
Horizontal branches shall connect to the bases of stacks at a point located not less than 10 times the diameter of the drainage stack downstream from the stack. Horizontal branches shall connect to horizontal stack offsets at a point located not less than 10 times the diameter of the drainage stack downstream from the upper stack.

SECTION P3006
SIZING OF DRAIN PIPE OFFSETS

P3006.1 Vertical offsets.
An offset in a vertical drain, with a change of direction of 45 degrees (0.79 rad) or less from the vertical, shall be sized as a straight vertical drain.



P3006.2 Horizontal offsets above the lowest branch.
A stack with an offset of more than 45 degrees (0.79 rad) from the vertical shall be sized as follows:

1. The portion of the stack above the offset shall be sized as for a regular stack based on the total number of fixture units above the offset.

2. The offset shall be sized as for a *building drain* in accordance with Table P3005.4.2.

3. The portion of the stack below the offset shall be sized as for the offset or based on the total number of fixture units on the entire stack, whichever is larger.

P3006.3 Horizontal offsets below the lowest branch.
In soil or waste stacks below the lowest horizontal branch, there shall be no change in diameter required if the offset is made at an angle not greater than 45 degrees (0.79 rad) from the vertical. If an offset greater than 45 degrees (0.79 rad) from the vertical is made, the offset and stack below it shall be sized as a *building drain* (see Table P3005.4.2).

SECTION P3007
SUMPS AND EJECTORS

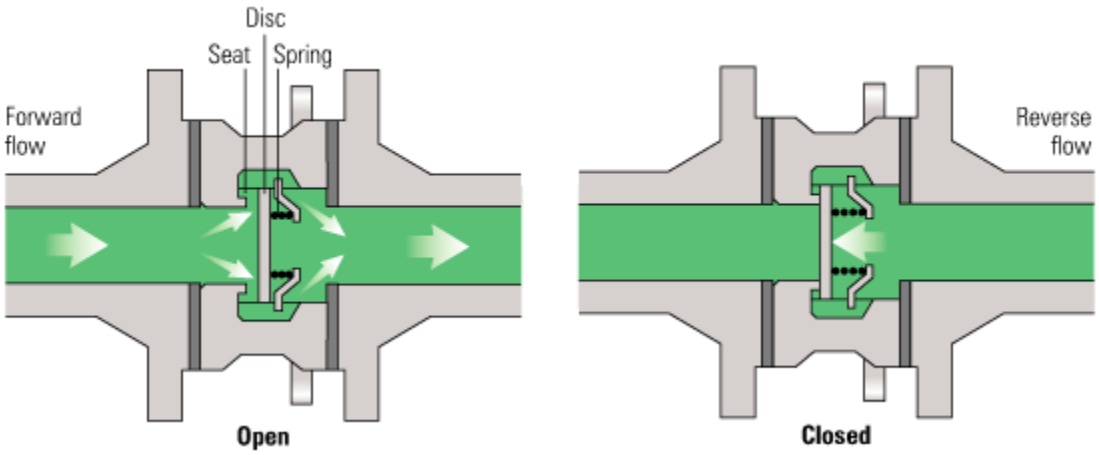
P3007.1 Building subdrains.
Building subdrains that cannot be discharged to the sewer by gravity flow shall be discharged into a tightly covered and vented sump from which the liquid shall be lifted and discharged into the building gravity drainage system by automatic pumping equipment or other *approved* method. In other than existing structures, the sump shall not receive drainage from any piping within the building capable of being discharged by gravity to the *building sewer*.

P3007.2 Valves required.
A check valve and a full open valve located on the discharge side of the check valve shall be installed in the pump or ejector discharge piping between the pump or ejector and the gravity drainage system. Access shall be provided to such valves. Such valves shall be located above the sump cover required by Section P3007.3.2 or, where the discharge pipe from the ejector is below grade, the valves shall be accessibly located outside the sump below grade in an access pit with a removable access cover.

P3007.3 Sump design.
The sump pump, pit and discharge piping shall conform to the requirements of Sections P3007.3.1 through P3007.3.5.

P3007.3.1 Sump pump.
The sump pump capacity and head shall be appropriate to anticipated use requirements.

P3007.3.2 Sump pit.
The sump pit shall be not less than 18 inches (457 mm) in diameter and 24 inches (610 mm) deep, unless otherwise *approved*. The pit shall be accessible and located so that all drainage flows into the pit by gravity. The sump pit shall be constructed of tile, concrete, steel, plastic or other *approved* materials. The pit bottom shall be solid and provide permanent support for the pump. The sump pit shall be fitted with a gastight removable cover adequate to support anticipated loads in the area of use. The sump pit shall be vented in accordance with Chapter 31.



P3007.3.3 Discharge pipe and fittings.
Discharge pipe and fittings serving sump pumps and ejectors shall be constructed of materials in accordance with Sections P3007.3.3.1 and P3007.3.3.2 and shall be approved.

P3007.3.3.1 Materials.
Pipe and fitting materials shall be constructed of brass, copper, CPVC, ductile iron, PE, or PVC.

P3007.3.3.2 Ratings.
Pipe and fittings shall be rated for the maximum system operating pressure and temperature. Pipe fitting materials shall be compatible with the pipe material. Where pipe and fittings are buried in the earth, they shall be suitable for burial.

P3007.3.4 Maximum effluent level.
The effluent level control shall be adjusted and maintained to at all times prevent the effluent in the sump from rising to within 2 inches (51 mm) of the invert of the gravity drain inlet into the sump.

P3007.3.5 Ejector connection to the drainage system.
Pumps connected to the drainage system shall connect to a *building sewer, building drain*, soil stack, waste stack or horizontal branch drain. Where the discharge line connects into horizontal drainage piping, the connection shall be made through a wye fitting into the top of the drainage piping and such wye fitting shall be located not less than 10 pipe diameters from the base of any soil stack, waste stack or fixture drain.

P3007.4 Sewage pumps and sewage ejectors.
A sewage pump or sewage ejector shall automatically discharge the contents of the sump to the building drainage system.

P3007.5 Macerating toilet systems.
Macerating toilet systems shall comply with CSA B45.9 or ASME A112.3.4 and shall be installed in accordance with the manufacturer's installation instructions.

P3007.6 Capacity.
A sewage pump or sewage ejector shall have the capacity and head for the application requirements. Pumps or ejectors that receive the discharge of water closets shall be capable of handling spherical solids with a diameter of up to and including 2 inches (51 mm). Other pumps or ejectors shall be capable of handling spherical solids with a diameter of up to and including 1 inch (25.4 mm). The minimum capacity of a pump or ejector based on the diameter of the discharge pipe shall be in accordance with Table 3007.6.

Exceptions:

1. Grinder pumps or grinder ejectors that receive the discharge of water closets shall have a minimum discharge opening of $1^1/_4$ inches (32 mm).

2. Macerating toilet assemblies that serve single water closets shall have a minimum discharge opening of $^3/_4$ inch (19 mm).

TABLE 3007.6
MINIMUM CAPACITY OF SEWAGE PUMP OR SEWAGE EJECTOR

DIAMETER OF THE DISCHARGE PIPE (inches)	CAPACITY OF PUMP OR EJECTOR (gpm)
2	21
$2^1/_2$	30
3	46

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m.

SECTION P3008
BACKWATER VALVES

P3008.1 Sewage backflow.
Where the flood level rims of plumbing fixtures are below the elevation of the manhole cover of the next upstream manhole in the public sewer, the fixtures shall be protected by a backwater valve installed in the *building drain*, branch of the *building drain* or horizontal branch serving such fixtures. Plumbing fixtures having flood level rims above the elevation of the manhole cover of the next upstream manhole in the public sewer shall not discharge through a backwater valve.

P3008.2 Material.
All bearing parts of backwater valves shall be of corrosion-resistant material. Backwater valves shall comply with ASME A112.14.1, CSA B181.1 or CSA B181.2.

P3008.3 Seal.
Backwater valves shall be constructed to provide a mechanical seal against backflow.

P3008.4 Diameter.
Backwater valves, when fully opened, shall have a capacity not less than that of the pipes in which they are installed.

P3008.5 Location.
Backwater valves shall be installed so that access is provided to the working parts for service and repair.

SECTION P3009
GRAY WATER RECYCLING SYSTEMS

P3009.1 Scope.
The provisions of Section P3009 shall govern the materials, design, construction and installation of gray water systems for flushing of water closets and urinals and for subsurface landscape irrigation. See Figures P3009.1(1) and P3009.1(2).

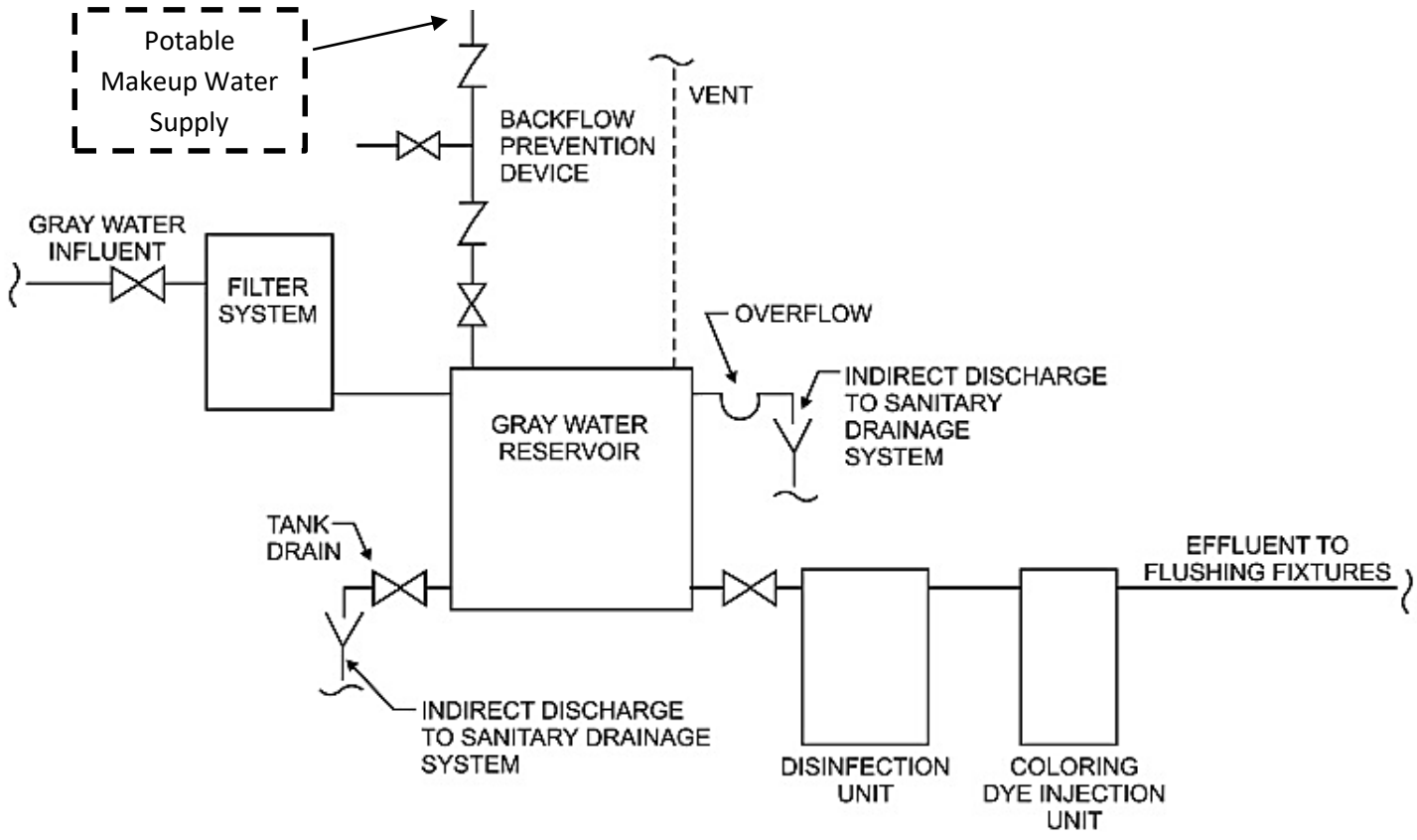


FIGURE P3009.1(1)
GRAY WATER RECYCLING SYSTEM FOR FLUSHING WATER CLOSETS AND URINALS

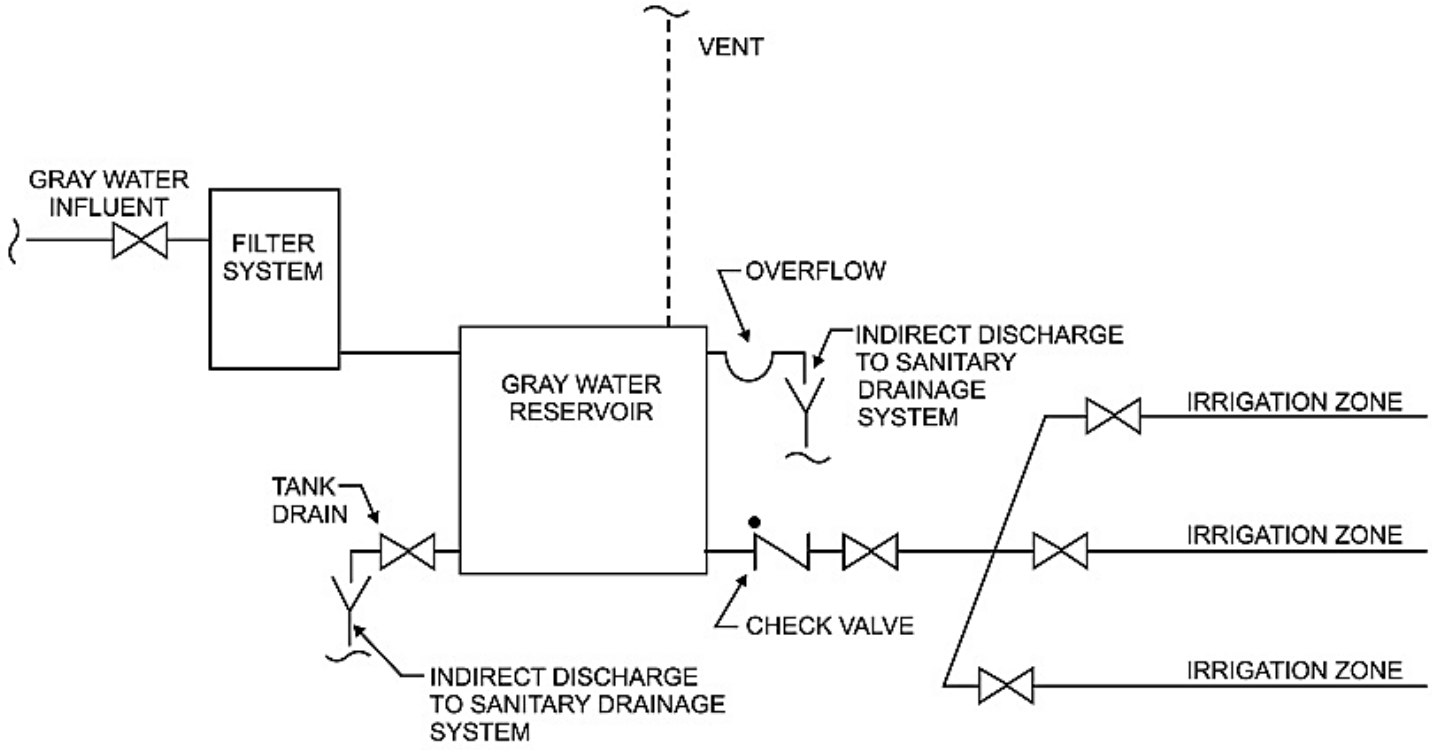


FIGURE P3009.1(2)
GRAY WATER RECYCLING SYSTEM FOR SUBSURFACE LANDSCAPE IRRIGATION

GRAY WATER RECYCLING SYSTEM FOR SUBSURFACE LANDSCAPE IRRIGATION

P3009.2 Installation.
In addition to the provisions of Section P3009, systems for flushing of water closets and urinals shall comply with Section P3009.13 and systems for subsurface landscape irrigation shall comply with Section P3009.14. Except as provided for in Section P3009, all systems shall comply with the provisions of the other sections of this code.

P3009.3 Materials.
Above-ground drain, waste and vent piping for gray water systems shall conform to one of the standards listed in Table P3002.1(1). Gray water underground building drainage and vent pipe shall conform to one of the standards listed in Table P3002.1(2).

P3009.4 Tests.
Drain, waste and vent piping for gray water systems shall be tested in accordance with Section P2503.

P3009.5 Inspections.
Gray water systems shall be inspected in accordance with Section P2503.

P3009.6 Potable water connections.
Only connections in accordance with Section 3009.13.1 shall be made between a gray water recycling system and a potable water system.

P3009.7 Waste water connections.
Gray water recycling systems shall receive only the waste discharge of bathtubs, showers, lavatories, clothes washers or laundry trays.

P3009.8 Collection reservoir.
Gray water shall be collected in an approved reservoir constructed of durable, nonabsorbent and corrosion-resistant materials. The reservoir shall be a closed and gas-tight vessel. Access openings shall be provided to allow inspection and cleaning of the reservoir interior.

P3009.9 Filtration.
Gray water entering the reservoir shall pass through an approved filter such as a media, sand or diatomaceous earth filter.

P3009.9.1 Required valve.
A full-open valve shall be installed downstream of the last fixture connection to the gray water discharge pipe before entering the required filter.

P3009.10 Overflow.
The collection reservoir shall be equipped with an overflow pipe having the same or larger diameter as the influent pipe for the gray water. The overflow pipe shall be trapped and shall be indirectly connected to the sanitary drainage system.

P3009.11 Drain.
A drain shall be located at the lowest point of the collection reservoir and shall be indirectly connected to the sanitary drainage system. The drain shall be the same diameter as the overflow pipe required in Section P3009.10.

P3009.12 Vent required.
The reservoir shall be provided with a vent sized in accordance with Chapter 31 and based on the diameter of the reservoir influent pipe.

P3009.13 Flushing water systems.
Systems for flushing water closets and urinals shall comply with Sections P3009.13.1 through P3009.13.6

P3009.13.1 Collection reservoir.
The holding capacity of the reservoir shall be a minimum of twice the volume of water required to meet the daily flushing requirements of the fixtures supplied with gray water, but not less than 50 gallons (189 L). The reservoir shall be sized to limit the retention time of gray water to a maximum of 72 hours.

P3009.13.2 Disinfection.
Gray water shall be disinfected by an approved method that employs one or more disinfectants such as chlorine, iodine or ozone that are recommended for use with the pipes, fittings and equipment by the manufacturer of the pipes, fittings and equipment.

