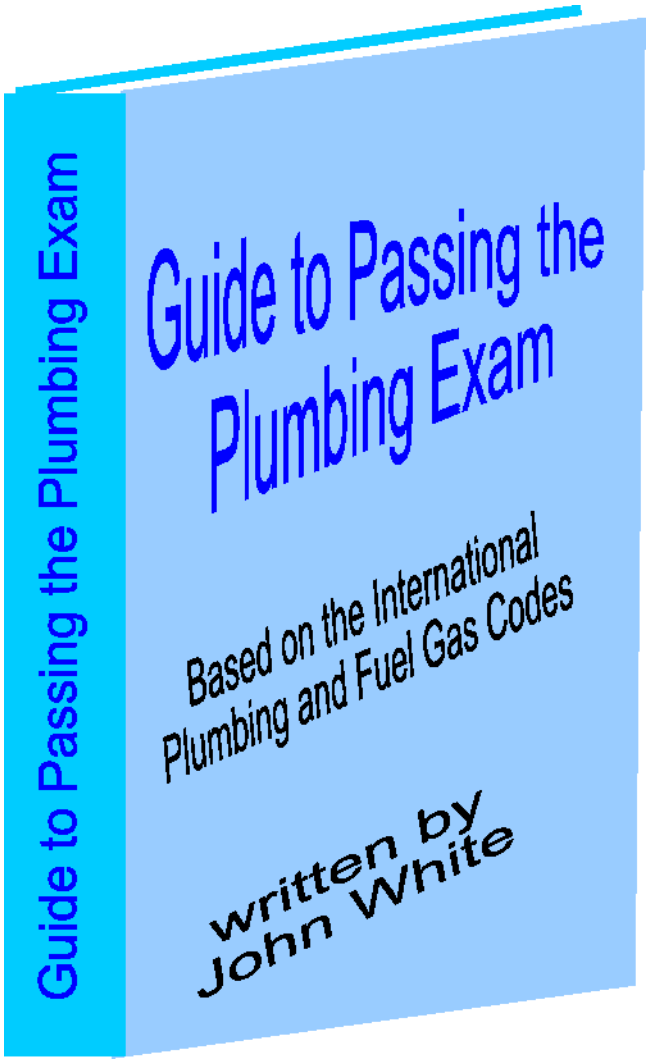

Guide to Passing the Plumbing Exam
Guide to Passing the Plumbing Exam
Based on the International Plumbing and Fuel Gas Codes
written by John White

IMPORTANT STUFF

This manual has been designed as a supplemental aid for students preparing to take the Plumbing Exam based on the international codes. It is not intended to replace any manuals or material required for study. Furthermore, it is not an approved reference to carry into the exam room.

The student must obtain the following reference material in order to use this manual. These references may to be taken into the exam room.

International Plumbing Code
International Fuel Gas Code

ENERGY MARKETING SERVICES
374 CATTLELOT LANE
BELHAVEN, NC 27810
252-341-5028
www.johnrwhite.net

International Plumbing Exam Prep Course

Introduction

Neither this course nor a standard classroom course will read the codebook for you. It is important that you read through the code to at the least become familiar with the content. It is not expected of you to memorize every word. That's why the exam is *open book.* You may not remember horizontally installed PVC pipe must be supported every 4 feet but at least you will know there is a code requirement and approximately where to find it in the book.

This section of the manual focuses on explaining the principles set forth in the code. As you read through each code chapter, refer to the corresponding chapter in this manual. If you should have difficulty understanding a code section, this manual will likely have an explanation. Following this section are 115 questions arranged chapter-by-chapter. Answering these questions will give you a clear and comprehensive grasp of the International Plumbing Code.

An extensive effort has been made to present accurate information in this *first edition.* Should you have questions or comments please feel free to contact us by email at **jrwmtw@gotricounty.com.**

Highlighting

Highlighting is a useful aid for finding and identifying important items throughout the code. Too much highlighting, however, will negate all your efforts. The trick is to highlight the least amount of words and still get the jist of the idea. For example, look at Chapter 3 section 312. The entire section talks about **tests and inspections.** 312.1 talks about **required tests.** It should be obvious to everyone that the plumbing must be tested; what's important is the sentence in the middle of the paragraph "All plumbing system piping must be tested with either water or air." This is the only thing that should be highlighted in the paragraph.

The following paragraph, 312.2 is titled **Drainage and vent water test.** What's important in this paragraph? First, it's talking about drainage and vent water testing (not water supply piping and not air testing). So highlight **Drainage and vent water t**est. In the center of the paragraph it tells what pressure is needed; highlight 10-foot. At the end of the paragraph it tells how long; highlight 15 minutes. Then there is an exception; highlight Exception one and two family dwellings 3 feet.

Get the idea?

Chapter 1- Administration

Permits

A permit is required for any plumbing work except when fixing leaks or unstopping clogs. If any part of the drainage or vent system must be removed or replaced a permit must be obtained. You may remove and replace an accessible trap.

Chapter 2- Definitions

Answers to many questions will come from this chapter on definitions. For example:
Question: A room containing a water closet, lavatory and bathtub is a

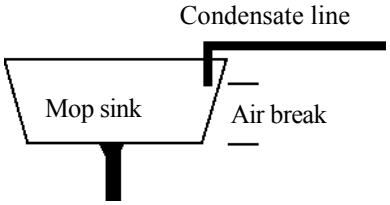
a. bath room
b. toilet room
c. toilet
d. all the above

Answer: After reading through the three definitions, (a) is the answer.

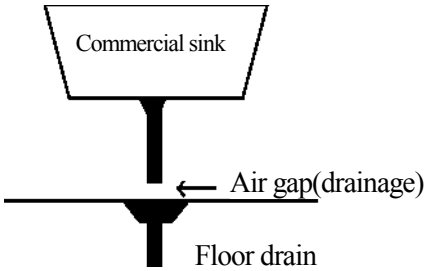
You should read and understand all the definitions. Below are illustrations of less understood definitions

Air admittance valve- same a studor vent

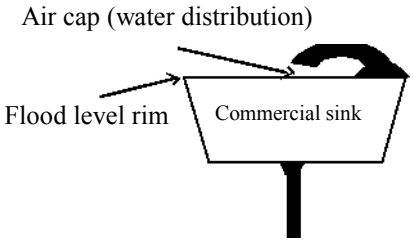
Air break – gap is <u>below</u> rim



Air gap (drainage)

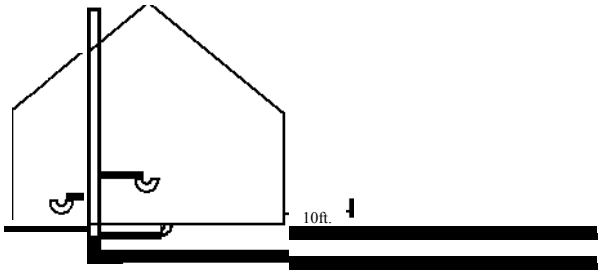


Air gap (water system)

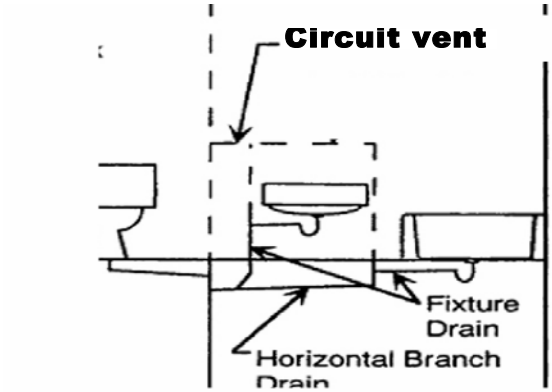


Base flood elevation – 100 year flood level

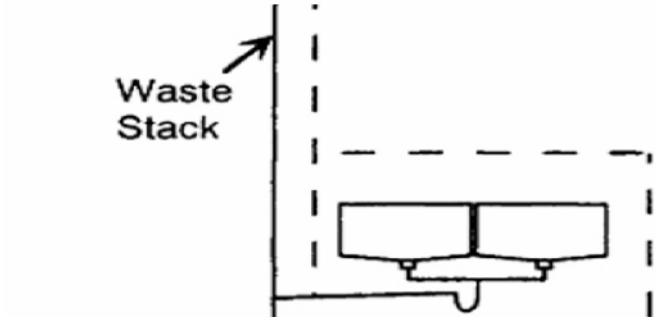
Building drain- extends 10 beyond building wall



Circuit vent



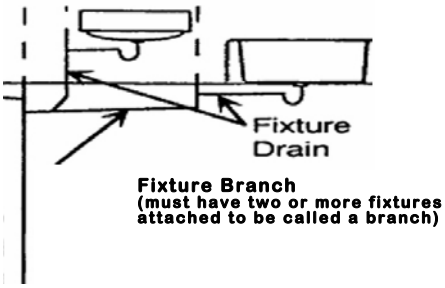
Combination fixture



Two or three compartment sink is a combination fixture

Developed length – The developed length of a stack vent or vent stack is measured from the vent connection to the open air. The developed length of other vents (ie. individual vent) is the measured length from its point of connection to the drainage system to its point of connection to a venting stack or outside termination.