P3009.13.3 Makeup water.
Potable water shall be supplied as a source of makeup water for the gray water system. The potable water supply shall be protected against backflow in accordance with Section P2902. There shall be a full-open valve located on the makeup water supply line to the collection reservoir.

P3009.13.4 Coloring.
The gray water shall be dyed blue or green with a food-grade vegetable dye before such water is supplied to the fixtures.

P3009.13.5 Materials.
Distribution piping shall conform to one of the standards listed in Table P2905.4.

P3009.13.6 Identification.
Distribution piping and reservoirs shall be identified as containing nonpotable water. Piping identification shall be in accordance with Section P2901.1.

P3009.14 Landscape irrigation systems.
Subsurface landscape irrigation systems shall comply with Sections P3009.14.1 through P3009.14.11

P3009.14.1 Collection reservoir.
Reservoirs shall be sized to limit the retention time of gray water to a maximum of 24 hours.

P3009.14.1.1 Identification.
The reservoir shall be identified as containing nonpotable water.

P3009.14.2 Valves required.
A check valve and a full-open valve located on the discharge side of the check valve shall be installed on the effluent pipe of the collection reservoir.

P3009.14.3 Makeup water.
Makeup water shall not be required for subsurface landscape irrigation systems. Where makeup water is provided, the installation shall be in accordance with Section 3009.13.3.

P3009.14.4 Disinfection.
Disinfection shall not be required for gray water used or subsurface landscape irrigation systems.

P3009.14.5 Coloring.
Gray water used for subsurface landscape irrigation systems shall not be required to be dyed.

P3009.14.6 Estimating gray water discharge.
The system shall be sized in accordance with the gallons-per-day-per-occupant number based on the type of fixtures connected to the gray water system. The discharge shall be calculated by the following equation:

P3009.14.8 Subsurface landscape irrigation site location.
The surface grade of all soil absorption systems shall be located at a point lower than the surface grade of any water well or reservoir on the same or adjoining lot. Where this is not possible, the site shall be located so that surface water drainage from the site is not directed toward a well or reservoir. The soil absorption system shall be located with a minimum horizontal distance between various elements as indicated in Table P3009.14.8. Private sewage disposal systems in compacted areas, such as parking lots and driveways, are prohibited. Surface water shall be diverted away from any soil absorption site on the same or neighboring lots.

TABLE P3009.14.8
LOCATION OF GRAY WATER SYSTEM

ELEMENT	MINIMUM HORIZONTAL DISTANCE	
	HOLDING TANK (feet)	IRRIGATION DISPOSAL FIELD (feet)
Buildings	5	2
Property line adjoining private property	5	5
Public water main	10	10
Seepage pits	5	5
Septic tanks	0	5
Streams and lakes	50	50
Water service	5	5
Water wells	50	100

For SI: 1 foot = 304.8 mm.

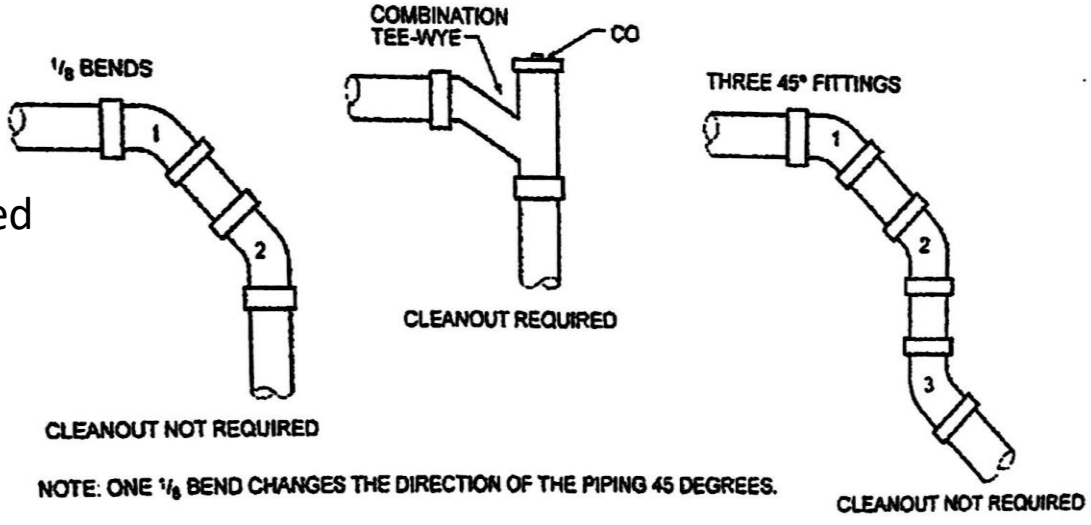
Chapter Notes:

- Sanitary drainage systems are sized by drainage fixture units (DFU) load values. DFU's take into consideration the probabilty of a load that impacts a drainage system.
- Drainage fixture unit values were determined based upon the average rate of discharge by a fixture.
- One DFU is equivalent to a discharge rate of 1 cubic foot per minute which equates to 7.5 gallons per minute.
- Liquid flowing in a vertical pipe will reach its terminal velocity in about 10 to 15 feet of vertical drop. This vertical flow velocity is in the range of 10 feet per second, as compared to approximately 2 feet per second for piping in the horizontal position at a standard slope of 2 percent.

- As liquid flows, it pushes air ahead and drags air behind, the air must be maintained, replenished/replaced, this is where the venting systems equalizes the system through this process.
- Prohibited Joints:
    1. Cement or concrete joints
    2. Mastic or hot-poured bituminous joints
    3. Joints made with fittings not approved for the specific installation
    4. Joints between different diameter pipes made with elastomeric willing O-rings
    5. Solvent-cement joints between different types of plastic pipe
    6. Saddle-type fittings
- Horizontal drainage piping shall be installed in uniform alignment at uniform slope. The minimum slope of a horizontal drainage pipe shall be in accordance with the below table:

Slope of Horizontal Drainage Pipe	
Size (Inches)	**Minimum Slope (Inch per foot)**
2 ½" or Less	**¼**
3" to 6"	**1/8**
8" or Larger	**1/16**

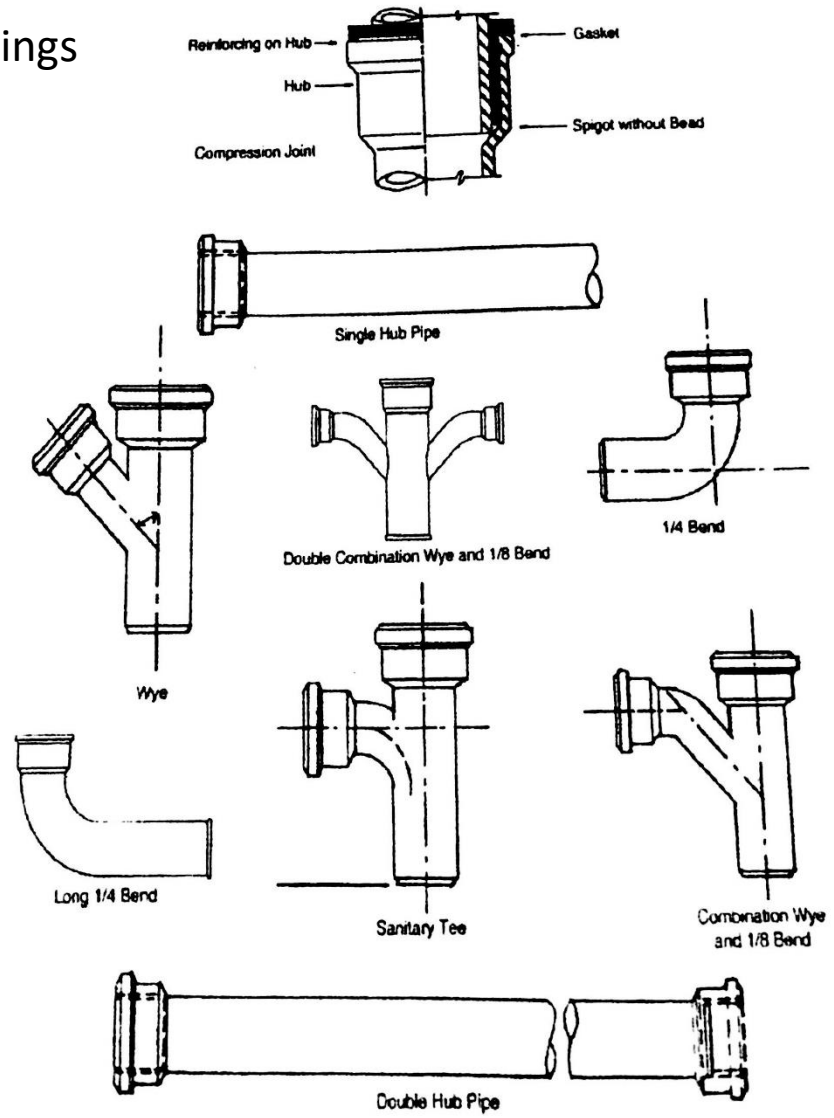
Cleanouts needed for Change-of-Direction



NOTE: ONE 1/8 BEND CHANGES THE DIRECTION OF THE PIPING 45 DEGREES.

For SI: 1 degree = 0.0175 rad.

Flow-Fittings



Chapter 7

IRC

Chapter 31 Vents

CONGER
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SERVICES, LLC.

SECTION P3101
VENT SYSTEMS

P3101.1 General.
This chapter shall govern the selection and installation of piping, tubing and fittings for vent systems. This chapter shall control the minimum diameter of vent pipes, circuit vents, branch vents and individual vents, and the size and length of vents and various aspects of vent stacks and stack vents. Additionally, this chapter regulates vent grades and connections, height above fixtures and relief vents for stacks and fixture traps, and the venting of sumps and sewers.

P3101.2 Trap seal protection.
The plumbing system shall be provided with a system of vent piping that will permit the admission or emission of air so that the seal of any fixture trap shall not be subjected to a pneumatic pressure differential of more than 1 inch of water column (249 Pa).

P3101.2.1 Venting required.
Every trap and trapped fixture shall be vented in accordance with one of the venting methods specified in this chapter.

P3101.3 Use limitations.
The plumbing vent system shall not be used for purposes other than the venting of the plumbing system.

P3101.4 Extension outside a structure.
In climates where the 97.5-percent value for outside design temperature is 0°F (-18°C) or less (ASHRAE 97.5-percent column, winter, see Chapter 3), vent pipes installed on the exterior of the structure shall be protected against freezing by insulation, heat or both. Vent terminals shall be protected from frost closure in accordance with Section P3103.2.

P3101.5 Flood resistance.
In flood hazard areas as established by Table R301.2(1), vents shall be located at or above the elevation required in Section R322.1 (flood hazard areas including A Zones) or R322.2 (coastal high-hazard areas including V Zones).

SECTION P3102
VENT STACKS AND STACK VENTS

P3102.1 Required vent extension.
The vent system serving each *building drain* shall have at least one vent pipe that extends to the outdoors.

P3102.2 Installation.
The required vent shall be a dry vent that connects to the *building drain* or an extension of a drain that connects to the *building drain*. Such vent shall not be an island fixture vent as permitted by Section P3112.

P3102.3 Size.
The required vent shall be sized in accordance with Section P3113.1 based on the required size of the *building drain*.

SECTION P3103
VENT TERMINALS

P3103.1 Roof extension.
Open vent pipes that extend through a roof shall be terminated not less than 6 inches (152 mm) above the roof or 6 inches (152 mm) above the anticipated snow accumulation, whichever is greater, except that where a roof is to be used for any purpose other than weather protection, the vent extension shall be run not less than 7 feet (2134 mm) above the roof.

P3103.2 Frost closure.
Where the 97.5-percent value for outside design temperature is 0°F (-18°C) or less, every vent extension through a roof or wall shall be not less than 3 inches (76 mm) in diameter. Any increase in the size of the vent shall be made inside the structure not less than 1 foot (305 mm) below the roof or inside the wall.

P3103.3 Flashings and sealing.
The juncture of each vent pipe with the roof line shall be made water tight by an *approved* flashing. Vent extensions in walls and soffits shall be made weather tight by caulking.

P3103.4 Prohibited use.
A vent terminal shall not be used for any purpose other than a vent terminal.

P3103.5 Location of vent terminal.
An open vent terminal from a drainage system shall not be located less than 4 feet (1219 mm) directly beneath any door, openable window, or other air intake opening of the building or of an adjacent building, nor shall any such vent terminal be within 10 feet (3048 mm) horizontally of such an opening unless it is not less than 3 feet (914 mm) above the top of such opening

P3103.6 Extension through the wall.
Vent terminals extending through the wall shall terminate not less than 10 feet (3048 mm) from the *lot line* and 10 feet (3048 mm) above the highest adjacent *grade* within 10 feet (3048 mm) horizontally of the vent terminal. Vent terminals shall not terminate under the overhang of a structure with soffit vents. Side wall vent terminals shall be protected to prevent birds or rodents from entering or blocking the vent opening.

SECTION P3104
VENT CONNECTIONS AND GRADES

P3104.1 Connection.
All individual branch and circuit vents shall connect to a vent stack, stack vent or extend to the open air.

Exception: Individual, branch and circuit vents shall be permitted to terminate at an *air admittance valve* in accordance with Section P3114.

P3104.2 Grade.
Vent and branch vent pipes shall be graded, connected and supported to allow moisture and condensate to drain back to the soil or waste pipe by gravity.

P3104.3 Vent connection to drainage system.
A dry vent connecting to a horizontal drain shall connect above the centerline of the horizontal drain pipe.

P3104.4 Vertical rise of vent.
A dry vent shall rise vertically to not less than 6 inches (152 mm) above the flood level rim of the highest trap or trapped fixture being vented.

P3104.5 Height above fixtures.
A connection between a vent pipe and a vent stack or stack vent shall be made not less than 6 inches (152 mm) above the flood level rim of the highest fixture served by the vent. Horizontal vent pipes forming branch vents shall be not less than 6 inches (152 mm) above the flood level rim of the highest fixture served.

P3104.6 Vent for future fixtures.
Where the drainage piping has been roughed-in for future fixtures, a rough-in connection for a vent, not less than one-half the diameter of the drain, shall be installed. The vent rough-in shall connect to the vent system or shall be vented by other means as provided in this chapter. The connection shall be identified to indicate that the connection is a vent.

SECTION P3105
FIXTURE VENTS

P3105.1 Distance of trap from vent.
Each fixture trap shall have a protecting vent located so that the slope and the *developed length* in the *fixture drain* from the trap weir to the vent fitting are within the requirements set forth in Table P3105.1.

Exception: The *developed length* of the *fixture drain* from the trap weir to the vent fitting for self-siphoning fixtures, such as water closets, shall not be limited.

TABLE P3105.1
MAXIMUM DISTANCE OF FIXTURE TRAP FROM VENT

SIZE OF TRAP (inches)	SLOPE (inch per foot)	DISTANCE FROM TRAP (feet)
$1\frac{1}{4}$	$\frac{1}{4}$	5
$1\frac{1}{2}$	$\frac{1}{4}$	6
2	$\frac{1}{4}$	8
3	$\frac{1}{8}$	12
4	$\frac{1}{8}$	16

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm,
1 inch per foot = 83.3 mm/m.

P3105.2 Fixture drains.
The total fall in a *fixture drain* resulting from pipe slope shall not exceed one pipe diameter, nor shall the vent pipe connection to a *fixture drain*, except for water closets, be below the weir of the trap.

P3105.3 Crown vent prohibited.
A vent shall not be installed within two pipe diameters of the trap weir.

SECTION P3106
INDIVIDUAL VENT

P3106.1 Individual vent permitted.
Each trap and trapped fixture shall be permitted to be provided with an individual vent. The individual vent shall connect to the *fixture drain* of the trap or trapped fixture being vented.

SECTION P3107
COMMON VENT

P3107.1 Individual vent as common vent.
An individual vent shall be permitted to vent two traps or trapped fixtures as a common vent. The traps or trapped fixtures being common vented shall be located on the same floor level.

P3107.2 Connection at the same level.
Where the *fixture drains* being common vented connect at the same level, the vent connection shall be at the interconnection of the *fixture drains* or downstream of the interconnection.

P3107.3 Connection at different levels.
Where the *fixture drains* connect at different levels, the vent shall connect as a vertical extension of the vertical drain. The vertical drain pipe connecting the two *fixture drains* shall be considered the vent for the lower *fixture drain*, and shall be sized in accordance with Table P3107.3. The upper fixture shall not be a water closet.

TABLE P3107.3
COMMON VENT SIZES

PIPE SIZE (inches)	MAXIMUM DISCHARGE FROM UPPER FIXTURE DRAIN (d.f.u.)
$1^1/_2$	1
2	4
$2^1/_2$ to 3	6

For SI: 1 inch = 25.4 mm.

SECTION P3108
WET VENTING

P3108.1 Horizontal wet vent permitted.
Any combination of fixtures within two *bathroom groups* located on the same floor level shall be permitted to be vented by a horizontal wet vent. The wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent along the direction of the flow in the drain pipe to the most downstream *fixture drain* connection. Each *fixture drain* shall connect horizontally to the horizontal branch being wet vented or shall have a dry vent. Each wet-vented *fixture drain* shall connect independently to the horizontal wet vent. Only the fixtures within the *bathroom groups* shall connect to the wet-vented horizontal branch drain. Any additional fixtures shall discharge downstream of the horizontal wet vent.

P3108.2 Dry vent connection.
The required dry-vent connection for wet-vented systems shall comply with Sections P3108.2.1 and P3108.2.2.

P3108.2.1 Horizontal wet vent.
The dry-vent connection for a horizontal wet-vent system shall be an individual vent or a common vent for any *bathroom group* fixture, except an emergency floor drain. Where the dry vent connects to a water closet *fixture drain*, the drain shall connect horizontally to the horizontal wet vent system. Not more than one wet-vented *fixture drain* shall discharge upstream of the dry-vented *fixture drain* connection.

P3108.2.2 Vertical wet vent.
The dry-vent connection for a vertical wet-vent system shall be an individual vent or common vent for the most upstream *fixture drain*.

P3108.3 Size.
Horizontal and vertical wet vents shall be not less than the size as specified in Table P3108.3, based on the fixture unit discharge to the wet vent. The dry vent serving the wet vent shall be sized based on the largest required diameter of pipe within the wet-vent system served by the dry vent.

TABLE P3108.3
WET VENT SIZE

WET VENT PIPE SIZE (inches)	FIXTURE UNIT LOAD (d.f.u.)
$1^1/_2$	1
2	4
$2^1/_2$	6
3	12
4	32

For SI: 1 inch = 25.4 mm.

P3108.4 Vertical wet vent permitted.
A combination of fixtures located on the same floor level shall be permitted to be vented by a vertical wet vent. The vertical wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent down to the lowest *fixture drain* connection. Each wet-vented fixture shall connect independently to the vertical wet vent. All water closet drains shall connect at the same elevation. Other *fixture drains* shall connect above or at the same elevation as the water closet *fixture drains*. The dry vent connection to the vertical wet vent shall be an individual or common vent serving one or two fixtures.

P3108.5 Trap weir to wet vent distances.
The maximum *developed length* of wet-vented *fixture drains* shall comply with Table P3105.1.

SECTION P3109
WASTE STACK VENT

P3109.1 Waste stack vent permitted.
A waste stack shall be considered a vent for all of the fixtures discharging to the stack where installed in accordance with the requirements of this section.

P3109.2 Stack installation.
The waste stack shall be vertical, and both horizontal and vertical offsets shall be prohibited between the lowest *fixture drain* connection and the highest *fixture drain* connection to the stack. Every *fixture drain* shall connect separately to the waste stack. The stack shall not receive the discharge of water closets or urinals.

P3109.3 Stack vent.
A stack vent shall be installed for the waste stack. The size of the stack vent shall be not less than the size of the waste stack. Offsets shall be permitted in the stack vent and shall be located not less than 6 inches (152 mm) above the flood level of the highest fixture, and shall be in accordance with Section P3104.5. The stack vent shall be permitted to connect with other stack vents and vent stacks in accordance with Section P3113.3.

P3109.4 Waste stack size.
The waste stack shall be sized based on the total discharge to the stack and the discharge within a *branch interval* in accordance with Table P3109.4. The waste stack shall be the same size throughout the length of the waste stack.

TABLE P3109.4
WASTE STACK VENT SIZE

STACK SIZE (inches)	MAXIMUM NUMBER OF FIXTURE UNITS (d.f.u.)	
	Total discharge into one branch interval	Total discharge for stack
$1^1/_2$	1	2
2	2	4
$2^1/_2$	No limit	8
3	No limit	24
4	No limit	50

For SI: 1 inch = 25.4 mm.

SECTION P3110
CIRCUIT VENTING

P3110.1 Circuit vent permitted.
A maximum of eight fixtures connected to a horizontal branch drain shall be permitted to be circuit vented. Each *fixture drain* shall connect horizontally to the horizontal branch being circuit vented. The horizontal branch drain shall be classified as a vent from the most downstream *fixture drain* connection to the most upstream *fixture drain* connection to the horizontal branch.

P3110.2 Vent connection.
The circuit vent connection shall be located between the two most upstream *fixture drains*. The vent shall connect to the horizontal branch and shall be installed in accordance with Section P3104. The circuit vent pipe shall not receive the discharge of any soil or waste.

P3110.3 Slope and size of horizontal branch.
The slope of the vent section of the horizontal branch drain shall be not greater than one unit vertical in 12 units horizontal (8-percent slope). The entire length of the vent section of the horizontal branch drain shall be sized for the total drainage discharge to the branch in accordance with Table P3005.4.1.

P3110.4 Additional fixtures.
Fixtures, other than the circuit vented fixtures shall be permitted to discharge, to the horizontal branch drain. Such fixtures shall be located on the same floor as the circuit vented fixtures and shall be either individually or common vented.

SECTION P3111
COMBINATION WASTE AND VENT SYSTEM

P3111.1 Type of fixtures.
A combination waste and vent system shall not serve fixtures other than floor drains, sinks and lavatories. A combination waste and vent system shall not receive the discharge of a food waste grinder.

P3111.2 Installation.
The only vertical pipe of a combination waste and vent system shall be the connection between the fixture drain and the horizontal combination waste and vent pipe. The vertical distance shall be not greater than 8 feet (2438 mm).

P3111.2.1 Slope.
The horizontal combination waste and vent pipe shall have a slope of not greater than $^1/_2$ unit vertical in 12 units horizontal (4-percent slope). The minimum slope shall be in accordance with Section P3005.3.

P3111.2.2 Connection.
The combination waste and vent pipe shall connect to a horizontal drain that is vented or a vent shall connect to the combination waste and vent. The vent connecting to the combination waste and vent pipe shall extend vertically not less than 6 inches (152 mm) above the flood level rim of the highest fixture being vented before offsetting horizontally.

P3111.2.3 Vent size.
The vent shall be sized for the total fixture unit load in accordance with Section P3113.1.

P3111.2.4 Fixture branch or drain.
The fixture branch or *fixture drain* shall connect to the combination waste and vent within a distance specified in Table P3105.1. The combination waste and vent pipe shall be considered the vent for the fixture.

P3111.3 Size.
The size of a combination drain and vent pipe shall be not less than that specified in Table 3111.3. The horizontal length of a combination drain and vent system shall be unlimited.

TABLE P3111.3
SIZE OF COMBINATION WASTE AND VENT PIPE

DIAMETER PIPE (inches)	MAXIMUM NUMBER OF FIXTURE UNITS (d.f.u.)	
	Connecting to a horizontal branch or stack	Connecting to a building drain or building subdrain
2	3	4
$2^1/_2$	6	26
3	12	31
4	20	50

For SI: 1 inch = 25.4 mm.

SECTION P3112
ISLAND FIXTURE VENTING

P3112.1 Limitation.
Island fixture venting shall not be permitted for fixtures other than sinks and lavatories. Kitchen sinks with a dishwasher waste connection, a food waste grinder, or both, in combination with the kitchen sink waste, shall be permitted to be vented in accordance with this section.

P3112.2 Vent connection.
The island fixture vent shall connect to the *fixture drain* as required for an individual or common vent. The vent shall rise vertically to above the drainage outlet of the fixture being vented before offsetting horizontally or vertically downward. The vent or branch vent for multiple island fixture vents shall extend not less than 6 inches (152 mm) above the highest island fixture being vented before connecting to the outside vent terminal.

P3112.3 Vent installation below the fixture flood level rim.
The vent located below the flood level rim of the fixture being vented shall be installed as required for drainage piping in accordance with Chapter 30, except for sizing. The vent shall be sized in accordance with Section P3113.1. The lowest point of the island fixture vent shall connect full size to the drainage system. The connection shall be to a vertical drain pipe or to the top half of a horizontal drain pipe. Cleanouts shall be provided in the island fixture vent to permit rodding of all vent piping located below the flood level rim of the fixtures. Rodding in both directions shall be permitted through a cleanout.

SECTION P3113
VENT PIPE SIZING

P3113.1 Size of vents.
The required diameter of individual vents, branch vents, circuit vents, vent stacks and stack vents shall be not less than one-half the required diameter of the drain served. The required size of the drain shall be determined in accordance with Chapter 30. Vent pipes shall be not less than $1^1/_4$ inches (32 mm) in diameter. Vents exceeding 40 feet (12 192 mm) in *developed length* shall be increased by one nominal pipe size for the entire *developed length* of the vent pipe.

P3113.2 Developed length.
The *developed length* of individual, branch, and circuit vents shall be measured from the farthest point of vent connection to the drainage system, to the point of connection to the vent stack, stack vent or termination outside of the building.

P3113.3 Branch vents.
Where branch vents are connected to a common branch vent, the common branch vent shall be sized in accordance with this section, based on the size of the common horizontal drainage branch that is or would be required to serve the total drainage fixture unit (d.f.u.) load being vented.

P3113.4 Sump vents.
Sump vent sizes shall be determined in accordance with Sections P3113.4.1 and P3113.4.2.

P3113.4.1 Sewage pumps and sewage ejectors other than pneumatic.
Drainage piping below sewer level shall be vented in the same manner as that of a gravity system. Building sump vent sizes for sumps with sewage pumps or sewage ejectors, other than pneumatic, shall be determined in accordance with Table P3113.4.1.

TABLE P3113.4.1
SIZE AND LENGTH OF SUMP VENTS

DISCHARGE CAPACITY OF PUMP (gpm)	MAXIMUM DEVELOPED LENGTH OF VENT (feet)[a]				
	Diameter of vent (inches)				
	$1^1/_4$	$1^1/_2$	2	$2^1/_2$	3
10	No limit[b]	No limit	No limit	No limit	No limit
20	270	No limit	No limit	No limit	No limit
40	72	160	No limit	No limit	No limit
60	31	75	270	No limit	No limit

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 gallon per minute (gpm) = 3.785 L/m.

a. Developed length plus an appropriate allowance for entrance losses and friction caused by fittings, changes in direction and diameter. Suggested allowances shall be obtained from NBS Monograph 31 or other approved sources. An allowance of 50 percent of the developed length shall be assumed if a more precise value is not available.
b. Actual values greater than 500 feet.

P3113.4.2 Pneumatic sewage ejectors.
The air pressure relief pipe from a pneumatic sewage ejector shall be connected to an independent vent stack terminating as required for vent extensions through the roof. The relief pipe shall be sized to relieve air pressure inside the ejector to atmospheric pressure, but shall not be less than $1^1/_4$ inches (32 mm) in size.

SECTION P3114
AIR ADMITTANCE VALVES

P3114.1 General.
Vent systems using *air admittance valves* shall comply with this section. Individual and branch-type air admittance valves shall conform to ASSE 1051. Stack-type air admittance valves shall conform to ASSE 1050.

P3114.2 Installation.
The valves shall be installed in accordance with the requirements of this section and the manufacturer's instructions. *Air admittance valves* shall be installed after the DWV testing required by Section P2503.5.1 or P2503.5.2 has been performed.

P3114.3 Where permitted.
Individual vents, branch vents, circuit vents and stack vents shall be permitted to terminate with a connection to an *air admittance valve*. Individual and branch type air admittance valves shall vent only fixtures that are on the same floor level and connect to a horizontal branch drain.

Unmatched Performance

Sensitivity to pressure changes, combined with its ability to consistently open and close, distinguishes the Oatey Sure-Vent® AAV from all others. Superior engineering along with stringent quality standards ensure a lifetime of unmatched performance.

ZERO PRESSURE

At zero pressure the Sure-Vent® AAV is sealed, ready to react to pressure changes. The Sure-Vent® AAV will not allow sewer gas to enter the structure.

NEGATIVE PRESSURE

A pressure change of -0.01 psi (-0.25" H_2O) will cause the Sure-Vent® AAV to open. When open, air will flow from the room, through the protective screening, past the seal and into the DWV system as the arrows indicate. When pressure is equalized, the Sure-Vent® AAV returns to the zero pressure position.

POSITIVE PRESSURE

The Sure-Vent® AAV seals at 0 psi and above indefinitely. The figure shows the Sure-Vent® AAV in a sealed position blocking sewer gasses. When pressure subsides, the Sure-Vent® AAV returns to the zero pressure position.

P3114.4 Location.
Individual and branch *air admittance valves* shall be located not less than 4 inches (102 mm) above the horizontal branch drain or *fixture drain* being vented. Stack-type air admittance valves shall be located not less than 6 inches (152 mm) above the flood level rim of the highest fixture being vented. The *air admittance valve* shall be located within the maximum *developed length* permitted for the vent. The *air admittance valve* shall be installed not less than 6 inches (152 mm) above insulation materials where installed in *attics*.

P3114.5 Access and ventilation.
Access shall be provided to all *air admittance valves*. The valve shall be located within a ventilated space that allows air to enter the valve.

P3114.6 Size.
The *air admittance valve* shall be rated for the size of the vent to which the valve is connected.

P3114.7 Vent required.
Within each plumbing system, not less than one stack vent or a vent stack shall extend outdoors to the open air.

P3114.8 Prohibited installations.
Air admittance valves without an engineered design shall not be used to vent sumps or tanks of any type.

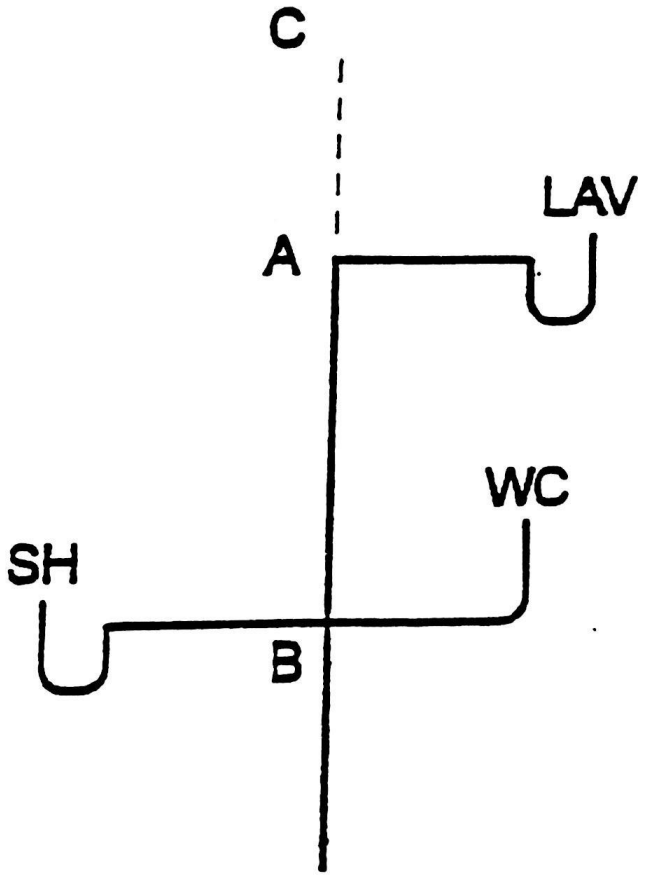
Chapter Notes:

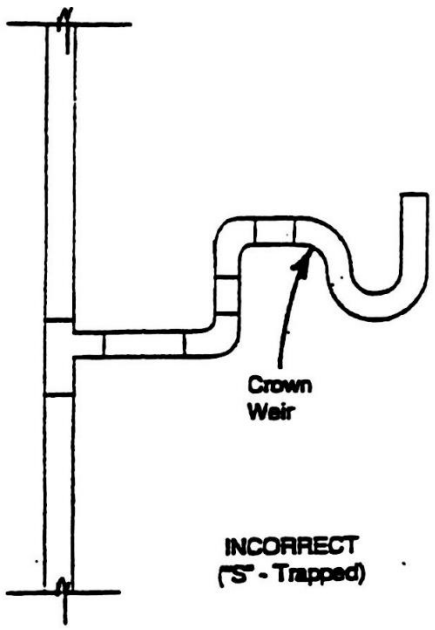
- The most common method of venting each trap or trapped fixture is provided with a separate or individual vent, which connects to the structure's main venting system.
- The minimum size again of any vent is one-half of the required size of the drain pipe with a minimum size 1 ¼"
- The purpose of venting is to protect the trap seal of each trap
- Vents are designed to maintain maximum differential pressures at each trap of not greater than 1" of wate column
- One function of the upstream vent is to replace this displaced air (as we spoke of with drainage) before the pressure differential becomes greater than that of the pressure generated by the 1" water column. As the water flows and is displacing air (pushing it ahead of the water flow) the downstream air pressure in the piping system would increase if there were no path of escape, the VENT does this easily.

- It is essential that there be openings to the atmosphere both upstream and downstream of any water flow so that air can be drawn in or pushed out of the piping system to prevent either excessive reductions or excessive increases in internal air pressures as liquid flows through the drainlines. This is the prime function of the venting system.
- Remember that the venting system is one or more vent pipes connected to the drainage system and terminates outside of the the dwelling; and the venting system:
    1. Prevents migration of internal air pressure
    2. Prevents retardation of liquid flow
    3. ***Prevents trap seal loss***
    4. Assures free circulation of air throughout system
- Each plumbing fixture trap, except as other-wise noted in this code (IRC) shall be protected against siphonage and back-pressure. Air circulation shall be assured throughout the drainage system by means of vent pipes installed in accordance by this code.
- Minimum Trap Arm length: 2 times the diameter of the trap arm & vent opening from trap shall not be lower than that of the weir (outlet).
- A vent pipe connection which is below the weir (outlet) of the trap effectively creates an S-Trap which creates a siphon-leg and is not code-compliant/illegal.
- Although vent piping may be installed in a horizontal position, vent connections may not be horizontal. In all cases the invert (interior bottom surface of a pipe) of a vent must be above the SPRING-LINE of the drainage piping to which it is connected.
- The SPRING-LINE of a drainage pipe is considered to be the midpoint (1/2 diameter) of the pipe, an elevation within a drainline that would normally not be exceeded except during surge conditions. The objective is to prevent the flow through a drainage system from detouring into the vent piping. This is best achieved by assuring the elevation of each horizontal vent's invert is above the drainline (trap-arm) served so that the vent will remain DRY.
- The unacceptable situation occurs when the vent inverts, which is below the drainline trap arm spring-line, this created situation is known as a fat-vent; under NO CIRCUMSTANCE is a fat-vent acceptable/permissable.

Wet Vent by Stack Venting (Private Bathroom Group)

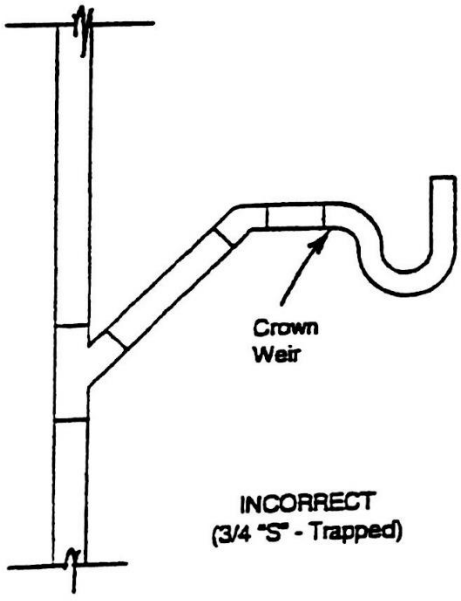
Item	Min. Size	DFU'S (Table 712.1)
LAV	1 ¼ inch	1
SH	2 inches	2
WC	3 inches	4
A-B[a]	1 ½ inches[a]	1
A-C	1 ½ inches	N/A
a = From Table 910.3 in Code N/A = not applicable		



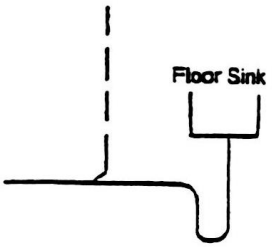


INCORRECT
("S" - Trapped)

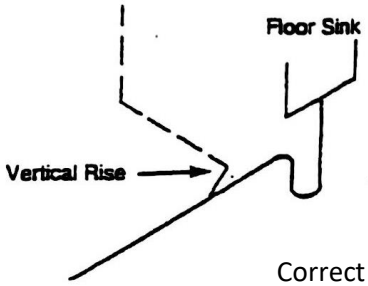
Note:
Crown = Top
Weir = Invert
The "crown" of a trap is the top of its outlet. The "crown weir" is the flood level of a trap immediately below its crown.