Fixture branch- drain must have at least two fixtures to be called a branch



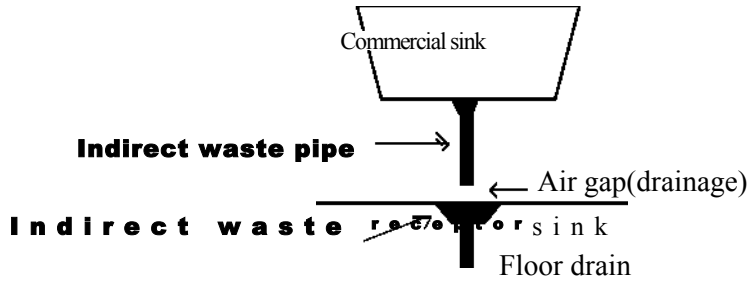
Grease interceptor- handles more than 50gpm, outside of building

Grease trap- handles 50 gpm or less, inside building

Horizontal pipe-less than 45-degrees

Hot water- 110 degrees +

Indirect waste pipe



Indirect waste receptor- may be floor sink, mop receptor, service sink and standpipe with air gap

Lead-free pipe and fittings- contain 8% or less lead

Lead-free solder and flux- contains .2% or less lead

Plumbing- note what's not included

Plumbing appurtenance-

Plumbing appurtenances include instruments, gauges, relief valves, limit switches, backflow assemblies, solenoid valves, and devices between solenoid valves

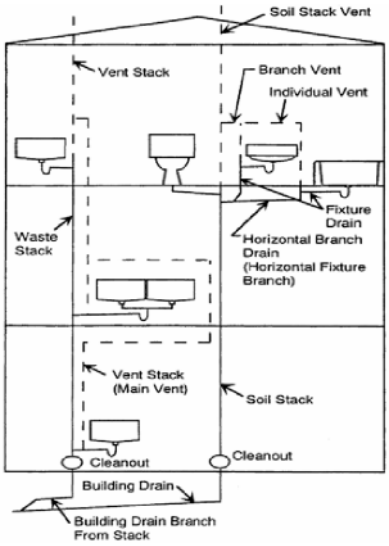
Plumbing system- includes storm sewer

Sanitary sewer- see building drain illustration

Slope- A pipe with a 1/4"'per foot slope is also described as "having 4 units vertical and 12 units horizontal". A 1/4" per foot drop produces a drop of 1' for each 4 foot length, likewise and 1/8" drop produces a drop of 1' for each 8 foot length of pipe. A 50 ft. pipe with a 1/4" slope would drop 12.5" from one end to the other (50 ft./4 ft. = 12.5).

Stack

Stack vent



Typical residential drain and vent system

Swimming pool- must have at least 2 foot depth

Tempered water- 85-110 degree water

Vent stack- see illustration above

Vertical pipe- 45-degree rule.

Is a pipe that makes an angle of 45 degrees with the horizontal a vertical or horizontal pipe? Answer: vertical (carefully read definition of both)

Water pipe

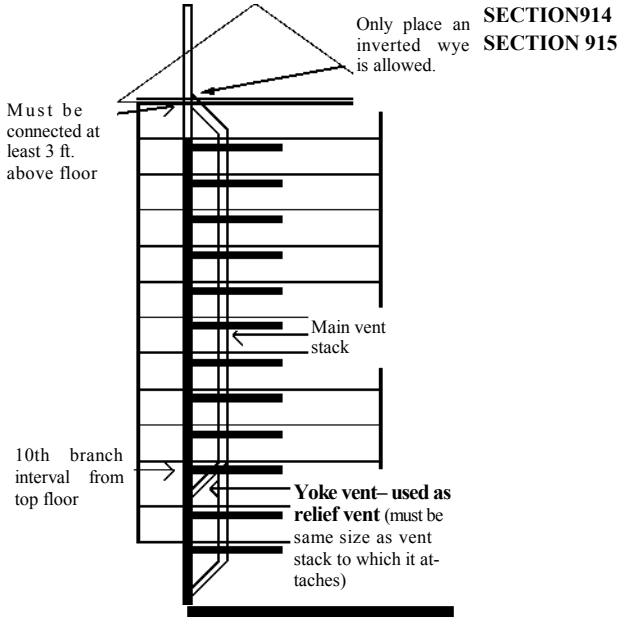
Riser

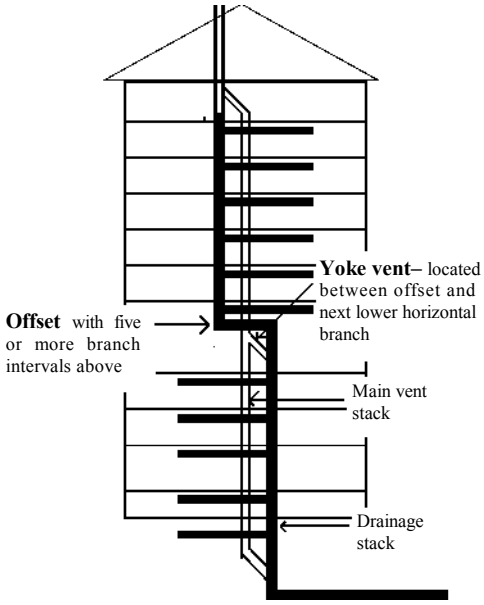
Water distribution pipe

Water service pipe- begins 5 ft. outside building wall

Yoke vent

See illustrations below and **Sections 914 and 915**





Chapter 3

Section 303- Plumbing products and materials must be **tested** or **certified** by a **third party agency** before being used. When the third party agency makes random, unannounced inspections or tests of the manufacturers products then the product becomes certified. When using Table 303.4, it is important to understand which category the product falls under. For example, a lavatory faucet would be a water **fixture fitting,** as defined in chapter 2. Therefore, third party **certification** is required.

Chapter 4

Section 403 dictates the minimum number of plumbing facilities required at in various occupancies. The following is an example for calculating the minimum facilities required in a 60,000 square foot department store.

Look at Table 403.1 in the Plumbing code. Find *Mercantile, Shopping Centers, Retail Stores, Supermarkets Exhibition Facilities.* The first thing to look at is the footnotes 13, 15 and 16. **When using any table be sure to read all applicable footnotes.**

Footnote 13 says to use table 403.4 to determine the percentages of male and female facilities. If you go to the row labeled retail stores you'll see 30% of the occupants will be male and 70% will be female.

Footnote 15 says, for this particular occupancy; use one occupant for every 100 sq. ft. of net area, and to calculate the net area, multiply the gross area by 70%.

Footnote 16 says employee toilet facilities must be located inside our store because it is greater than 1000 sq. ft. (footnote 15 says it's OK to use public toilets for employees in our building)

Calculating number of water closets –

1. Determine the number of occupants

   Occupants = (Gross area x .70) / 100
   = (60,000 x .70) / 100
   = 42,000/100
   = 420 people

2. Determine number of males and females.

   Go to Table 403.4, find Retail Stores; 30 % are males and 70 % are females

   Males = .30 x 420 =126
   Females = .70 x 420 = 294

3. Go to Table 403.1, *Mercantile, Shopping Centers, Retail Stores, Supermarkets Exhibition Facilities.* Under the **Water Closets** column it shows 2 water closets for 51-150. Since we have 126 males, 2 water

closets are required. Since we have 294 females we must have 3 water closets for the first 150, plus 2 more for the remaining 144 (note says, add 1 water closet for each additional 100 females) for a total of 5 female water closets.