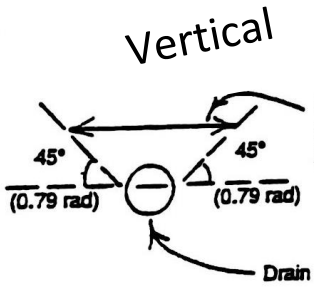
INCORRECT
(3/4 "S" - Trapped)



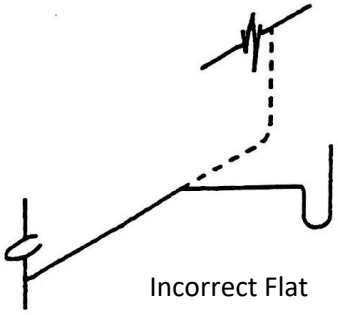
Correct



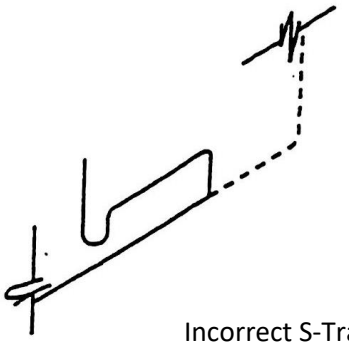
Correct



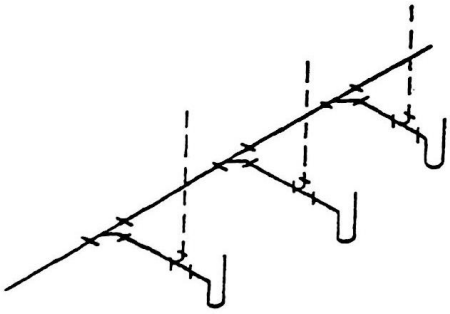
Vent take-off above center-line of drain



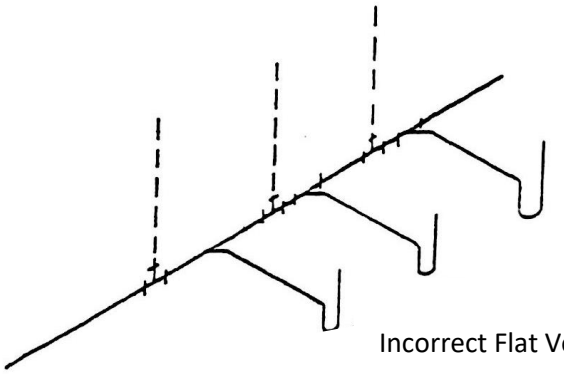
Incorrect Flat Vent



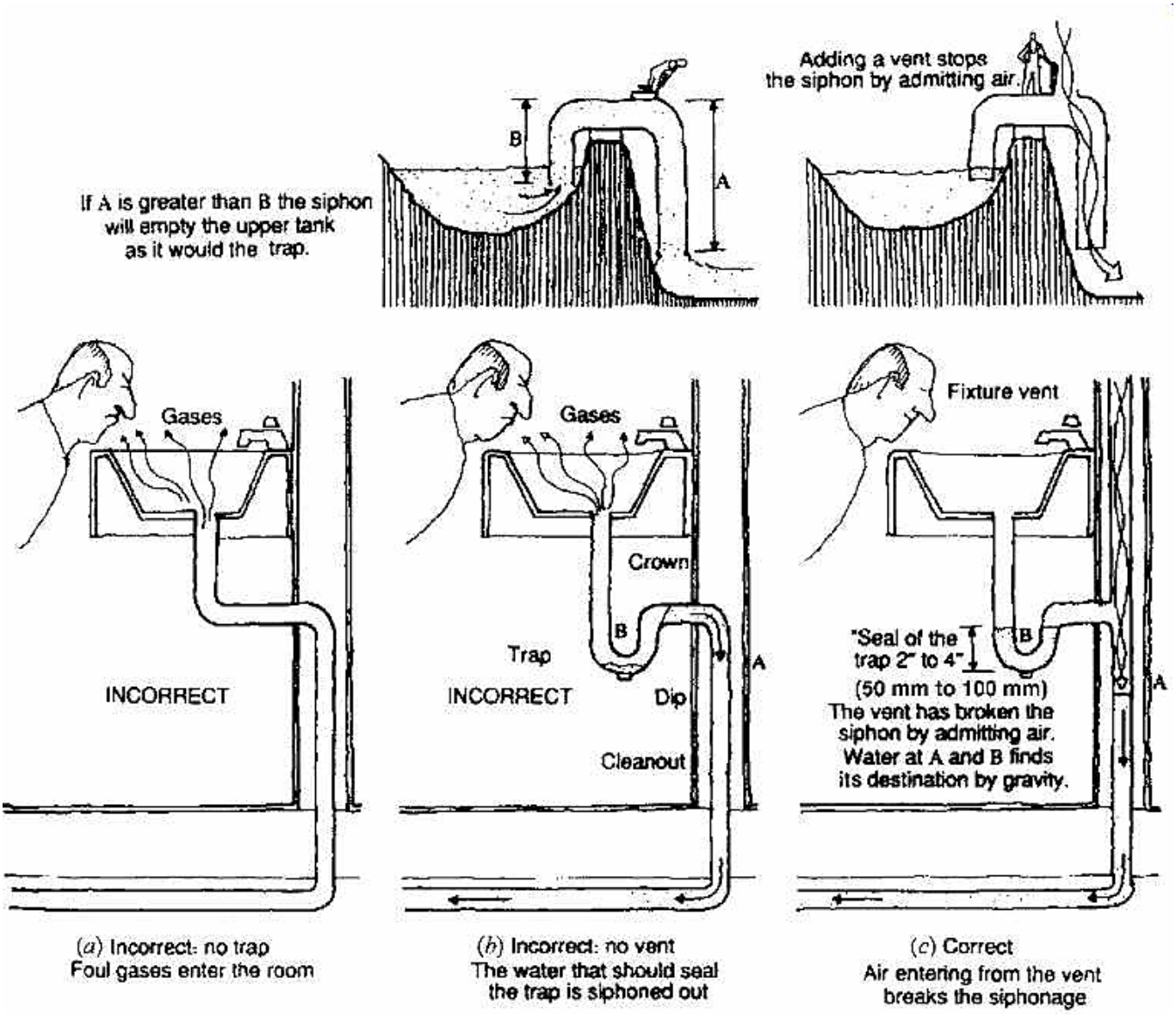
Incorrect S-Trap Flat Vent



Correct



Incorrect Flat Vent



(*a*) Incorrect: no trap
Foul gases enter the room

(*b*) Incorrect: no vent
The water that should seal the trap is siphoned out

(*c*) Correct
Air entering from the vent breaks the siphonage

Chapter 8

IRC

Chapter 32 Traps

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SECTION P3201
FIXTURE TRAPS

P3201.1 Design of traps.
Traps shall be of standard design, shall have smooth uniform internal waterways, shall be self-cleaning and shall not have interior partitions except where integral with the fixture. Traps shall be constructed of lead, cast iron, cast or drawn brass or *approved* plastic. Tubular brass traps shall be not less than No. 20 gage (0.8 mm) thickness. Solid connections, slip joints and couplings shall be permitted to be used on the trap inlet, trap outlet, or within the trap seal. Slip joints shall be accessible.

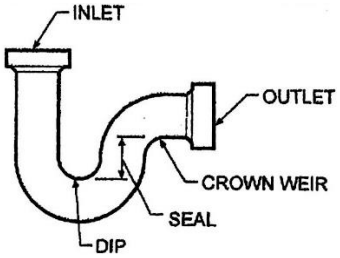
P3201.2 Trap seals and trap seal protection.
Traps shall have a liquid seal not less than 2 inches (51 mm) and not more than 4 inches (102 mm). Traps for floor drains shall be fitted with a trap primer or shall be of the deep seal design. Trap seal primer valves shall connect to the trap at a point above the level of the trap seal.

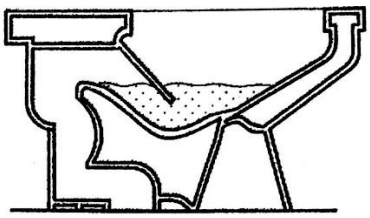
P3201.3 Trap setting and protection.
Traps shall be set level with respect to their water seals and shall be protected from freezing. Trap seals shall be protected from siphonage, aspiration or back pressure by an *approved* system of venting (see Section P3101).

P3201.4 Building traps.
Building traps shall not be installed, except in special cases where sewer gases are extremely corrosive or noxious, as directed by the *building official*.

P3201.5 Prohibited trap designs.
The following types of traps are prohibited:

1. Bell traps.
2. Separate fixture traps with interior partitions, except those lavatory traps made of plastic, stainless steel or other corrosion-resistant material.
3. "S" traps.
4. Drum traps.
5. Trap designs with moving parts.




WATER CLOSETS HAVE A INTEGRAL TRAP

P3201.6 Number of fixtures per trap.
Each plumbing fixture shall be separately trapped by a water seal trap. The vertical distance from the fixture outlet to the trap weir shall not exceed 24 inches (610 mm) and the horizontal distance shall not exceed 30 inches (762 mm) measured from the center line of the fixture outlet to the centerline of the inlet of the trap. The height of a clothes washer standpipe above a trap shall conform to Section P2706.2. Fixtures shall not be double trapped.

Exceptions:

1. Fixtures that have integral traps.
2. A single trap shall be permitted to serve two or three like fixtures limited to kitchen sinks, laundry tubs and lavatories. Such fixtures shall be adjacent to each other and located in the same room with a continuous waste arrangement. The trap shall be installed at the center fixture where three fixtures are installed. Common trapped fixture outlets shall be not more than 30 inches (762 mm) apart.
3. Connection of a laundry tray waste line into a standpipe for the automatic clothes-washer drain shall be permitted in accordance with Section P2706.2.1.

P3201.7 Size of fixture traps.
Fixture trap size shall be sufficient to drain the fixture rapidly and not less than the size indicated in Table P3201.7. A trap shall not be larger than the drainage pipe into which the trap discharges.

TABLE P3201.7
SIZE OF TRAPS AND TRAP ARMS FOR PLUMBING FIXTURES

PLUMBING FIXTURE	TRAP SIZE MINIMUM (inches)
Bathtub (with or without shower head and/or whirlpool attachments)	$1^1/_2$
Bidet	$1^1/_4$
Clothes washer standpipe	2
Dishwasher (on separate trap)	$1^1/_2$
Floor drain	2
Kitchen sink (one or two traps, with or without dishwasher and garbage grinder)	$1^1/_2$
Laundry tub (one or more compartments)	$1^1/_2$
Lavatory	$1^1/_4$
Shower (based on the total flow rate through showerheads and bodysprays) Flow rate: 5.7 gpm and less More than 5.7 gpm up to 12.3 gpm More than 12.3 gpm up to 25.8 gpm More than 25.8 gpm up to 55.6 gpm	 $1^1/_2$ 2 3 4
Water closet	Note a

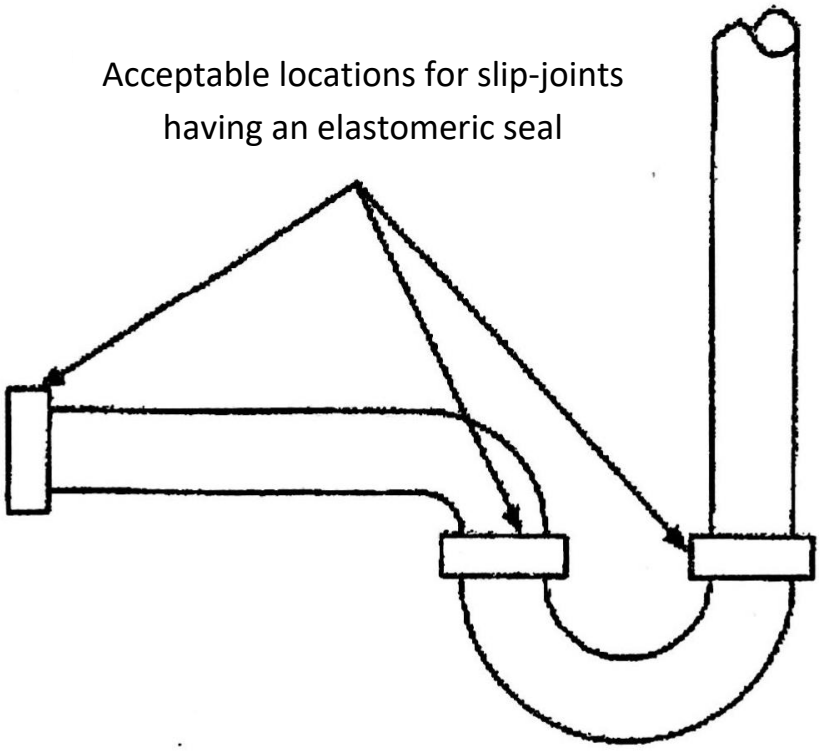
For SI: 1 inch = 25.4 mm.
a. Consult fixture standards for trap dimensions of specific bowls.

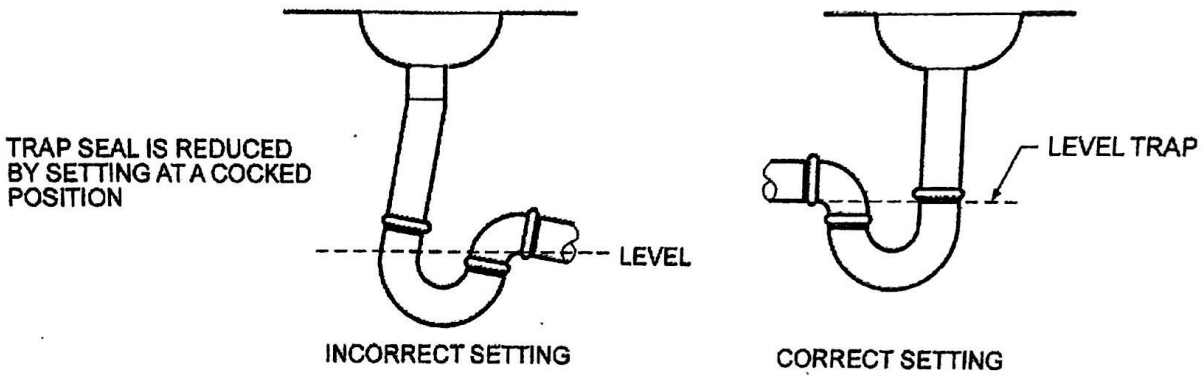
Chapter Notes:

- The water seal trap was developed as one of the simplest forms of isolating sewer gas from the interior of structures as well as preventing vermin from entering. The use of the trap helped accelerate the revolution of indoor plumbing and resulted in the development of the venting system.
- Each fixture trap shall have a water seal of not less than 2” and no more than 4” except where a deeper seal is found necessary due to special conditions and/or special design relating to ADA/Handicapped accessible fixtures.
- Traps shall be set true to their water seals and freeze-protected.
- Trap: a fitting or device so designed and contructed as to provide when properly vented, a liquid seal which will prevent the back passage of air without materially affecting the flow of sewage or waste through it.
- Trap Seal: The vertical distance between the crown weir and the top-dip of the trap.
- Crown Weir (Trap-Weir): The lowest point in the cross section of the horizontal waterway at the exit of the trap.
- Top-Dip (of Trap): The highest point in the internal cross section of the trap at the lowest part of the bend (inverted siphon). By contrast, the bottom dip is the lowest point in the internal cross section.

- Each plumbing fixture must be separately trapped by an approved type water seal trap; NO MORE than one trap is permitted on a trap arm: NO FIXTURE MAY BE DOUBLE TRAPPED (the piping between the two traps would become air bound, resulting in a slow drain, and increasing the possibility of a stoppage.
- ONE trap MAY serve no more than 3-single compartment sinks (kitchen) or laundry tub of the same depth or 3 lavatories immediately adjacent to each other and in the same room if the waste outlets are NOT MORE than 30" apart.
- Water-closets have a designed S-Trap that effectively empties, thus cleans the entire trap.
- The vertical distance between a fixture outlet and the trap weir will be as short as pratical, but the tailpiece form the fixture cannot exceed 24" in length. The exception is the standpipe for a clothes washer, which is a minimum 18" and a maximum determined by the AHJ. Where a laundry trap waste line connects into a standpipe for a clothes washer, the standpipe shall extend not less than 30" above the standpipe trap weir and shall extend above the flood level rim of the laundry tray.

Acceptable locations for slip-joints
having an elastomeric seal




TRAP SEAL IS REDUCED
BY SETTING AT A COCKED
POSITION
LEVEL
INCORRECT SETTING
LEVEL TRAP
CORRECT SETTING

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Tradesman – Appendix A

Math Participation Exercises

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Plumbing Math

1. Atmospheric pressure at sea level is most nearly:
    A. 8.345 lbs.
    B. 14.7 psi
    C. .434 psi
    D. 62.4 psi
2. One cubic foot contains approximately:
    A. 144 cu. In.
    B. 8.345 gallons
    C. 1728 cu. In.
    D. 14.7 psi
3. The full length of a house sewer is 100 foot and the total fall is 25 inches. The slope or grade of the sewer is approximately:
    A. 1 percent
    B. ¼ in. per ft.
    C. 2 percent
    D. ½ in. per ft.
4. The scale on a set of plans states that 1/8 in. = 1 foot. The actual length of a water line with a plan dimension of 5 inches would be approximately:
    A. 8 ft.
    B. 5 ft.
    C. 80 ft.
    D. 40 ft.
5. By doubling the diameter of the pipe, you will:
    A. Double the area
    B. Increase friction loss
    C. Increase the area 4 times
    D. Reduce the volume of flow
6. The volume of water in one cubic foot is most nearly:
    A. 7 ½ gal.
    B. 6 ½ gal.
    C. 28 qt.
    D. 10 qt.
7. The pressure at the base of a column of water 1 inch high is approximately:
    A. 0.4345 psi
    B. 4.345 psi

C. 0.036 psi
D. 2.31 psi

8. One gallon of water weighs approximately:
   A. 8.345 lbs.
   B. 14.7 lbs.
   C. 4.345 lbs.
   D. 7.48 lbs.
9. A cubic foot of water weighs approximately:
   A. 144 lbs.
   B. 231 lbs.
   C. 62.4 lbs.
   D. 43.4 lbs.
10. A square foot contains approximately:
   A. 100 sq. in.
   B. 144 sq. in.
   C. 48 sq. in.
   D. 1440 sq. in.
11. The cross-sectional area of a 2 inch diameter pipe is:
   A. 3.14 sq. in.
   B. 6.28 sq. in.
   C. 4.00 sq. in.
   D. 2.00 sq. in.
12. Disregarding any friction loss, the pressure required to raise a column of water 200 feet would most nearly be:
   A. 100 psi
   B. 200 psi
   C. 86 psi
   D. 43 psi
13. If a tank has a volume of 1,000 cubic inches, how many gallons could it hold?
   A. 0.579
   B. 5.79
   C. 43.287
   D. 4.3287
14. What is the weight of the water in that 1,000 cu. In. tank?
   A. 36.123 lbs.
   B. 62.42 lbs.
   C. 48.318 lbs.
   D. 4.8318 lbs.
15. If a tank has the capacity to hold 80 cubic feet, what is the weight inside the tank?

A. 6,676.0 lbs.
B. 667.6 lbs.
C. 4,993.648 lbs.
D. 499.3648 lbs.

16. How many gallons could be held in a tank with a capacity of 80 cubic feet?
    A. 48.95
    B. 598.4
    C. 5,984
    D. 489.5
17. A cold water pipe is to be offset 4 feet, using 45 degree elbows. The length of the diagonal section of piping will be most nearly:
    A. 5 ft.
    B. 5 ft. 7 in.
    C. 6 ft.
    D. 6 ft. 8 in.
18. A tank is 8 feet 0 inches in diameter and 12 feet 0 inches high. What is the capacity in cubic feet?
    A. 602.88
    B. 314.13
    C. 192.0
    D. 96.0
19. How many gallons will the tank in question #18 hold?
    A. 4,509.54
    B. 2,349.69
    C. 1,436.16
    D. 718.08
20. What is the pressure at the base of the tank in question #18?
    A. 312.01
    B. 41.712
    C. 5.214
    D. 624.01
21. A fuel tank 5 feet in diameter and 60 feet long is to be either suspended from the structural steel or strapped to an anchoring slab with 4-U shaped straps. The total length of the strap material should be?
    A. 13 ft.
    B. 26 ft.
    C. 39 ft.
    D. 52 ft.
22. How high will water be lifted within a pipe when placed under 25 psi of pressure?

A. 130.35 inches
B. 25.435 inches
C. 57.53 feet
D. 25.435 feet

23. A tank is 42 inches in diameter and 40 inches high.
    - What is the capacity in cubic feet?
    - How many gallons will it hold?
    - What is the pressure at the base of the tank?
    - What is the total weight of the water in the tank?
24. A 6-inch standpipe is 42 feet tall and full of water.
    - What is the capacity in cubic inches?
    - What is the capacity in cubic feet?
    - How many gallons will it hold?
    - What is the pressure at the base of the standpipe?
    - What is the force exerted by the water?
25. An 8-inch standpipe is 150 feet tall and full of water. Pressure gauges are placed at the base of the standpipe, one third of the way up the standpipe and half way up the standpipe. What is the pressure at each gauge?
26. What would be the height in feet of a column of water necessary to develop 13 psi of water pressure?
27. Fill in the blank with the height the water can be lifted, by the psi note below:
    - 65 psi_____
    - 72 psi_____
    - 88 psi_____
28. Fill in the blank with the pressure produced by the following:
    - 28 ft. of head_____
    - 49.5 ft. of head_____
    - 67.5 ft. of head_____
29. A water line has 40 psi available at the meter. The most remote outlet on the water service is 250 feet away and 20 feet higher than the meter. The water service will realize ½ pound friction loss per 100 feet. Water is the water pressure at the most remote outlet?
30. A pump tank has a diameter 40 inches. To keep the tank from short-cycling. The floats must be placed to allow minimum of 50 gallons of water discharge. What is the minimum distance between the start and stop floats in the tank?

Use this space to work your problems:

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Tradesman – Appendix B

Needs Determination

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- ✓ *Isometric Sketches* will enable you in the field to visualize your plumbing schematic (2-D) in way that will allow for a practical and accurate method of obtaining your material/supply lists!
- ✓ Remember to include application supplies such as solvent cement & primer for TSBPE testing purposes BUT also for real-field jobs, this step will guide you through your career.

Let's draw an Isometric Sketch!

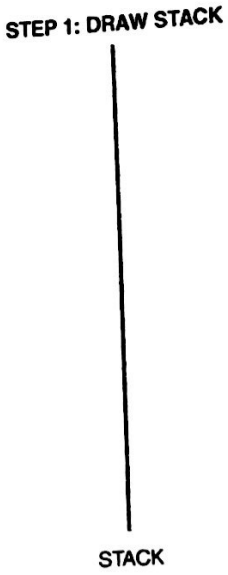
1. Get your isometric graphing paper ready!

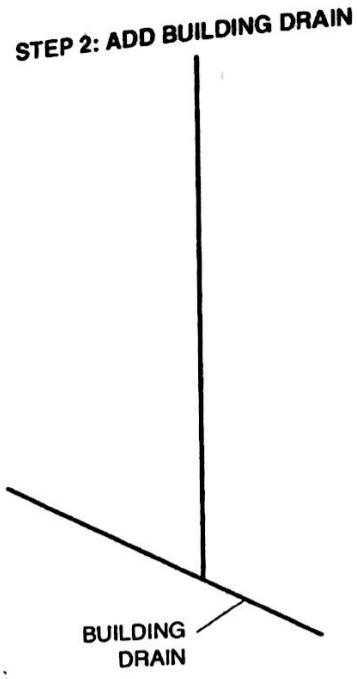
2. Begin by drawing the stack as a vertical line.

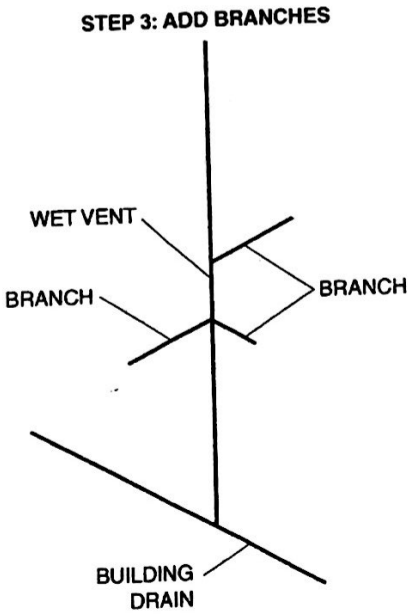
3. Add the building drain at a 30-degree angle to the bottom of the stack.

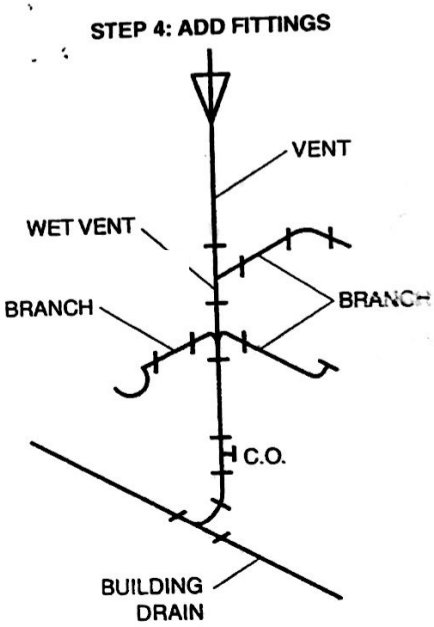
4. Add the branch piping. Remember that branches are drawn on the vertical line in the relative positions that they will actually be installed.

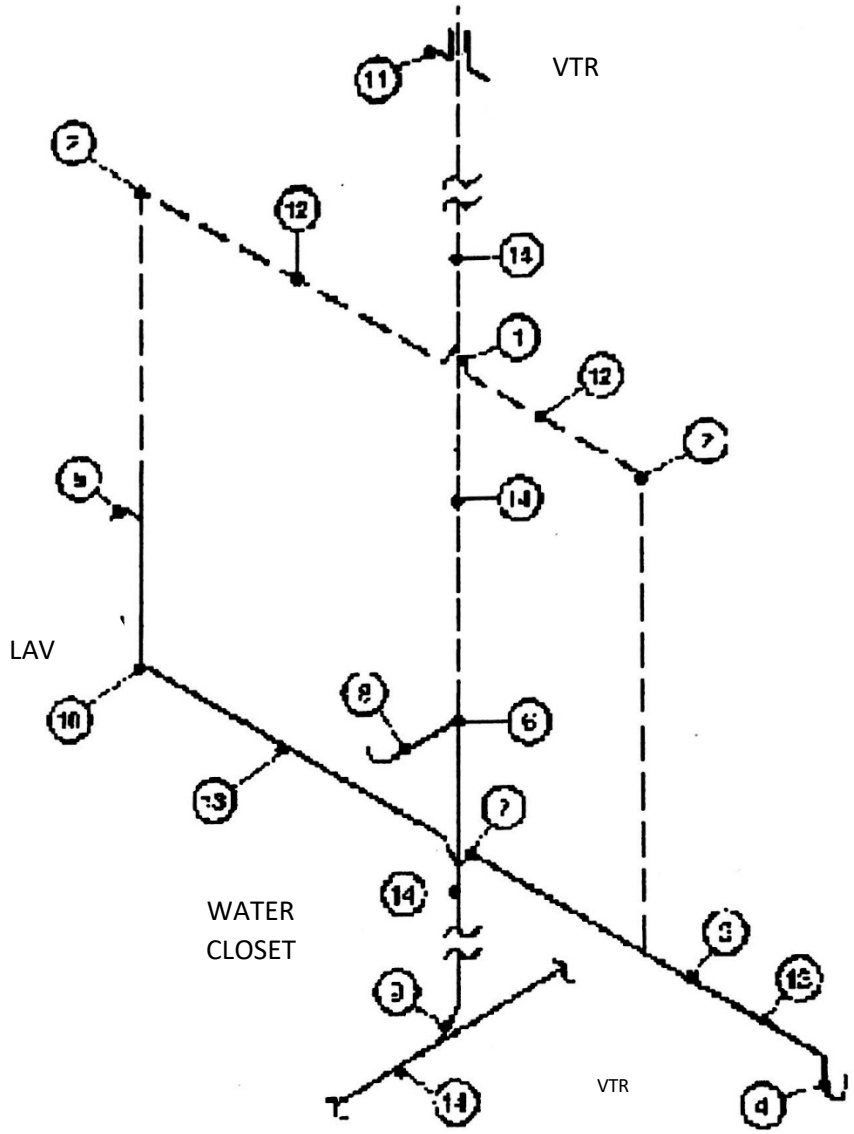
5. Finally, add the fitting along the branches and stack. All wyes, tees, and other connections to the stack and drain should indicate the direction of flow. Indicate the vent above the highest fixture branch.


STEP 1: DRAW STACK
STACK


STEP 2: ADD BUILDING DRAIN
BUILDING
DRAIN

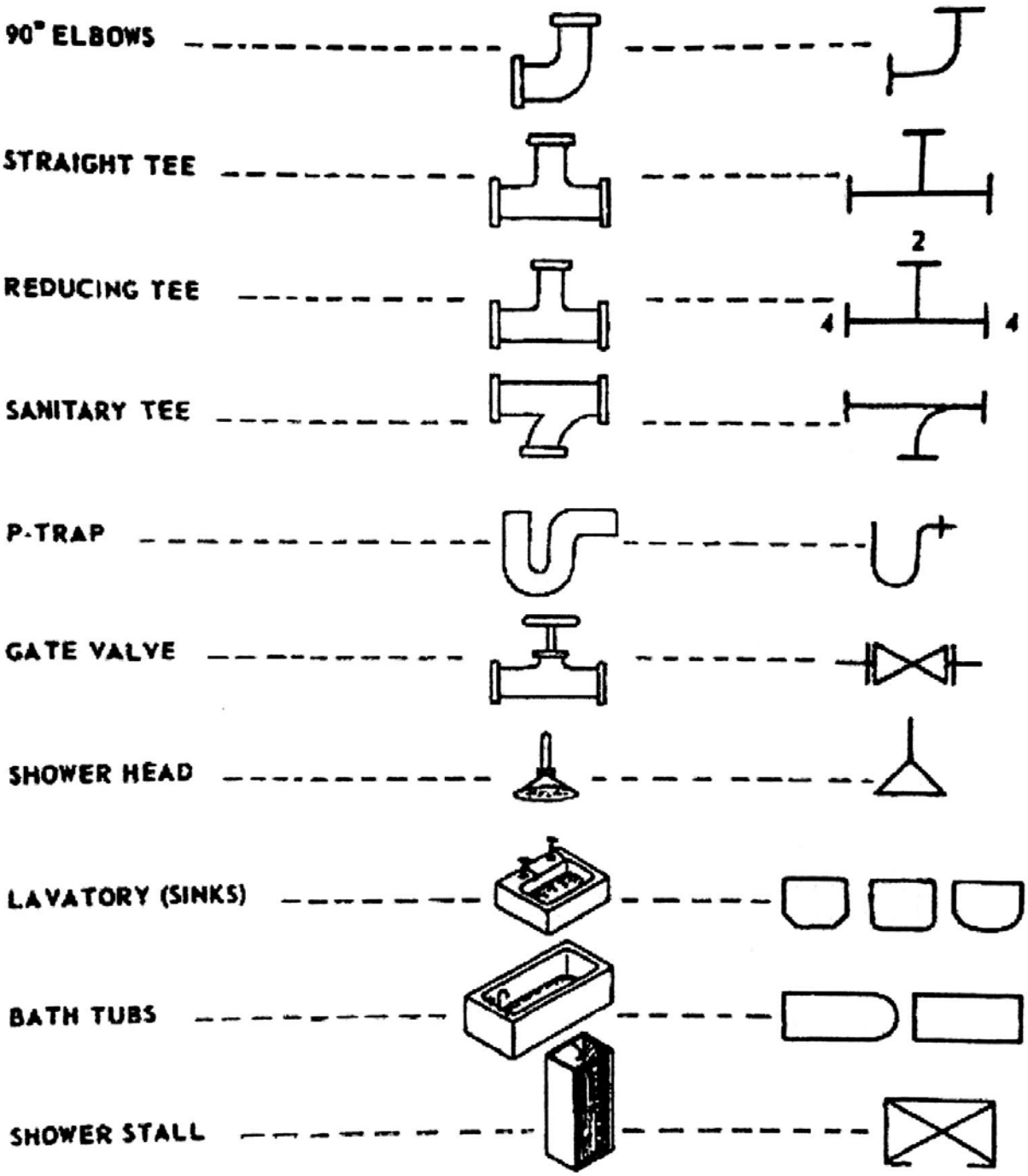

STEP 3: ADD BRANCHES
WET VENT
BRANCH
BRANCH
BUILDING
DRAIN

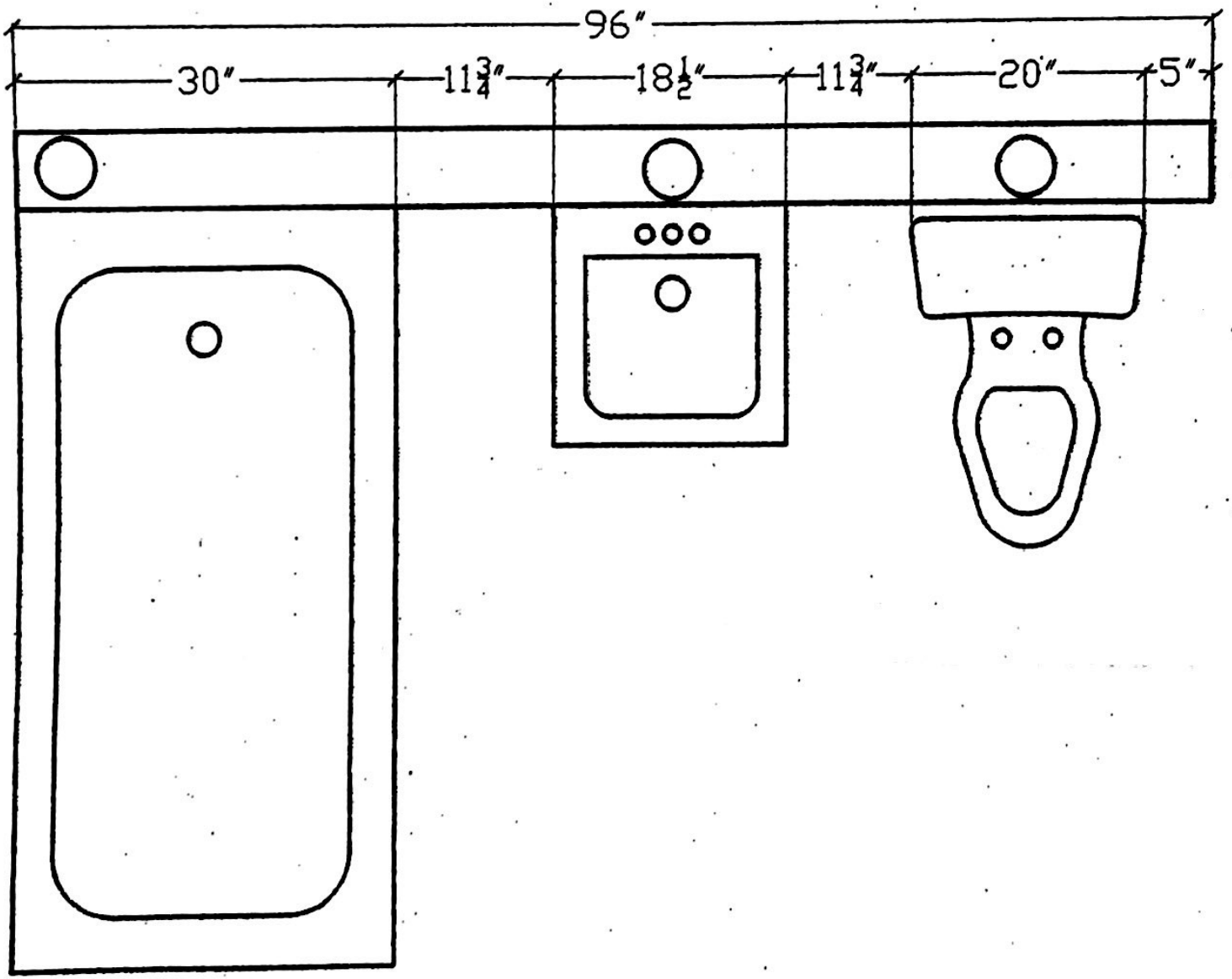

STEP 4: ADD FITTINGS
VENT
WET VENT
BRANCH
BRANCH
C.O.
BUILDING
DRAIN



1. 4" x 1-1/2" cross
2. 1-1/2" 1/4 bend
3. 2" x 1-1/2" reducing tee
4. 2" shower drain/trap assembly
5. 2" x 1-1/4" x 1-1/2" sanitary tee
6. 4" sanitary tee
7. 4" x 2" san. tee. double tapped
8. 4" closet bend
9. 4" combination
10. 2" 1/4 bend
11. Flashing
12. 1-1/2" no-hub C.I. pipe
13. 2" no-hub C.I. pipe
14. 4" no-hub C.I. pipe

Figure 1-2
Typical DWV isometric drawing


90° ELBOWS
STRAIGHT TEE
REDUCING TEE
2
4
4
SANITARY TEE
P-TRAP
GATE VALVE
SHOWER HEAD
LAVATORY (SINKS)
BATH TUBS
SHOWER STALL



DWG 10F3	FLOOR PLAN	SCALE: 1"=1'

"Grade" Overview

- Grade is expressed as vertical fall in fractions of an inch per foot of horizontal run. For example, a grade of ¼ inch means that the line of pipe will fall ¼ inch for every foot of run. The fall is the total change in elevation for the length of pipe. The run is the horizontal length of the run of pipe.
- Relationship of grade, fall and run. Remember the following:
    1. Grade is expressed in inches per foot
    2. Fall is expressed in inches
    3. Run is expressed in feet
- Depending upon which of the components you need to calculate, use one of the following formulas:
    - Grade = Fall *divided by* run (G = F/R)
    - Fall = Grade x Run (F = G x R)
    - Run = Fall *divided by* Grade (R = F/G)
      Example: G = 10 degrees/40 degrees = .250 or ¼" per foot
- Therefore, the grade for a 40' horizontal run of pipe with a 10" fall is ¼" per foot.
- The line of pipe runs a horizontal distance of 16 feet at a grade of ¼ inch per foot:
    - F = G x R
    - F = ¼ per foot x 16' = 4" **FALL** is 4"
- Once you know both grade & fall, you can determine the horizontal run of pipe without actually measuring it:
    - Run = 8" *divided by* ¼ per foot = 32'
- The length of the run from the stack to the sewer inlet is 100'; say you are using 3" pipe, which requires a slope of least ¼ inch per foot. To calculate the depth this run of pipe requires: multiply the slope by the length of the run. This run of pipe would require 25 inches of depth.