Calculating number of urinals

Under the **Urinal** column it shows 1 urinal for 51-150 males. Therefore only 1 is needed as we have 126 males.

Calculating number of lavatories

Under the Lavatories column it shows 2 for the men's room and 3 for the women's room.

51-150 2 lavatories
Over 150- add 1 for each additional 200 people

Calculating number of drinking fountains

Under the **Drinking Fountain** column we use the total number of occupants (420); 251-500 shows 3 fountains are required. Note - drinking fountains are not allowed in toilet rooms.

CHAPTER 6

Section 603.2 Separation of water service and building drain/sewer. This section is saying the buried water line and sewer line cannot be closer than 5 feet to each other, either horizontally or vertically. However, if the lines are within 5 feet of the building, and the sewer is made of material listed in either Table 702.2 or 702.3 then you may place the waterline closer than 5 feet but keep the water line at least 12 inches **above** the sewer pipe. If the sewer pipe is made of cast iron, ABS or PVC then you may place both lines next to each other.

Section 604. Design of water distribution system

GPM – gallons per minute – fixtures require a certain **amount** of water to work properly.

PSI – pounds per square inch – fixture require a certain **pressure** to work properly.

Design criteria for installing a plumbing fixture

Using a **water closet, tank, close coupled** (standard tank type water closet) as our example, look at Table 604.3. The chart says it takes 3 gallons per minute @ 8 pounds per square inch pressure in order to work. Table 604.4 says the water closet better not use more than 1.6 gallons per flush no matter what the GPM or PSI is. Table 604.5 says, in order to assure the water closet will get 3 GPM @ 8 PSI that a 3/8" supply pipe must feed it. Table 604.10.1 says, if you where to connect five of the above water closets to a manifold, then the manifold would

have to be 1 1/4"@ 4 feet per second velocity (5 water closets x 3 gpm = 15 total gpm).

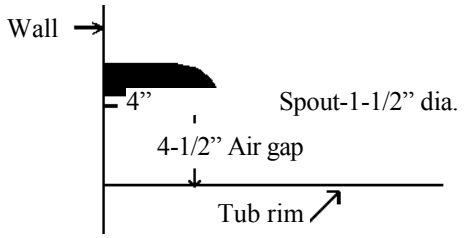
Overflow pipes and drains for water tanks. (Section 605.5.4-605.7)

Table 606.5.4 says determine the capacity of the pipe that is supplying the water to the tank (tank size is irrelevant). If our tank is being supplied at a rate of 350 gpm then the **overflow pipe** must be 4".

The tank must have a drain. The minimum **drain pipe** size is determined using Table 606.5.7. If the tank were 4000 gallons then a 2-1/2" drain pipe would be required.

Table 608.15.1 minimum required air gaps.

See **Air gap (water system)** under definitions in this book for illustration. This table specifies the minimum air gap requirement between the fixture rim and the water supply outlet. Read footnote describing the difference between *away from a wall* and *close to a wall.* To help visualize the difference, suppose we had a 1-1/2" diameter whirlpool spout protruding from a wall. If the inside edge of the spout opening is 4" away from the wall then it would be *close to a wall,* because 4" is less than 3 times the spout diameter (1-1/2" x 3 = 4-1/2"). The air gap would have to be 4-1/2" (3 x 1-1/2")



Sizing a water distribution system (Appendix E)

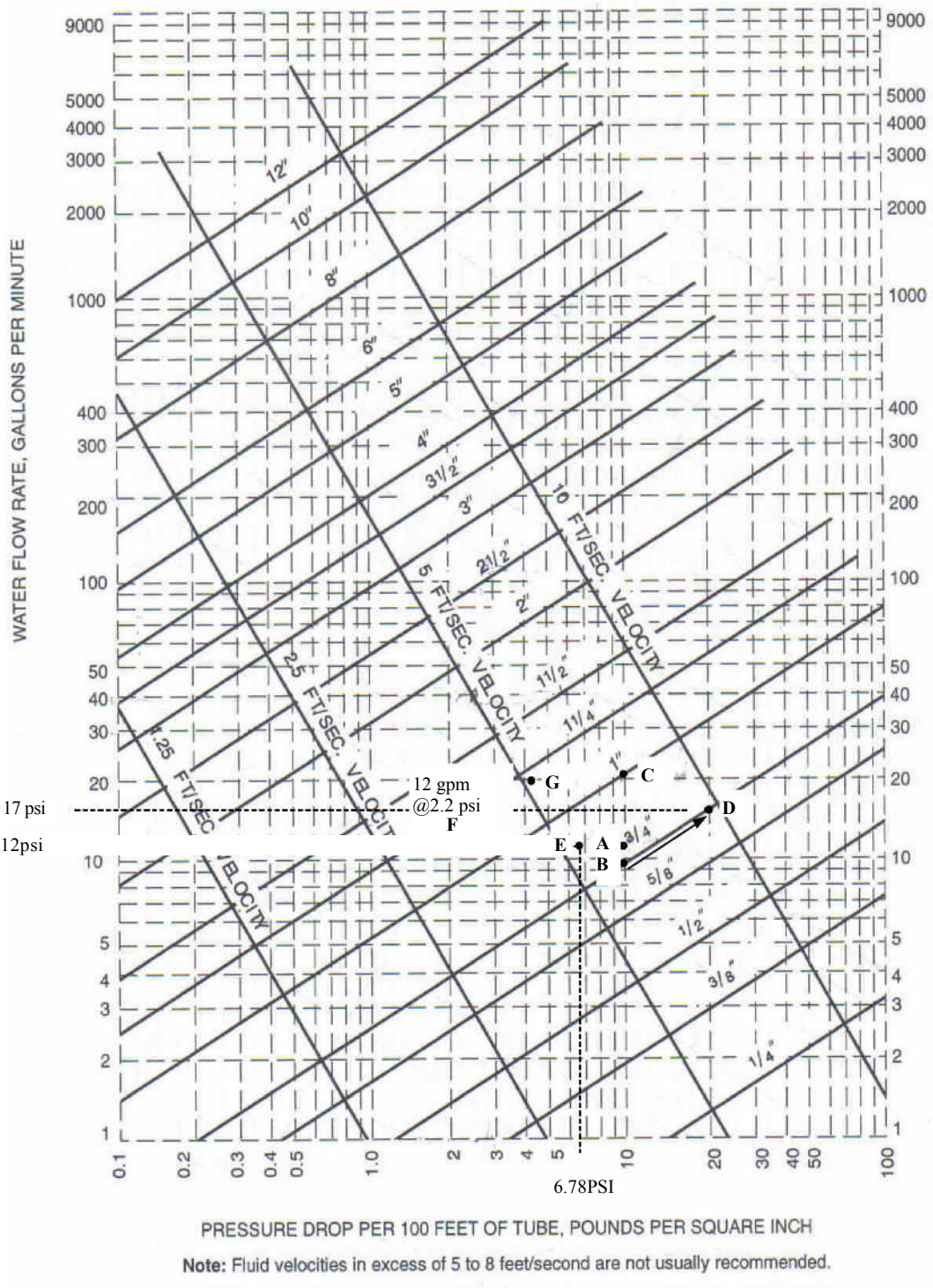
The method used to size a water distribution system in appendix E is only one example of many approved engineering practices used to size piping. Section E 101.1.2 states that alternative engineering practices are acceptable. If you try to read and follow along the **segmented loss method** example, as given in Appendix E, you may become frustrated and confused. The numbers and math in Table E101A are incorrect. The following discussion will give you the basic principles for sizing water pipes. Understanding these principles should allow you to answer any test questions regarding pipe sizing

Understanding friction charts

The length of a pipe is not the length of a pipe.

A pipe has two lengths (1) a **developed length,** which is the actual measured length and (2) an **effective length,** which is caused by the addition of fittings and valves. Table E103C lists the **equivalent lengths** of various fittings and valves.