¼ inch per foot x 100' = 25" Deep

I want you to learn how to do these, but there's a **General Rule**:

- Standard fall is ¼" per foot (Industry Standard)
- With Variance of 1/8" per foot on 4" and above

Practice Exercises:

1. Calculate G where R = 28' and F = 7"
   G =

2. Calculate F where G = ¼" per foot and R = 50'
   F =

3. Calculate R where G = ¼" per foot and F = 13"
   R =

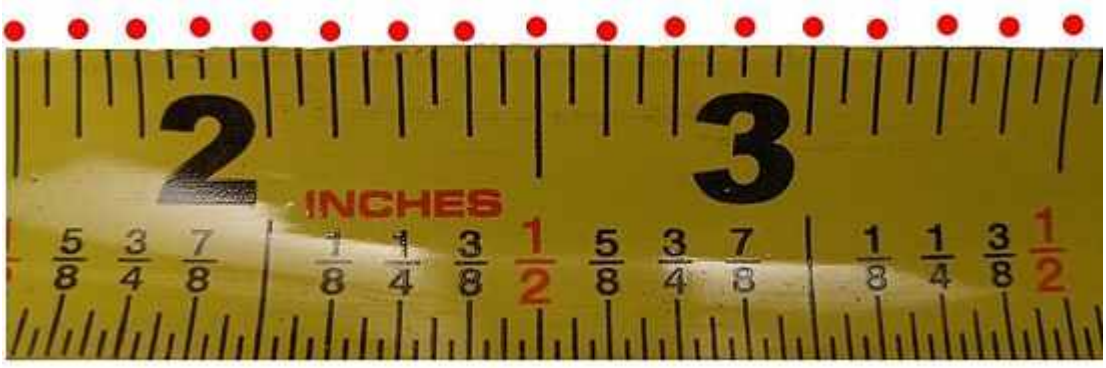
Steps in Reading a Tape Measure

Read one inch. One-inch marks are longer marks that, for spacing reasons, are usually found *near* but not *on* the large numbers designating inches. If it's difficult to distinguish these lines on the top half of the tape, look at the bottom, where the lines will be extra long.

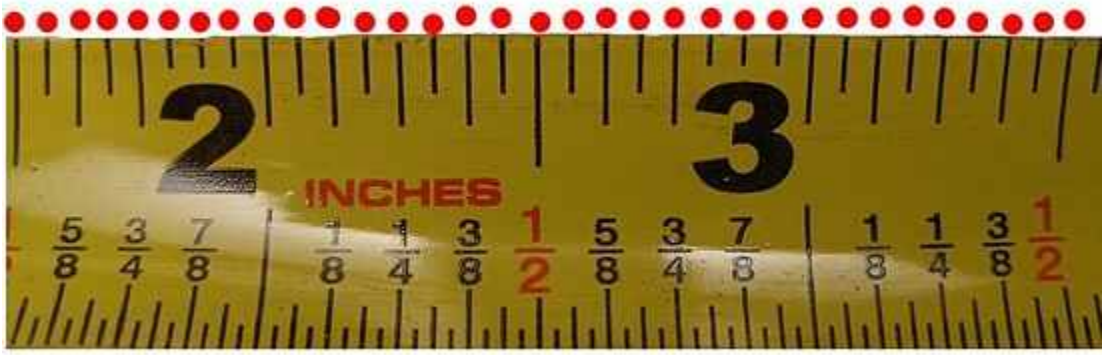
Read half an inch. A half-inch mark is centered between two one-inch marks and is usually has longest or second longest marks on the top half of the tape. There are 2 of these per inch.

Read a quarter of an inch. Lines marking a quarter of an inch often aren't distinguished from the eighth-inch marks (explained in the next step). There are 4 of these per inch.

Read an eighth of an inch. Lines marking an eighth of an inch are often the same length as quarter-inch marks. There are 8 of these per inch.



Read a sixteenth of an inch. The sixteenth-inch marks are usually the shortest lines on the measuring tape. There are 16 of these per inch.



Note that some measuring tapes will mark down to one-thirty-second of an inch, which is conventionally the smallest point to which an inch is measured.

Measure a length and mark the spot on the tape.

Add the complete and incomplete inch segments to determine total length. Start by noting whether or not the point is past an inch mark. Then, note whether or not it is past a half-inch mark. Repeat with a quarter-inch mark, an eighth-inch mark, and so on until you have determined the point's precise location. Since you will be adding and subtracting fractions like 1/2, 1/16, and so on, you must know how to add fractions with unlike denominators. The denominator is the number in the bottom half of the fraction (whereas the numerator is the number in the top half). All fractions must have the same denominator in order to be added or subtracted.

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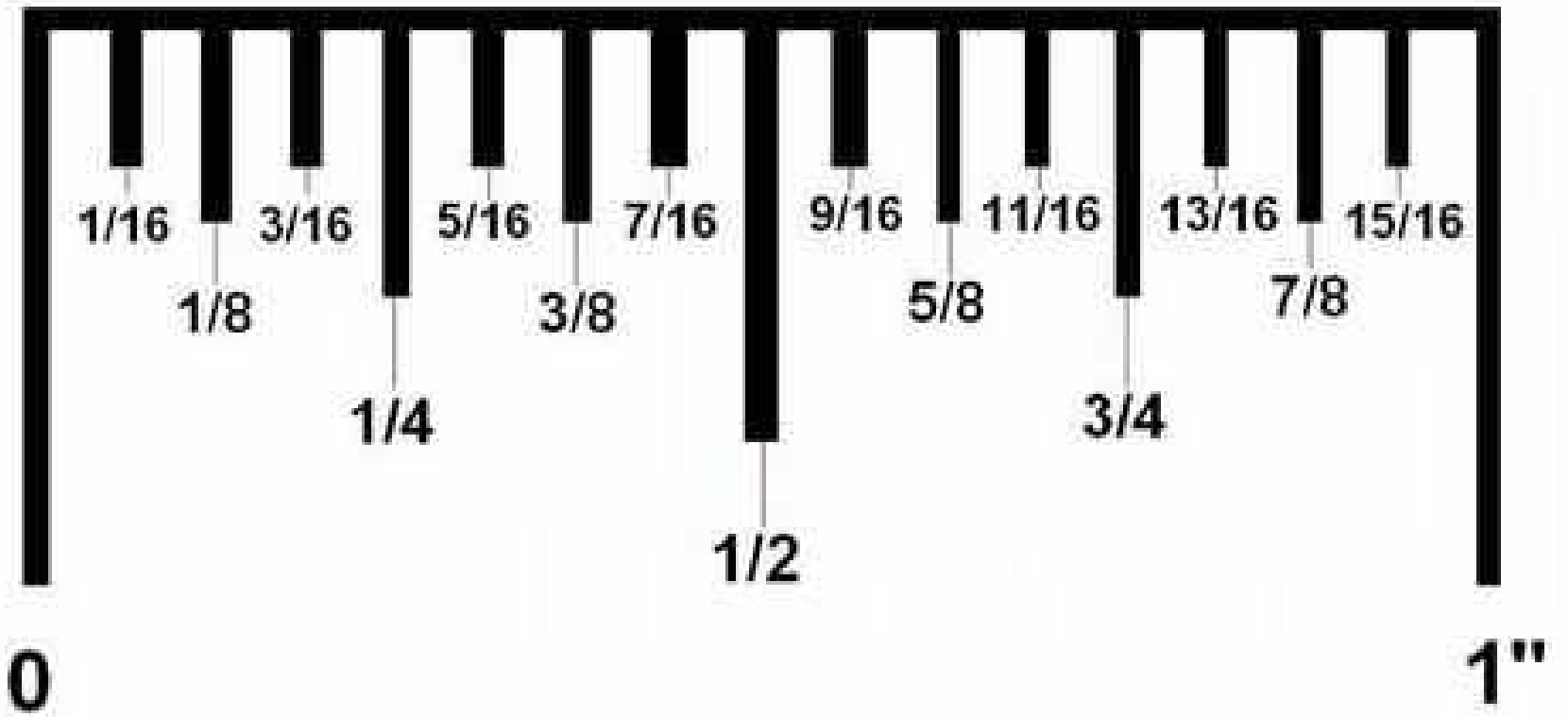
1. In the example below, the red dot is past the 2-inch mark, the half-inch mark, and one eighth-inch mark. Since 2 inches is a whole number, just worry about adding the half- and eight-inch. To solve for 1/2 inch + 1/8 inch, give the numbers a common denominator – in this case, 8. This gives us 4/8 + 1/8 = 5/8. Thus, **this mark is at 2 and 5/8 inches**. *You can also simply recognize that the point is on an eighth-inch mark and count five of these from left to right to get 5/8*.

2. In the example below, the red dot is past the 2-inch mark, one quarter-inch mark, and one sixteenth-inch mark. To solve for 1/4 + 1/16, use a common denominator of 16. This makes 4/16 + 1/16 = 5/16. Thus, **this mark is at 2 and 5/16 inches**. *You can also simply recognize that the point is on a sixteenth-inch mark and count five of these from left to right to get 5/16*.

3. In the example below, the red dot is only one sixteenth-inch away from 3 inches. Since we know there are sixteen of these total between 2 and 3 inches and that out dot is one away from completing them, we can add this in our heads; **this mark is at 2 and 15/16 inches**. *You can also simply recognize that the point is on a sixteenth-inch mark and count fifteen of these from left to right to get 15/16*.


1/16
1/8
3/16
1/4
5/16
3/8
7/16
1/2
9/16
5/8
11/16
3/4
13/16
7/8
15/16
0
1"

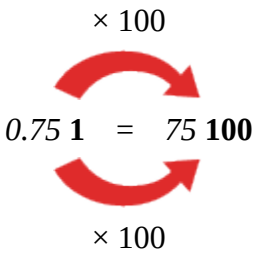
To convert a Decimal to a Fraction, follow these simple steps:

- **Step 1:** Write down the decimal divided by 1, like this: ***decimal* / 1**
- **Step 2:** Multiply both top and bottom by 10 for every number after the decimal point. (For example, if there are two numbers after the decimal point, then use 100, if there are three then use 1000, etc.)
- **Step 3: Simplify** (or reduce) the fraction

Example: Convert 0.75 to a fraction

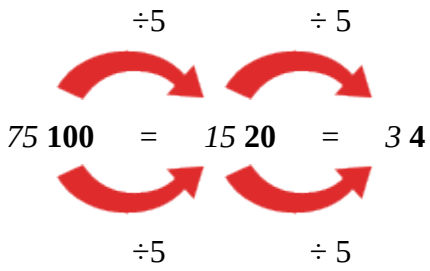
Step 1: Write down 0.75 divided by 1: ***0.75***

Step 2: Multiply both top and bottom by **100** (there are 2 digits after the decimal point so that is 10×10=100):



(Do you see how it turns the top number into a whole number?)

Step 3: Simplify the fraction (this took me two steps):



Answer = *3*/4

Note: 75/100 is called a ***decimal fraction*** *and 3/4 is called a* ***common fraction****!*

Example: Convert 0.625 to a fraction

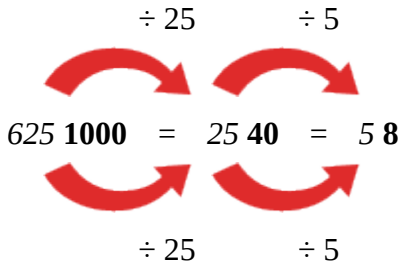
Step 1: write down:

0.625 **1**

Step 2: multiply both top and bottom by **1,000** (there are 3 digits after the decimal point so that is 10×10×10=1,000)

625 **1000**

Step 3: Simplify the fraction (it took me two steps here):



Answer = *5*/8

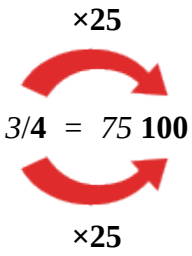
To convert a Fraction to a Decimal manually, follow these steps:

- **Step 1**: Find a number you can multiply by **the bottom of the fraction** to make it 10, or 100, or 1000, or any 1 followed by 0s.
- **Step 2**: Multiply both top and bottom by that number.
- **Step 3**. Then write down just the top number, putting the decimal point in the correct spot (one space from the right hand side for every zero in the bottom number)

Example: Convert *3*/4 to a Decimal

Step 1: We can multiply 4 by 25 to become 100

Step 2: Multiply top and bottom by 25:



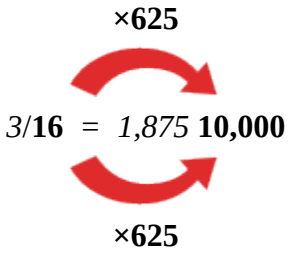
Step 3: Write down 75 with the decimal point 2 spaces from the right (because 100 has 2 zeros);

Answer = 0.75

Example: Convert *3*/16 to a Decimal

Step 1: We have to multiply 16 by **625** to become 10,000

Step 2: Multiply top and bottom by 625:



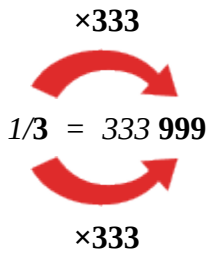
Step 3: Write down 1875 with the decimal point 4 spaces from the right (because 10,000 has 4 zeros);

Answer = 0.1875

Example: Convert *1*/3 to a Decimal

Step 1: There is no way to multiply 3 to become 10 or 100 or any "1 followed by 0s", but we can calculate an **approximate** decimal by choosing to multiply by, say, 333

Step 2: Multiply top and bottom by 333:



Step 3: Now, **999 is *nearly* 1,000**, so let us write down 333 with the decimal point 3 spaces from the right (because 1,000 has 3 zeros):

Answer = 0.333 (accurate to only 3 decimal places !!)

Conger Construction Services, LLC.