A 3/4", 90-degree elbow has an equivalent length of 2.5 feet. If seven elbows were used in 130 foot of developed length of pipe, then we would have to add 17.50 feet (7 x 2.5) to the pipe to determine its total effective length. The **total effective length** would therefore be 147.5 feet (130 +17.5)



Note: Fluid velocities in excess of 5 to 8 feet/second are not usually recommended.

If the street pressure is 45 psi, and you were to run a pipe with a total effective length of 100 feet, to a fixture requiring 12 gallons per minute @ 10 psi what size would the pipe have to be if the total pressure losses through a meter, backflow preventer, valves, tees and elbows equal 25 psi.

First, we must determine the pressure left to push the water down the pipe. This is called the **available pressure.**

Street pressure	+45 psi
Pressure losses through meter, bfp, valves, tees and elbows	-25 psi
Pressure needed to operate fixture	-10 psi
Pressure left to size pipe (available pressure)	**+10 psi**

Turn to Figure E103A.2, located in Appendix E, *Friction Loss in Smooth Pipe.* Place a dot at the intersection of 12 gallons per minute and 10 psi pressure drop (Point A). It falls between ~" and 1" (diagonal lines). If you were to install a ~" pipe the gpm would be at 10 (Point B), therefore, the fixture would starve for water. A 1" pipe, however, will have the capability to deliver up to 20 gpm (Point C) before suffering a pressure loss below 10 psi.

> For the sake of conversation, go back to point B. At this point a ~" pipe will deliver 10 gpm @ 10 psi. If we were to increase the pressure to 20 psi, we would stay on the ~" line (we're not changing the pipe size) and follow it to the 20 psi line (point D). If you draw a horizontal line to the left, it would it would indicate 17 gpm will flow through the pipe @ 20 psi.

Notice, at the bottom of the chart is say, PRESSURE DROP PER 100 FEET OF TUBE. The above illustration for using a friction chart is correct **only if** the pipe is **exactly**100 feet in **total effective length.** If the pipe is any other length (which is almost always the case), the pressure loss must be adjusted. To determine the **adjusted pressure loss** of the above pipe (assume 147.5 feet to be the TEL) we would use the following formula.

$$\textbf{Adjusted pressure loss} = \frac{\textbf{Available pressure x 100}}{\textbf{Total effective length}}$$

$$= \frac{10\text{psix}100}{147.5\text{ ft.}}$$

$$= \textbf{6.78 psi}$$

Now that we know the adjusted pressure loss (6.78 psi) and the required flow rate (12 gpm) we can return to the friction chart and select the correct pipe size, which in this example, happens to remain 1" (Point E).

Velocity
Always check the **velocity** (feet per second, fps) using the opposite diagonal lines on the friction chart. In this example the velocity is about 6 feet per second (8 fps is max, 5 fps

is recommended). High velocities cause noise and pipe erosion. If the velocity is too high, you must select a larger pipe size, by moving directly to the left, along the gpm line until an acceptable velocity is obtained.

Practice question
If, using the above example, the pipe has a total effective length of 450 feet what size would you select?

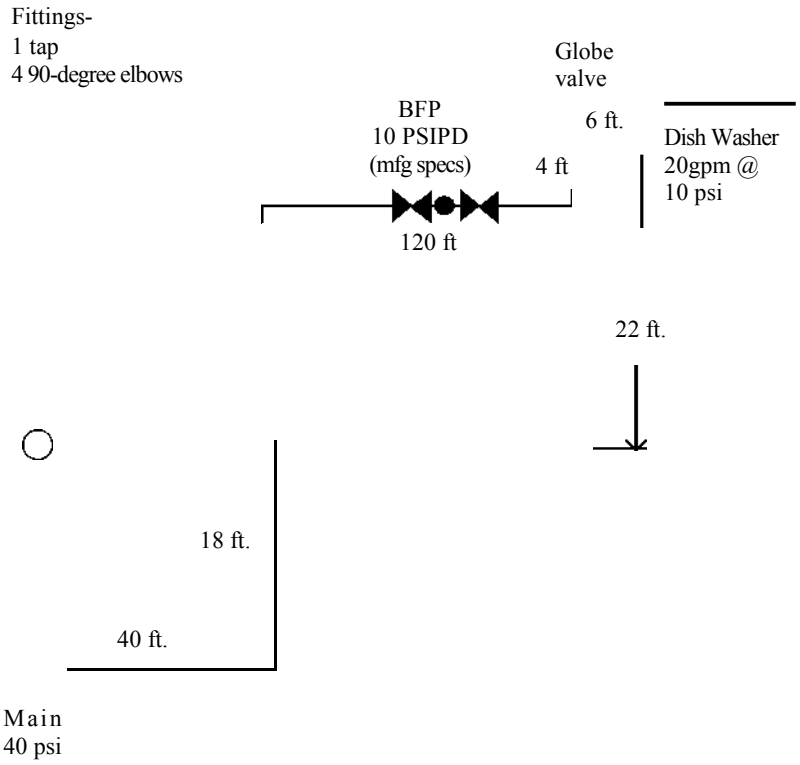
Answer:

$$\frac{10 \text{ psi} \times 100}{450} = 2.22 \text{ psi adjusted pressure loss}$$

12 gpm @ 2.22 psi pressure loss shows 1 1/4" pipe should be selected (point F). Check velocity (less than 5 pfs-OK)

Let's throw a few more things into a piping system

Below is a diagram of a commercial dishwasher installation.



In the above example, we have a number of items that contribute to pressure drop, as you will see below. These pressure drops must be subtracted from the street pressure in order to determine the available pressure left for sizing the pipe.

Minimum pressure required to operate fixtures or appliances. Table 604.3 lists the minimum pressure and flow rates to operate various fixture and appliances. If the appliance is not listed use the manufacturer's specs. Since this is a commercial dishwasher we will use the manufacturer's specification of 10 gpm.

Developed length or measured length – This is the actual measure length between the tap at the main and the fixture or appliance. The total **developed length above is 188**

feet.

Valves and fittings- When a valve or fitting is added to a system it restricts the flow. The resistance is expressed as **equivalent feet.** If a 90-degree elbow is equal to 2

equivalent feet than a 10 ft pipe with 1 elbow would offer the same resistance as a 12 foot straight pipe (10 ft. developed length +2 ft. equivalent length). In the above illustration we have four 90-degree elbows. Looking at Table E103B a 1-1/4", 90-degree elbow is equivalent to 4 ft. Since there are four elbows we must add 16 feet to the developed length of the pipe. The globe valve adds another 35 feet. When the **equivalent lengths** are added to the **developed length** we have the **total effective length.** The total **effective length of our pipe is 239 feet (188 + 16+35 = 239).**

> You may be asking yourself, "How do I know what size valves and fittings to use if I don't know the pipe size yet?" Answer: You don't know. You must guess or estimate the final pipe size so you have a fitting size to work with. In the end you may find you need a 2" pipe, then you must redo the procedure to be sure the 2" pipe works.

Taps and tees- unlike valves and fittings, the pressure losses caused by taps and tees (off the main) are **expressed in psi.** Table E103A lists these losses. At the main, our pipe is connected with a 1-1/4" tap; the required gpm is 20, therefore, the tap offers a pressure loss of **.31 psi.** ***Branch tees*** *are expressed in equivalent lengths, Table E103C.*

Appurtenances- meters, backflow preventers, grease traps, etc are appurtenances. The pressure prop produce by these items is **expressed in psi** and can be found in the manufacturer's specifications. The backflow preventer in our illustration offers a pressure drop of **10 psi.**

Height or elevation- water exerts a pressure of .433 psi per foot elevation. A 10-foot high column of water would have 4.33 psi at the base (10 ft. x .433 = 4.33). The height of our dishwasher connection from the tap is 22 ft. Therefore there is a pressure loss of **9.53 psi** to lift the water (22 ft. x .433 = 9.53).

> If the dishwasher were located **below** the tap, say 15 feet, then there would be a pressure **gain** of 6.50 psi (15 x .433 = 6.50). Thus we would add the gain to the street pressure.