Tradesman – Appendix C

Final Exam

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1. A violation of the Plumbing License Law or Board Rules is a:
    A. Class B Felony and $500.00 Fine
    B. Class A Felony and $1500.00 Fine
    C. Class C Misdemeanor
    D. Class A Misdemeanor
2. The total number of water closets on a 3-inch stack is_____.
    A. 2
    B. 3
    C. 4
    D. 6
3. The vent for a kitchen sink serves as a drain for a laundry tub. The size of the wet-vented section is _____inches.
    A. 1 ½
    B. 2
    C. 2 ½
    D. 3
4. Special venting for island fixtures is used for_____.
    A. Bathtubs
    B. Showers
    C. Kitchen sinks
    D. Water closets
5. The tailpiece for a lavatory shall not be less than_____inch.
    A. 1 ¼
    B. 1 ¾
    C. 1 ½
    D. 1
6. Not trap for any clothes washer standpipe shall be installed_____.
    A. 6 inches above the floor
    B. Below the floor
    C. In a partition
    D. 18 inches above the floor
7. One reason that the board may suspend or revoke a license or registration is if that person:
    A. does not pay their plumbing bills on time.
    B. pursues another line of business other than plumbing.
    C. does not maintain equipment.
    D. obtains a license or registration through error or fraud.
8. If a licensee or registrant changes his or her address, the license or registrant:
    A. is no longer eligible to move to the next level of license or registration
    B. can rely on the board to find out about the change on its own
    C. shall inform the board in writing of the change.
    D. may not renew the license or registration.
9. Which material is not approved for cleanout plug or caps:
    A. PVC
    B. Black Steel
    C. Brass

D. Galvanized

10. The code requirement for an adequate supply of potable running water is for:
    A. Safety or sanitation
    B. Protection of trap seals
    C. Water cooled equipment
    D. Hydronic systems
11. The requirements of the plumbing codes shall apply to:
    A. New commercial installations only
    B. Replacements of 5 feet or more of sewer pipe only
    C. Installation, alterations, repairs, maintenance, addition to any plumbing system.
    D. Both A & B
12. A cross connection is:
    A. Any connection between a potable water supply system and non-potable, polluted, contaminated water system.
    B. Any connection between a building drain and building sewer
    C. Any connection between two city potable water systems
    D. Both B & C
13. In a water supply system, what is known as black-flow?
    A. The flow of water or other liquids, mixtures or substances into potable water supply from any source except the intended source.
    B. Back-siphonage as a result of pressure loss, negative pressure or falling below atmosphere pressure condition.
    C. Back-pressure as a result of pressure in excess of water supply pressure.
    D. All of the above
14. The primary reason for installing backflow prevention assemblies is to:
    A. Prevent excessive pressure
    B. Prevent mixing of hot and cold water
    C. Prevent pollution or contamination of the potable water system
    D. Prevent scalding
15. A fitting connected to the sanitary drainage system for the purpose of preventing the escape of sewer gas from the sanitary drainage system is called a:
    A. Trap adapter
    B. Trap primer
    C. Vent tee
    D. Trap
16. The minimum slope for 4” horizontal drainage piping shall be:
    A. 1/16 inch per foot
    B. 1/8 inch per foot
    C. ¼ inch per foot
    D. ½ inch per foot
17. All horizontal drainage piping shall be installed in practical alignment and:
    A. Uphill slope
    B. Uniform slope
    C. Erratic slope
    D. Varying slope

18. One approved material used to make non-threaded joints in plastic pipe is:
    A. Silicone
    B. Teflon
    C. Pipe dope
    D. Solvent Cement
19. Vertical drainage piping connecting to horizontal drainage piping shall not enter through a:
    A. A combination wye and 1/8 bend
    B. Wye
    C. Long sweep
    D. Sanitary tee
20. Plumbing codes were adopted:
    A. To help the plumbing contactor
    B. To help the licensed plumber
    C. To protect the public
    D. All of the above
21. "A physical separation which may be a low inlet into the indirect waste receptor from the fixtures, appliance, or devices indirectly connected" is the definition for an:
    A. Air break
    B. Air gap
    C. Indirect waste
    D. Individual vent
22. Before any portion of a combination waste and vent system is installed, the Code requires:
    A. The owner gives his consent in writing
    B. Plans and specifications be approved by the Administrative Authority
    C. Trap Primer be installed for each trap
    D. A separate connection be made to the public sewer
23. Copper tube and fittings used for drainage and installed above ground shall be at least:
    A. Type DWV
    B. Type K
    C. Type L
    D. Type M
24. Ink markings and represented by what color for type L copper?
    A. Red
    B. Yellow
    C. Blue
    D. Green
25. Ballcocks in water closet tanks shall be installed so that the critical level of the water inlet is above the full opening of the overflow pipe, at least:
    A. ½ inch
    B. 1 inch
    C. 3 inches
    D. 6 inches
26. The rough-in height for lavatories, from finished floor to flood level rim, is most frequently recommended by manufacturer's as:
    A. 27 inches

B. 29 inches
C. 31 inches
D. 36

27. A waste pipe in a plumbing system may receive the discharge from:
    A. Lavatories
    B. Water Closets
    C. Bed Pan Washers
    D. All of the above
28. The trap seal is the maximum vertical depth of the liquid that a trap will retain, measured between the crown weir and:
    A. The dip of the trap
    B. The top of the dip of the trap
    C. The bottom of the dip of the trap
    D. Any part of the dip of the trap
29. Fixture traps shall have a water seal of not less than:
    A. 2 inches
    B. 4 inches
    C. 6 inches
    D. 1 inch
30. PEX tubing shall not be installed within the first _____of piping connected to a water heater:
    A. 12 inches
    B. 18 inches
    C. 24 inches
    D. 36 inches
31. Which of the following answers is the best definitions of the term “potable water?”
    A. Water suitable for drinking purposes
    B. Water suitable for all household use
    C. Water free of pathogenic use
    D. Water unfit for industrial use because of injurious substances
32. The minimum size of any building sewer shall be determined on the basis of the:
    A. Number of bedrooms
    B. Number of bathrooms
    C. Type of building
    D. Total fixture units
33. What width is an ADA approved water closet stall:
    A. 36 inches
    B. 30 inches
    C. 60 inches
    D. 48 inches
34. The wall thickness of type L water tube is:
    A. Less than type M water tube
    B. The same as type K hard tube
    C. Greater than type K soft tube
    D. Less than type K but greater than type M

35. Many plumbing codes use the “fixture unit” system in determining sizes of waste and vent lines, etc. The “fixture unit” is based on the discharge of water from a lavatory at a rate of:
    A. 7.5 gallons per minute
    B. 5 gallons per minute
    C. 1.5 cubic feet per minute
    D. None of the above
36. Each outlet on a non-potable water line which may be used for drinking purposes shall be posted:
    A. DANGER – PROCESSED WATER
    B. DANGER – CONTAMINATED WATER
    C. DANGER – POLLUTED WATER
    D. CAUTION – NON POTABLE WATER DO NOT DRINK
37. Two minor fixtures sharing a vertical vent stack are considered a common vent if their connections are not more than how far apart:
    A. 16 inches
    B. 18 inches
    C. 12 inches
    D. 24 inches
38. Caulked joints in cast iron piping are filled with oakum and how many inches of molten lead?
    A. ½ inch
    B. 5/8 inch
    C. 1 inch
    D. ¾ inch
39. The size of the supply piping outlet for any gas appliance shall be not less than:
    A. ¾ inch if total length is less than 80 feet
    B. The inlet connection of that appliance
    C. The smallest size pipe in the system
    D. 1 inch to allow for future expansion
40. The minimum height for a horizontal vent or re-vent is:
    A. 48 inches
    B. Flood level of fixture
    C. 42 inches
    D. 6 inches of the highest flood rim
41. Burred ends of all pipe and tubing shall be:
    A. Avoided by use of special cutting tool
    B. Confined to exposed and readily accessible locations
    C. Reamed to the full bore of the pipe or tube
    D. Painted to reduce friction
42. All piping, fixtures, and equipment shall be adequately supported to the satisfaction of the:
    A. Contractor
    B. Administrative Authority
    C. Owner
    D. Engineer
43. The piping material not approved in the code for water piping located inside a building is:
    A. Brass
    B. CPVC

C. Asbestos Cement
D. PEX

44. IPS is the abbreviation for:
    A. Iron pipe standard
    B. Iron pipe size
    C. Inside pipe standard
    D. Inside pipe size
45. Surfaces to be joined by soldering or brazing shall be cleaned bright by:
    A. Mechanical or manual means
    B. A self-cleaning flux
    C. A corrosive flux
    D. Sulfuric acid
46. Every building in which plumbing fixtures are installed shall have a connection to a:
    A. Cesspool
    B. Drywell
    C. Public or private sewer
    D. Storm sewer
47. Building water supplies shall be smaller than that required and, in case smaller than:
    A. ½ inch
    B. ¾ inch
    C. 1 inch
    D. 2 inch
48. Hard drawn copper tubing, marked with a blue stripe, is referred to as:
    A. Type “K”
    B. Type “L”
    C. Type “M”
    D. Type “DWV”
49. One of the following is not required in computing the size of a gas piping system:
    A. Maximum length
    B. Maximum demand
    C. Type of appliance
    D. Pipe material
50. Backflow in water supply piping can be prevented by installing:
    A. An air gap
    B. A vacuum breaker
    C. Double check valve
    D. All of the above
51. A plumbing drainage system is venter for the purpose of:
    A. Preventing loss of seal by trap siphonage
    B. Preventing loss of seal by trap capillary action.
    C. Preventing loos of seal by back-pressure
    D. Maintaining pressure which prevent loss of trap seal.
52. Compared to a grade of ¼ inch per foot, a 2% grade is:
    A. Slightly more
    B. Slightly less

C. Exactly the same
D. Cannot be compared

53. The vertical distance between a fixture outlet and the trap weir shall not exceed:
    A. 18 inches
    B. 24 inches
    C. 32 inches
    D. 36 inches
54. Mechanical devices installed to absorb water hammers shall be:
    A. Accessible
    B. Readily accessible
    C. Concealed
    D. Exposed
55. Which of the following should not be used in finding a leak in a gas line to a gas water heater:
    A. Electronic gas detector (sniffer)
    B. Open flame
    C. Soapy water
    D. Sound or feel
56. All malleable iron water fittings shall be:
    A. 2 inches or smaller
    B. Galvanized
    C. Flanged
    D. Removed
57. Horizontal drainage piping shall be run at a uniform slope of not less than which of the following percentage:
    A. 1
    B. 2
    C. 3
    D. 4
58. B.T.U. is the abbreviation for:
    A. Basic Temperature Unit
    B. British Thermal Unit
    C. Binary Thermal Unit
    D. None of the above
59. An area drain is a receptacle designed to:
    A. Collect drainage from an open area
    B. Collect surface or rain water form an open area
    C. Collect sewage, surface or rain water from an open area
    D. Any of the above
60. A hush tube is used on a:
    A. Regulator on an acetylene torch
    B. Flushometer valve
    C. Closet tank ballcock
    D. Bathtub overflow
61. A stack that conveys the discharge of plumbing fixtures such as water closets and urinals is:
    A. Waste stack

B. Soil stack
C. Combination stack
D. None of the none

62. A water piping system with a pressure of 110 psi will require a:
    A. Reduced pressure backflow device
    B. Extra heavy pipe and fittings
    C. Pressure regulator and strainer
    D. Pressure relief valve
63. The type of valve required on a building supply to any building is a:
    A. Full-way valve
    B. Corporation valve
    C. Butterfly valve
    D. Globe valve
64. Building sewers shall be tested by completely filling the sewer with water from the_____.
    A. Lowest to the highest point
    B. Lowest to at least 5-foot head
    C. Lowest to at least a 10-foot head
    D. Lowest to at least ground level
65. Except for plastic piping systems, hot and cold water piping may be tested with_____.
    A. 40 psi air or 150 psi water for 10 minutes
    B. 35 psi air for at least 15 minutes
    C. 50 psi air or the working pressure of the water in the system for at least 15 minutes
    D. 100 psi air for at least 10 minutes
66. A stack by code definition is _____.
    A. The main vent
    B. Any vertical vent
    C. The vertical main of soil, waste, or vent piping that extends on or more stories
    D. The horizontal main of soil, waste, or vent stack
67. A type B gas vent shall terminate at least _____feet in vertical height above the bottom of the gas water heater.
    A. 4
    B. 5
    C. 10
    D. 12
68. The maximum horizontal distance of a trap arm is measured from the inner edge of the vent to the_____.
    A. Weir of the trap
    B. Dip
    C. Inlet
    D. Outlet
69. Cast iron pipe shall not be_____.
    A. Used for drain lines
    B. Used below ground
    C. Painted
    D. Threaded

70. All trenches deeper than the footing of any building or structure and paralleling the same must be at least_____.
    A. 45 degrees therefrom
    B. 4 feet therefrom
    C. 2 feet wide
    D. 2 feet deep
71. Horizontal drainage lines connecting with other horizontal drainage lines shall enter through_____.
    A. 45-degree wye-branches
    B. Sanitary-tee branches
    C. Tapped-tee branches
    D. A side inlet quarter bend
72. In each horizontal drain piping, the distance between cleanouts shall not exceed_____.
    A. 50 feet
    B. 75 feet
    C. 100 feet
    D. 300 feet
73. Sleeves shall be provided to protect all piping through_____and_____walls.
    A. Floors, concrete
    B. Concrete, masonry
    C. Wood, concrete
    D. None of the above
74. The required clearance in front of a 3-inch cleanout is _____inches.
    A. 6
    B. 12
    C. 18
    D. 24
75. A device to prevent backflow into the potable water system is called a_____.
    A. Backflow connection
    B. Backflow preventer
    C. Back-siphonage
    D. Siphon leg
76. In each run of horizontal drain piping, the distance between cleanouts shall not exceed _____feet.
    A. 50 feet
    B. 75 feet
    C. 100 feet
    D. 300 feet
77. That portion of a venting system that connects a water heater to a vent is a_____.
    A. Vent
    B. Vent connector
    C. Chimney connector
    D. Type B Vent
78. The maximum distance a gas shutoff valve may be from a gas appliance is _____feet.
    A. 2
    B. 3
    C. 6

D. 10

79. Waste and vent pipes may be tested with a_____.
    A. 5-foot head of water
    B. Smoke test
    C. 15 psi air
    D. 10-foot head of water
80. Gas pressure tests shall not be less than_____.
    A. 10 pounds
    B. 15 pounds
    C. 20 pounds
    D. 1 ½ times the proposed maximum working pressure
81. An expansion tank is required when_____.
    A. The water heater is located in the basement
    B. The T&P is plugged
    C. The pressure exceeds 150 psi
    D. A backflow is installed on the water piping system
82. A backwater valve is used_____.
    A. To back well water into the system
    B. To act as a bypass
    C. To prevent sewer main from backing up in the lower level fixtures
    D. To pressurize the building sewer
83. Gray water is untreated household wastewater that has not come in contact with_____.
    A. Showers
    B. Tubs
    C. Toilets
    D. Lavatories
84. No person shall cover or conceal any work regulated by code until it is inspected and approved by the _____.
    A. Authority Having Jurisdiction
    B. Plumbing contractor
    C. General contractor
    D. Owner
85. Pressure relief valves located inside buildings shall be provide with full-size drains that shall extend_____.
    A. Outside of the building
    B. Under the building
    C. To a plumbing fixture
    D. To a fixture tailpiece

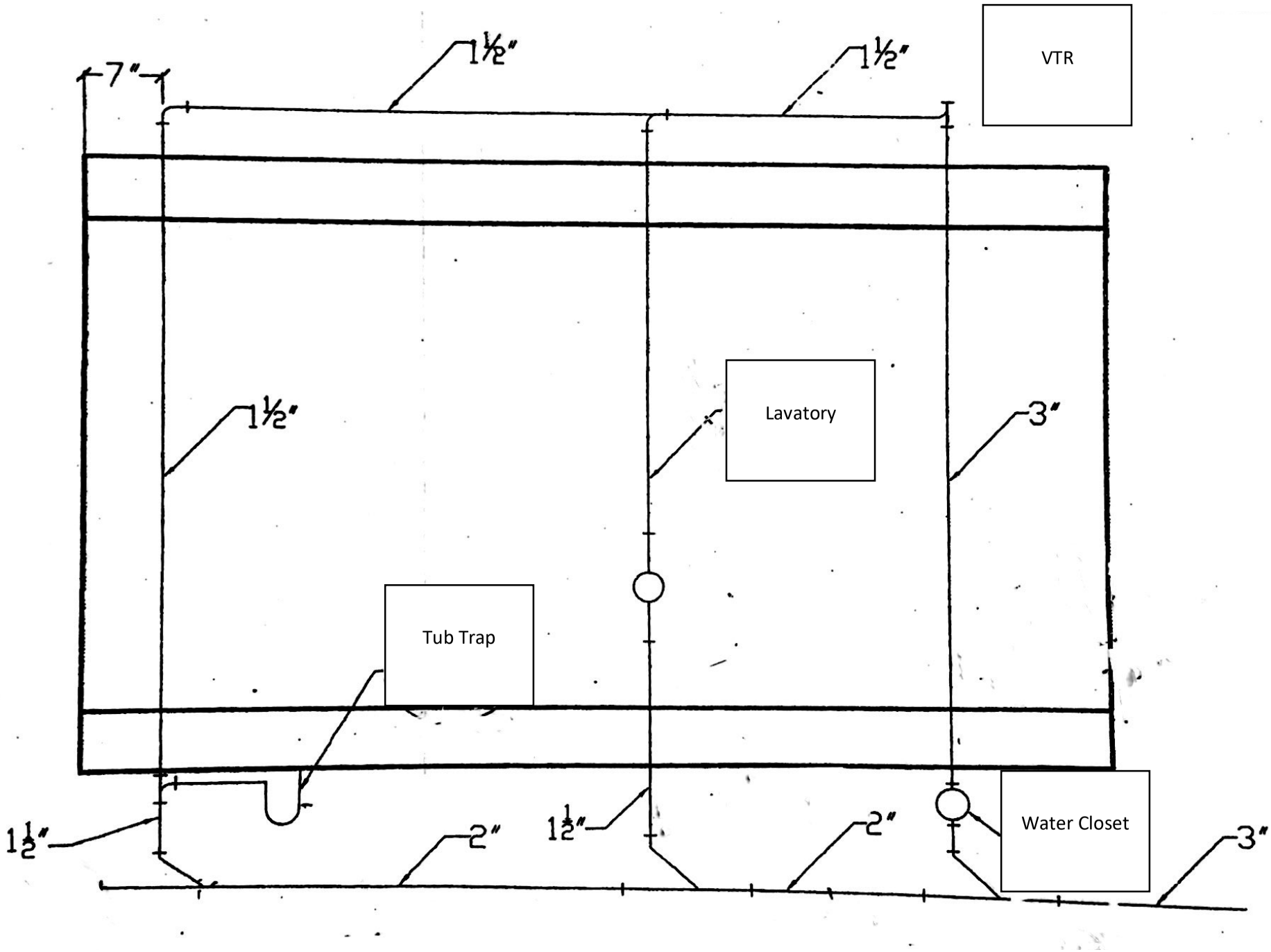
Conger Construction Services, LLC.