Let's size the pipe using the four steps below

1. Determine the **available pressure** to size pipe.

A	Pressure attap	+40psi	
B	Pressure drop due to height (.433 x 22)		- 9.53 psi
2.D C	Pressure needed to operate appliance		- 10 psi
D	Pressure drop of backflow preventer (Mfg. Specs.)		e- 10 psi
E	ePressure drop of tap -		.31 psi
F	r Total pressure losses (B+C+D+E)	- 29.84 psi	
G		+ **10.16 psi**	

2. Determine the **total effective length.**

Total effective length = developed length + equivalent lengths
= 188+16+35
= **239 feet**

3. Determine the **adjusted pressure drop.**

Adjusted pressure drop = Available pressure x 100
Total effective length

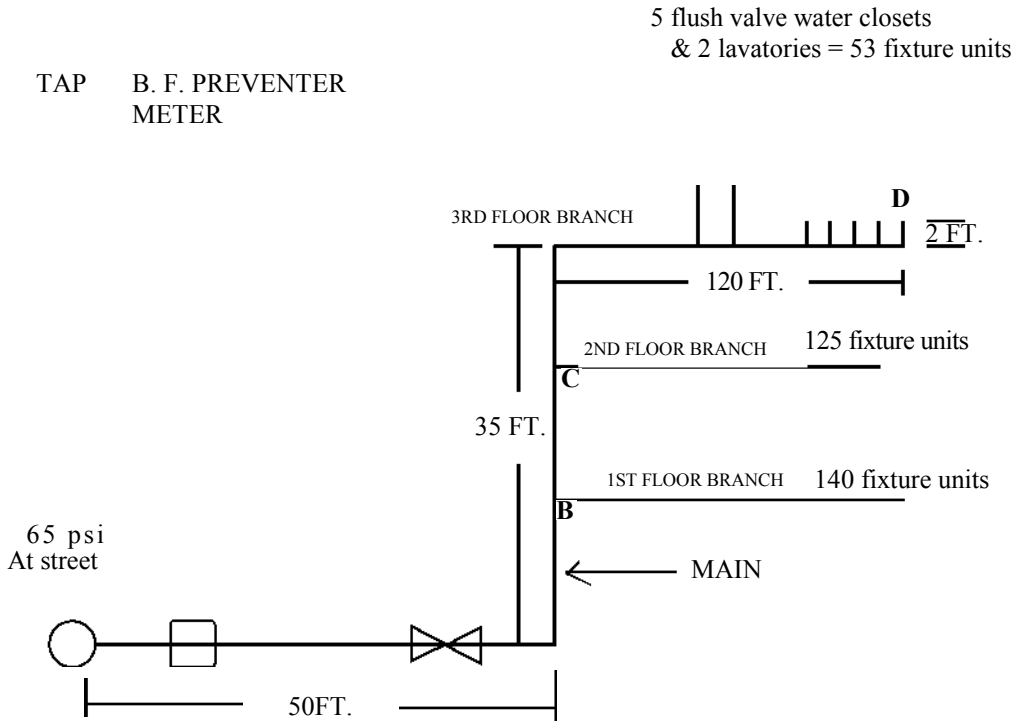
= 10.16x 100
239

= 1016
239

= 4.25 psi

4. **Go to friction chart,** Table E103A.2. Find the intersection of 20 gallons per minute and 4.25 psi pressure drop (point G). The chart indicates a 1-1/4" pipe will work. Check the velocity; looks like about 6 fps- OK.

Below is a sample commercial building:



1. Determine the **available pressure drop**

The available static pressure is the pressure remaining after the pressure losses due to valves, meters, devices and height are deducted from the street pressure. This pressure is what's left to size the pipe.

Pressure at city main	65.00 psi
Highest pressure needed to operate a fixture. See Table 604.3 water closet, siphonic, flushometer valve	-15.00 psi
Tap loss- (assume we have a 2 inch tap) Go to Table E103A, Appendix E. The example above has a total of 318 water supply fixture units (wsfu). Table E102 shows 318 wsfu = 127 gallons per minute (when a figure falls between two bins use the higher bin, 400 in this case), therefore a 2" tap @ 140 gpm has a pressure loss of 2.20	-2.20 psi
Meter loss- manufacurer's specs says 10.00 psi loss	-10.00 psi
Backflow preventer- manufacture's specs says 9.50 psi loss	-9.50 psi
Allowance for future demand (estimate)	-3.00
Allowance for height of fixture. Water exerts a pressure of .433 pounds per foot of elevation. The highest fixture is 37 feet **above the tap,** therefore a pressure of 16.02 psi will be lost in order to lift the water	-16.02 psi
Available pressure drop- this is the static pressure left for the piping system	**9.28 psi**

2. Determine the **longest effective length**

The longest length is from the tap to point D. 207 feet is the measured or developed length. There are also 3 elbows and 8 straight tees. These fittings add friction loss to the system and are treated as equivalent lengths to pipe. Using table E103C, a 2" 90-degree elbow is equivalent to 5.5 feet of straight pipe. Since there are 3 elbows between the tap and point D we must add 16.5 feet to the measured length. Likewise there are 8 tees along the way, which add .5 feet each

(1.5 feet total). So, a total of 18 feet must be added to the 207 measured feet to come up with 225 effective feet.

3. Determine the **adjusted static** pressure.

$$\textbf{Adjusted static pressure} = \frac{\textbf{available static pressure x 100}}{\textbf{Longest total effective length}}$$

$$= \frac{9.28 \times 100}{225}$$

$$= \frac{928}{225}$$

$$= \mathbf{4.12^*}$$

***This is the only pressure drop you will use to size all pipes connected to the same main**

4. Determine gallons per minute for each section of piping
   A. Convert fixture units to gpm using Table E102.

1. 1st floor branch (140 fu) = 77 gpm 3. 2nd floor branch (125 fu) = 77 gpm
3. 3rd floor branch (53 fu) =54 gpm

When sizing mains, total all fixture units it must carry, then convert to gpm

4. Main section from tap to B must deliver all water (140 +125+53 + 318fu), 127 gpm.
5. Main section B-C must deliver water to 2nd and 3rd floors (125+55 = 178 fu), 85.5 gpm.
6. Section C-D delivers only water for third floor (53 fu), 54

5. Go to friction chart and size each section using the same adjusted pressure drop (4.12) for each section with its respective gpm requirement.

1st floor branch (77 gpm @ 4.17 psi)	2”
2nd floor branch (77gpm @ 4.17 psi)	2”
3rd floor branch (54 gpm @ 4.17 psi)	2”
Main- tap to B (127 gpm @ 4.17psi)	2.5”
Main- B-C (85.5 gpm @4.17 psi)	2.5”
Main- C- 3rd floor (54 gpm @4.17 psi)	2”

Chapter 7
SANITARY DRAINAGE

Section 704.1 slope of horizontal drainage piping

Older codes required a 1/4' per foot slope for any pipe **less than 3" diameter.** This code has changed the rule to **less than 2-1/2" diameter.** A 3" drain now, needs only a 1/8" slope.

704.3 Connections to offsets and bases of stacks.

704.3– Horizontal branch cannot be connected to horizontal drain within 10 times drains diameter of stack

711.2– If there are more than four branch intervals above the offset then horizontal branch cannot connect in any portion of the offset. Must be connected at least two feet above or below the offset

3" stack

Horizontal branch

30"

(3"x 10)

706.3 Note: double sanitary tees cannot be used to discharge back-to-back fixtures or appliances with pumping action discharge.

Table 706.3

This table is full of important footnotes; be assured of getting questions off it. Note: a **sanitary tee** cannot lay on its side or come of the top of a drain under any circumstances.

709.3 Continuous and semicontinuous flow fixtures. A fixture with a continuous flow of 3 gallons per minute is equal to _____ fixture units.

Fixture units = gpm x 2

= 3x2

= **6**

709.4 A three-compartment sink must empty into an indirect waste receptor. What is the minimum size drain and trap of the waste receptor?

Table 709.1 indicates a sink has a load factor of 2 fixture units for a sink.

2 fixture units x 3 sinks = 6 fixture units

Table 709.2 indicates a 4" drain and trap are required to handle 6 fixture units.

Using the drainage tables.

Table 709.1

Fixture units are probability factors for sizing drains in order to provide an uninterrupted flow of waste in pipes. The fixture units were developed by the National Bureau of Standards in 1940 and are still used today.

As always, when using a plumbing chart, be sure to read the footnotes

For our example, we will use a three story house with two bathroom groups (1.6 gpf water closet) one includes a bidet, a laundry sink, kitchen sink with disposal, dishwasher and clothes washer. The total fixture units for sizing the sewer, building drain and stack are as follows:

Fixture	Fixture units	Explanation
Bathroom group 1	5	
Bathroom group 2	2	See footnote h
Bidet	0	Section 202 defines a bathroom group as including a bidet
Laundry sink	2	
Kitchen sink	2	
Clothes washer	2	
Dishwasher	0	Dishwasher is included with kitchen sink
First floor water closet	3	
First floor lavatory	1	
Total fixture units	**17**	

Notes: Although the trap size for a kitchen sink is 1 1/2", the vertical drain must be 2" (see footnote g). Urinals and water closets have integral traps; therefore the drainage pipe must be the size of the outlet.

Tables 710.1 (1) and 710.1 (2)

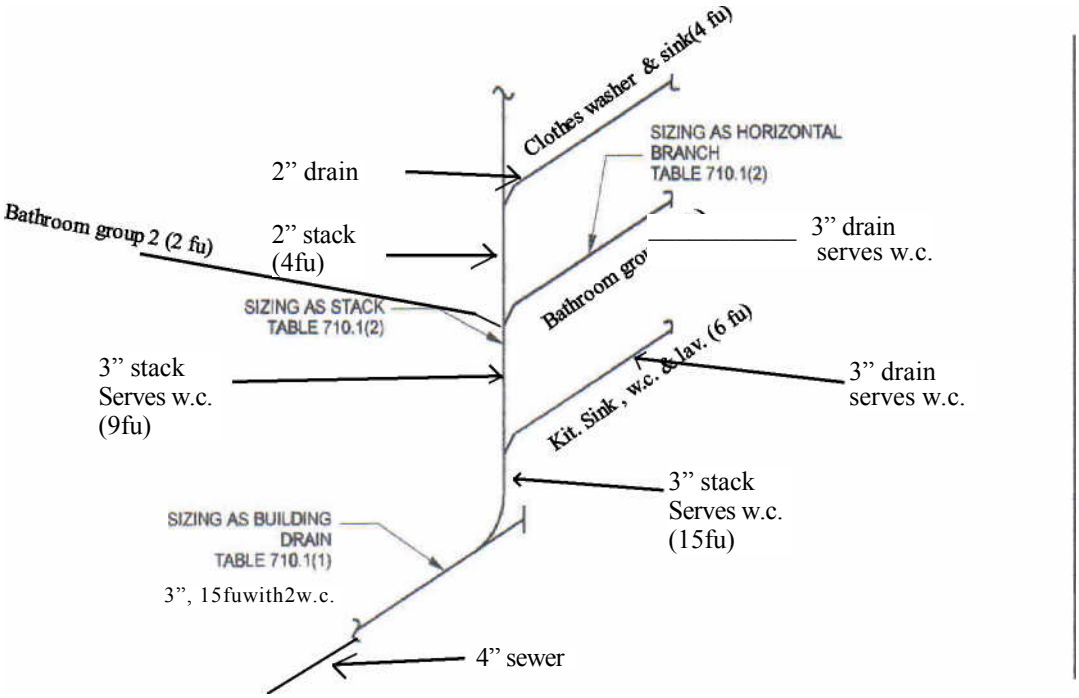
Below is a schematic of the three-story home. The first floor has a kitchen sink, water closet and lavatory. The second floor has two bathroom groups and the third floor has a clothes washer and sink. Each floor is served by a **horizontal drain branch** (to be a branch it must serve two or more fixtures). The fixture units are taken from Table 709.1 and are in parentheses. The slope per ft. is 1/4 inch.

Beginning at the sewer, we will size the drain system.

The **sewer** is 4". The sewer must handle a total of 17 fixture units (taken from **Table 709.1** and calculated above). Table 710.1 (1) indicates, under the 1/4"

slope column, a 2” sewer will work. However the code says in footnote b. *No building sewer shall be less than 4” in size.*

The **building drain** must be 3”. Again, **Table 710.1(1)** indicates a 2“ drain will work, but, footnote a says, *the minimum size of any building drain serving a water closet shall be 3 inches.*



Stacks and **horizontal fixture drains** are sized using **Table 710.1 (2)** The second column of the Table is used to size the horizontal drain for each fixture branch. The third, forth and fifth column are used to size the stack. Since this home has three branch intervals (three stories of plumbing) we must use the fourth column to size the stack

The stack between the building drain and first floor (first interval) is 3”. According to the Table, a 2 Y2” stack will work, but remember, it has to serve two water closets. Therefore its minimum size must be 3”.

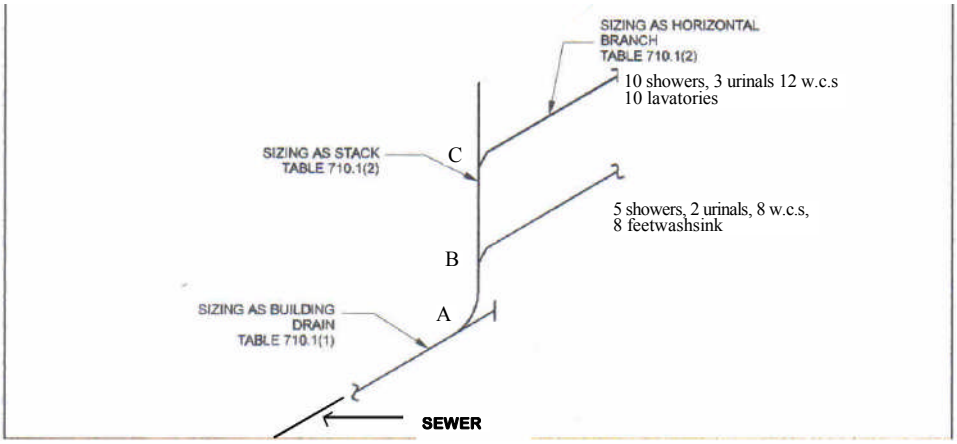
The stack between the first and second interval is serving the second and third floors for a total of only 11 fixture units (2 fu +5 fu + 4 fu). Because the stack must serve the water closets on the second floor, it must be 3”

The stack between the second and third floor serves only 4 fixture units. Table 7 10.1(2) indicates a 1 Y2” stack will work, however, the second column indicates the horizontal drain on the third floor must be 2”. Section 704.2 says,

"The size of drainage piping shall not be reduced in size in the direction of flow." Therefore the stack must also be 2 ".

The horizontal drains for the first and second intervals must be 3" because they serve water closets. **Note:** when sizing the **horizontal drain branch** for bathroom group 2 use 5 dfu, not 2 as use to size the building drain and sewer

Sizing drainage for a factory



Lets size the drainage system for the above factory locker rooms.

Determine fixture units

Table 709.1 will give us the fixture units needed to size the various components of the system.

Branch at point B

5 showers x 2 fu	= 10 fixture units
2 urinals x 4 fu	= 8 fixture units
8 water closets x 4	= 32 fixture units
8 feet wash sink (4 faucets) x 1 (see footnote 8, table 403.1)	= 4 fixture units
Total fixture units for interval B	=54 fixture units

Branch at point C

10 showers x 2	=20 fixture units
3 urinals x 4	= 12 fixture units
12 water closets x 4	=48 fixture units
10 lavatories x 1	= 10 fixture units
Total fixture units for interval C	=90 fixture units

Total fixture units on sewer (branches B+C) = 148 fixture units

Determine component sizes

Sewer- @ 1/8" slope: 4"	Table 710.1(1) column 3
Building drain @ 1/4" slope: 4"	Table 710.1(1) column 4
Horizontal branch drain B: 4"	Table 710.1 (2) column 2
Horizontal branch drain C: 4"	Table 710.1 (2) column 2
Stack A-B: 4"	Table 710.1 (1) column 4
Stack B-C; 4"	Table 710.1 (1) column 4