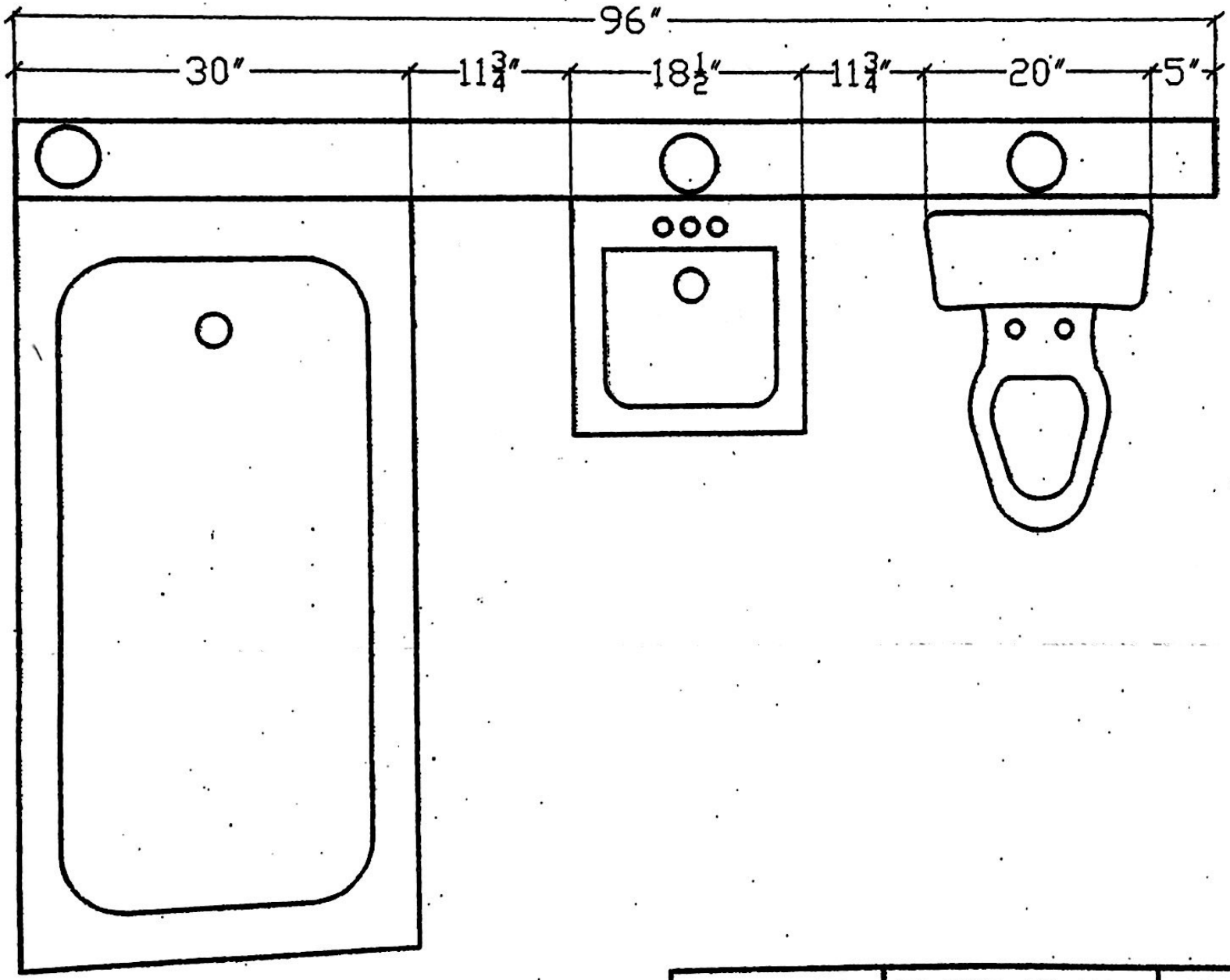
Tradesman – Appendix D

1-2 Family Dwelling Floor Plan Examples

CONGER CONSTRUCTION SERVICES, LLC.

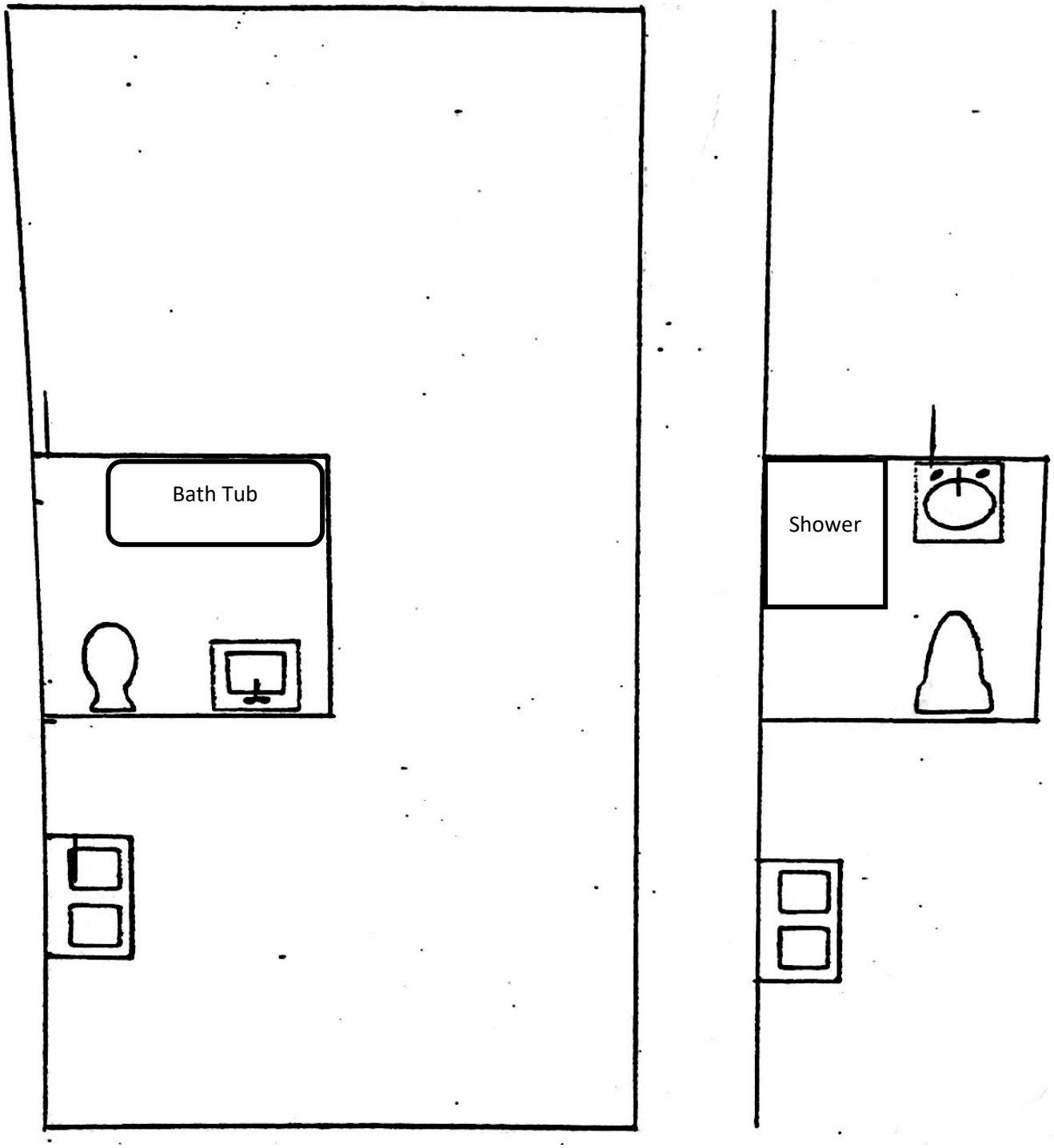
www.conger-construction-services.com

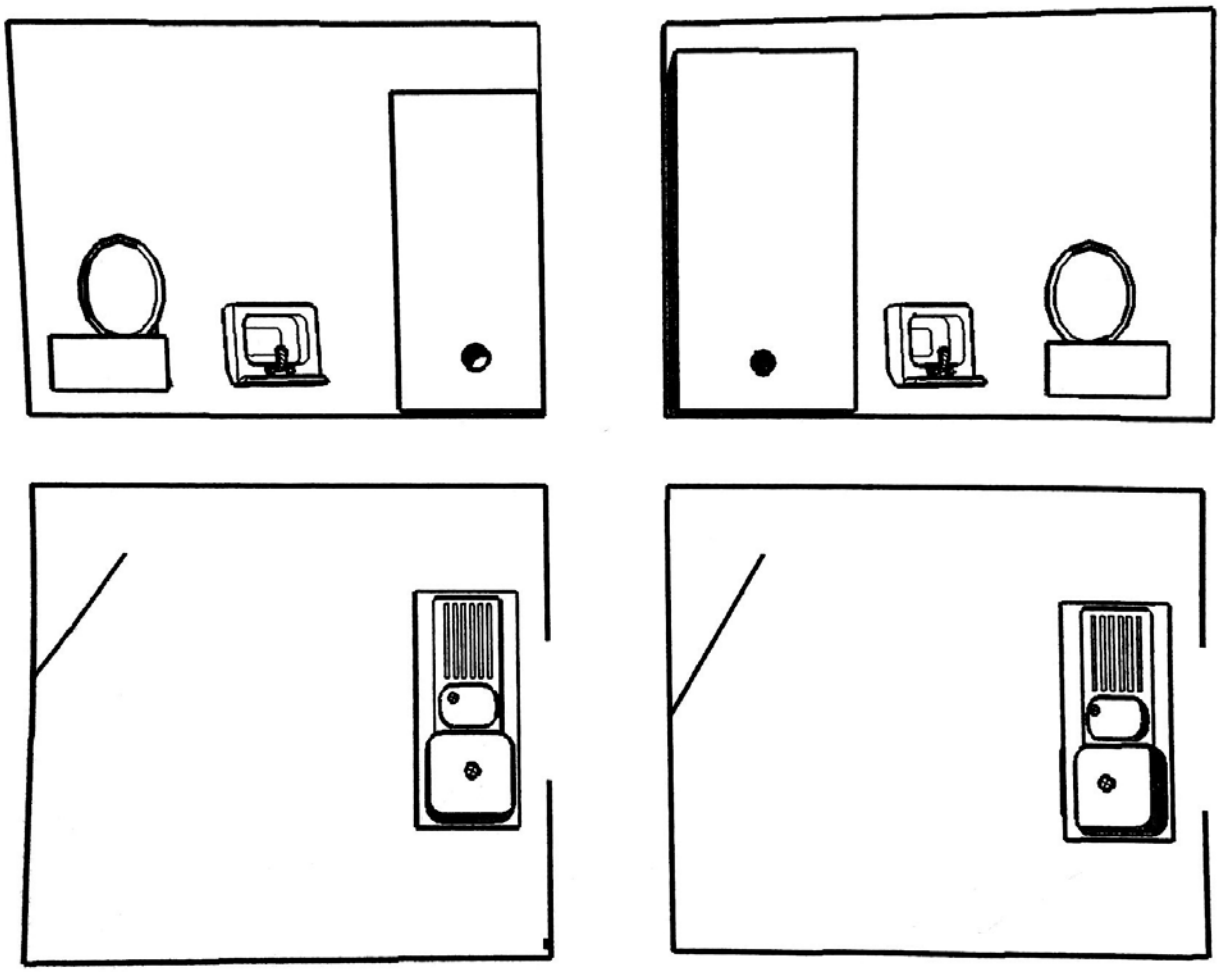

7"
1½"
1½"
VTR
1½"
Lavatory
3"
Tub Trap
1½"
2"
1½"
2"
Water Closet
3"

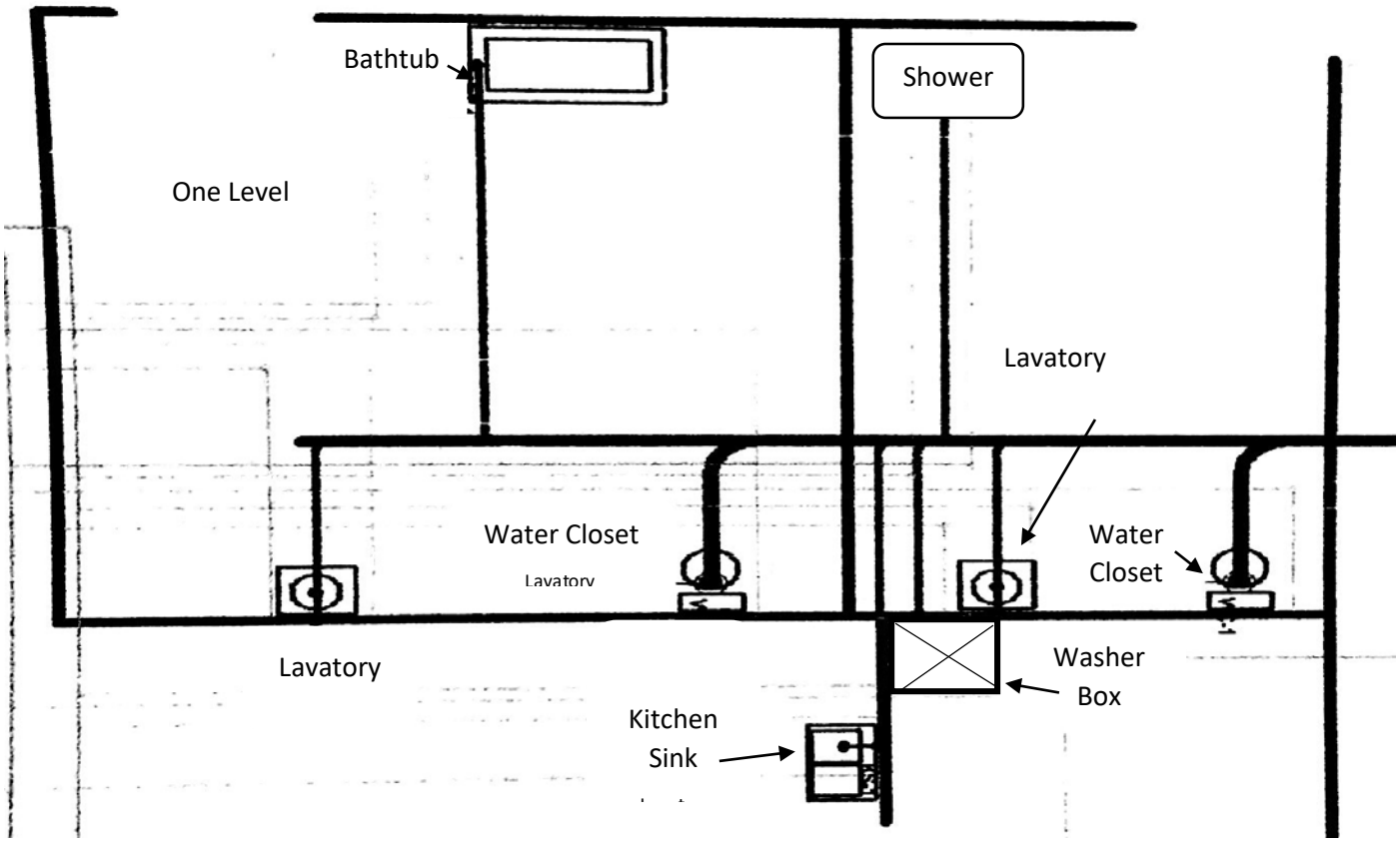


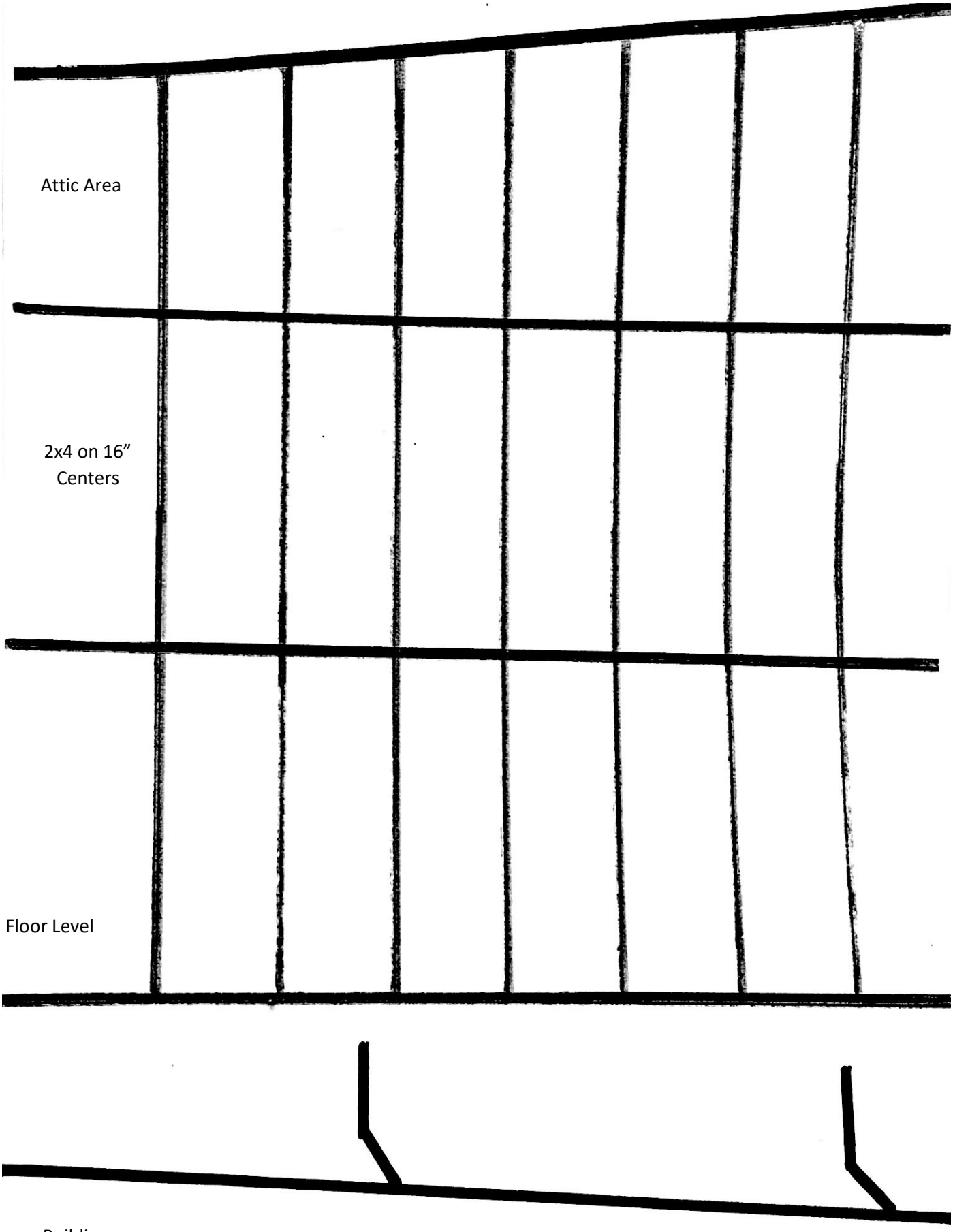
DWG 10F3	FLOOR PLAN	SCALE: 1"=1'

Shower
Shower
Floor 1
Floor 2


Bath Tub
Shower




Bathtub
Shower
One Level
Lavatory
Water Closet
Lavatory
Water
Closet
Lavatory
Washer
Box
Kitchen
Sink


Attic Area
2x4 on 16”
Centers
Floor Level
Building
Drain

Conger Construction Services, LLC.

Tradesman – Appendix E

Laws/Rules Table of Content Study Guide

CONGER CONSTRUCTION SERVICES, LLC.

www.conger-construction-services.com

Access the full version of the Official Laws/Rules:

http://www.tsbpe.state.tx.us/plumbing-license-law.html

(Please note, you will highlight typical areas to study)

Texas State Board of Plumbing Examiners
Board Rules

February 2016

Note: This publication has been formatted for easy reading; it is not the official publication of the Board's rules. The official publication of the Board's rules is in the Texas Administrative Code, available online at:
http://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=3&ti=22&pt=17

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SEPTEMBER 1, 2017 (UNOFFICIAL VERSION)

NOTE: This publication has been formatted for easy reading and reference and is not the official publication of the Plumbing License Law. For the official publication of the Plumbing License Law (Occupations Code, Title 8, Chapter 1301) please refer to:
http://www.statutes.legis.state.tx.us/?link=OC

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