Chapter 8
Indirect/Special Waste

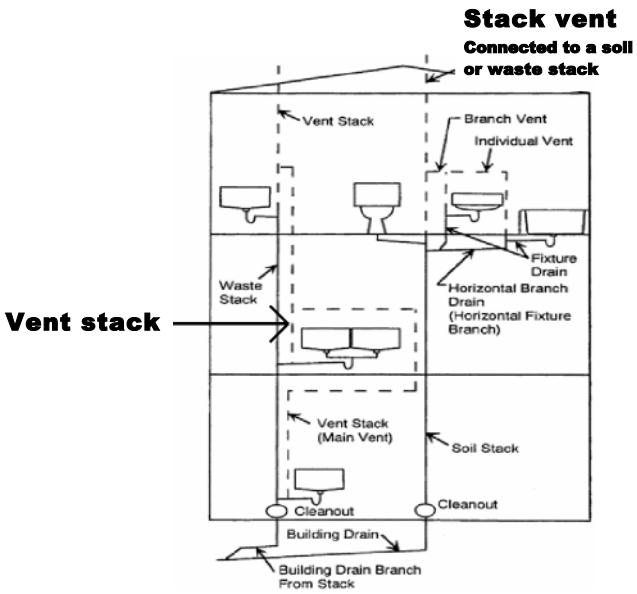
The illustrations under the definition chapter of this manual show the difference between an air break and an air gap. Basically, any food handling equipment (except residential), sterilizers, potable clear water waste (such as relief valves on water heaters), and swimming pools must have an air gap. Nonpotable clear water waste from equipment such as boiler drips or process tanks is the only type of waste that may be drained through either an air gap or air break.

The size of all air gaps must be twice the waste pipe opening. If the waste pipe from the fixture or equipment is greater then 2 feet horizontally or four feet in total length then a trap must be installed on the waste pipe.

Sections 802.3 and 802.4 describe the requirements for waste receptors and washing machine standpipes; expect a question from these sections.

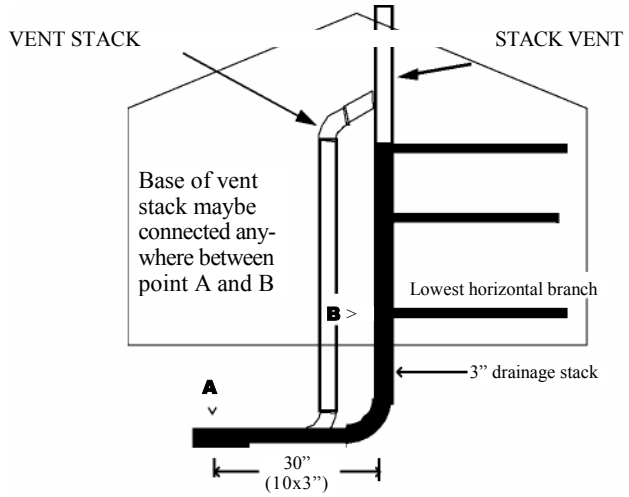
Chapter 9
Vents

When waste water flows down a drain pipe it must displace air that is in front of it. If this air is not given a place to go such as up a vent then it will bubble into the fixture. This effect is experienced when emptying a soda bottle. Another reason for venting is to give the sewer gases a mean to escape to the outside air. A third reason for venting is to prevent the discharged waste water from siphoning water from other fixtures and traps. And lastly, to prevent water from backing up into lower fixtures.



A **stack** is any vertical soil, waste or vent with or without offsets that extend through at least one story. A **vent stack** is for venting only and does not carry, nor is it designed to carry, any waste. A **stack vent** is that portion of a soil or waste stack above the highest fixture or branch drain connection

Section 903.
Every building must have at least one vent extended to the outside (2" minimum size). A **vent stack** is only required in buildings with five branch intervals or more. When a vent stack is installed, its base must be connected to the drainage stack at or below the lowest horizontal branch on the stack. It may, however, be connected to the building drain as long as it is within a distance of 10 times the diameter of the drainage stack.



Section 914 and 915 (see illustration under Yoke vent in definition section)
If the building has more than ten branch intervals then a relief vent must be installed on the drainage stack at each tenth interval, beginning with the top floor.

If there is a horizontal offset in the drainage stack then a relief vent must be installed if five or more branch intervals are above the offset.

Section 906

If the distance between a trap and vent is too great, siphoning of the trap seal may occur during discharge. This section contains Table 906.1 ,which dictates the maximum distance allowed between a trap weir (see illustration below) and vent. If the trap size is unknown refer to Table 709.1 in Chapter 7. The drain size is determined by fixture units, using Table 7 10.1(2). Beware of footnote (g) when determining drain size for a sink with disposal or dishwasher.

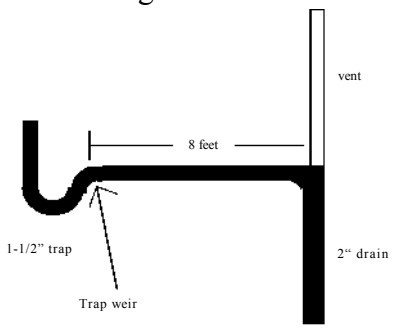
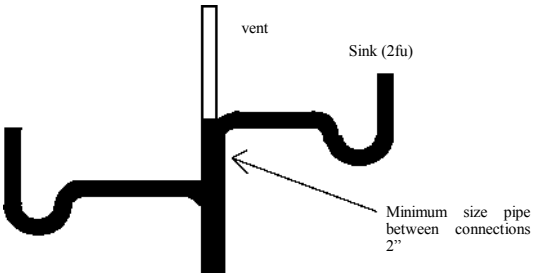


Table 906.1

Section 908

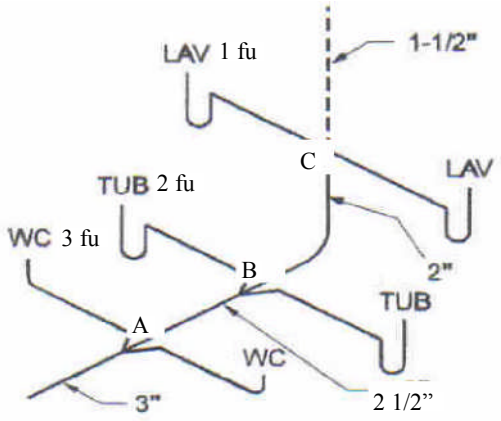
Common vents

Below is an illustration of two fixtures, at different levels, sharing an individual vent. Use Table 908.3 to size the vertical section between the fixtures (note: A water closet is not allowed to be the *upper* fixture)



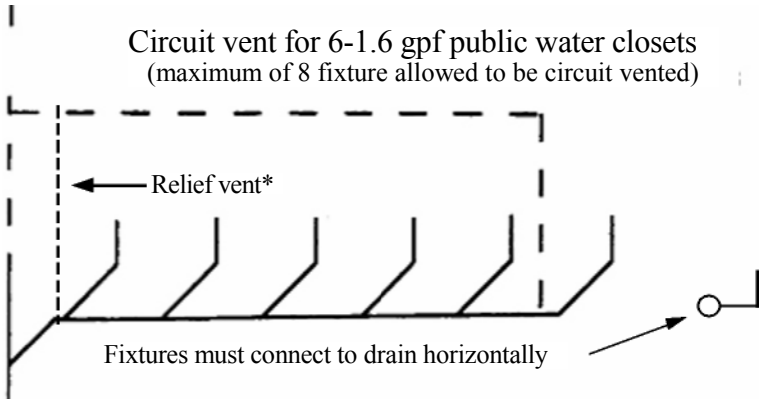
Section 909 wet venting

Below is an illustration of wet venting back-to-back bathrooms.



- The fixture units are obtained from Table 709.1
- Drain size is from table 710.1(2) column 2 (total 12 dfu)
- Section A-C is a wet vent
- Section A-B must handle 6 dfu. Table 909.3 indicates a 2-1/2" pipe is needed as a wet vent.
- Section B-C must handle 2 dfu. Table 909.3 indicates a 2 "pipe is needed as a wet vent.
- The dry vent beyond point C must be 1-1/2" as section 916.2 says vents other than stack vents or vent stacks must be at least one half the diameter of the drain served (3")

Circuit vents (Section 911)



Determine vent size- 4 dfu x 6 w,c. =24 dfu (Table709.1)
Table 710.1(2) says 4' drain required
Section 916.2 says, vents other than stack vents or vent stacks must be 1/2 diameter of drain. Therefore, the circuit vent size is 2"

*A relief vent must be installed when four or more w.c. are connected to a drain **and** the soil stack receives discharge from upper branches

Vent pipe sizing (Section 916)

Table 916.1 is used only to size **stack vents, vent stacks** and **combination vent** systems.

All other vents shall be sized as 1/2 the diameter of the drain served but never smaller than 1-1/4" (If the developed length of the vent is greater than 40 feet, you must increase the size by one pipe size).

Using Table 916.1

The base of a vent stack is connected to a waste stack handling 450 dfu and extends 50 feet upward where it connects to a stack vent. The stack vent continues another 15 feet to the outside air. What is the minimum vent stack size if the waste stack is handling 3 branch intervals?

The first thing we need to know is the size of the building drain stack.
Table 710.1(2) indicates a 5" drain is needed to handle 450 dfu (540 dfu maximum).

Next, we'll turn to Table 916.1 and find a row corresponding to a 5" waste stack and 450 dfu (about half way down the chart is 5" waste stack @ 490 dfu). The total developed length of our stack is 65 feet (50 feet + 15 feet). Therefore slide your finger to the right until you find a column containing

at least 65 feet (250 is correct, 63 is too short). At the top of the chart it indicates a 4" vent stack is required.

Sump vents (Using Table 916.5.1)

A 40-gallon per minute sewage pump is feeding a sump. A pipe with a developed length of 55 feet must vent it. What is the minimum allowed size for the vent pipe?

Footnote (a) says to add 50% to the developed length for entrance and friction loses; therefore the maximum developed length would be 55 ft. plus 27.5 ft. (.5 x 55) for a total of 82.5 feet. Table 9 16.5.1 indicates a 1-1/2" vent is needed.

Section 919 (Single stack discharge and ventilating systems)

This is a plumbing system whereas a single stack is used as both the waste and venting system. Fixtures may discharge directly into the sack without being vented or into a branch, which is vented via a loop or circuit vent. A professional engineer must design the system. To prevent siphoning of fixture traps the piping is larger than conventional plumbing systems and the trap to stack distance is modified as per Table 91 9.6B. Before the system is put into service it must be tested in accordance with section 312 and pass a **simultaneous discharge test** as prescribed in section 919.11

Vertical stacks are sized **using discharge units,** instead of drainage fixture units. Table 919.5A lists the discharge units for various fixtures and Table 919.5B lists the vertical stack sizes needed to accommodate the total discharge.

Paragraph 919.5.5 explains how to adjust the discharge unit values when *intervals between use* are not the same as listed in Table 919.5A. A sample adjustment would be as follows:

Suppose the interval of use for a water closet is expected to be 1 hour (60 minutes) and a sink 40 minutes. What would the discharge units be?

$$\textbf{Adjusted discharge units} = \frac{\textbf{Table use minutes x Table discharge units}}{\textbf{Expected use minutes}}$$

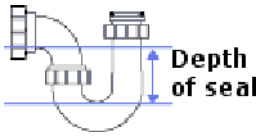
$$\text{Adjusted discharge units (w.c.)} = \frac{20 \times 15}{60} = \frac{300}{60} = 5$$

$$\text{Adjusted discharge units (sink)} = \frac{25 \times 8}{40} = \frac{200}{40} = 5$$

Chapter 10
TRAPS, INTERCEPTORS AND SEPARATORS

Traps

The dept of seal must be at least 2” but no more than 4”

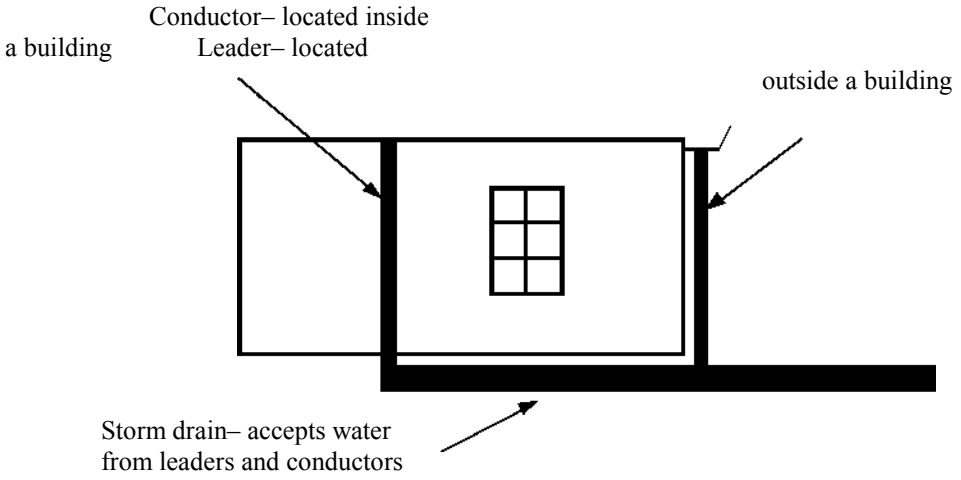


The diameter (size) is according to Table 709.1

Note: Trap cannot be larger than drainage pipe it’s connected to.

Chapter 11
STORM DRAINAGE

Leaders, conductors and storm drain illustration



Size the storm drainage system for the above roof if it were 6300 square feet, located in Wake County.

1. Determine the hourly rainfall rate using figure 1106.1 or Appendix B
   Looks like 4"
2. Using Table 1106.2; under the rainfall rate column of 4, we find 6300 sq. ft. falls between 4600 and 8650; choose 8650. To the right, under *diameter of leader* we find 5" to be the correct leader or conductor size. If we wish to use a square pipe, the minimum size would have to be 5" x 5" (footnote a).
3. Using Table 1106.3; if the storm drain slopes 1/8" per foot, then the drain would need to be 8".
4. If we were to install gutters, we'd go to Table 1106.6 and find that under 4" rainfall the best we could do is 10" diameter gutters with a 1/4" per foot slope.

If the above building has a taller building attached directly to it, with a 100 ft. long wall extending 20 feet higher, then 1/2 of the exposed wall must be added to the roof of our building before sizing the roof drainage system.

Our roof	6300 sq.ft.
Neighbor's wall- 20' x 100' = 2000 sq. ft.	
2000 sq. ft. x .5 = 1000 sq. ft.	1000 sq. ft.
Square footage used to size roof drain components	7300 sq.ft.

Section 1107
If our roof has a parapet wall where water could be trapped in the event the roof drain failed then a secondary system must be installed. Leaders and conductors are sized using the rainfall charts in Table 1106.1 a instead of 1106.1. The discharge is to be above grade where it will be observed.

Section1 108
If the storm drain for our building, is also used as a sanitary drain to discharge 375 dfu, we would size the drain and sewer as follows (paragraph 1108.1):

Square footage of roof	6300 sq. ft.
First 256 dfu	4000 sq. ft.
Remaining 119 dfux 15.6 sq.ft./dfu	1856 sq. ft.
	12,156 sq. ft.

According to Table 1106.3, a 12,156 sq. ft. roof requires a 10" drain @ 1/8" slope.

INTERNATIONAL PRIVATE SEWAGE DISPOSAL CODE

This code, separate from the International Plumbing Code, may be required study material for some state exams. We have therefore, provided the following explanation for sizing septic systems.

Chapter 6- Soil absorption systems

Sizing an absorption field for other than one and two family residential.

To size the trench area required for a 36 unit (2 bedroom) apartment project on percolation class 2 soil use the following formula:

Area = number of units (Table 604.1(2)
X
Conversion factor (Table 604.1(2)
X
Absorption area from table 604.1(1)

Area= 72x1.5x165
= 17,820 square feet

Seepage pit sizing (Section 605.3)

According to Table 603.1 a single family home on percolation class 2 soil requires 250 square feet of trench. If a 10-foot total diameter pit were to be used, what would the dept of the permeable strata be?

Looking at Table 605.3, in column 1, find 10 feet slide your finger to the right until at least 250 sq. ft. is located (251). Go to the top and you'll see 8 feet as the answer.

Chapter 8
Tanks

The size septic tank for our apartment building would be calculated according to Section 802.7.2 and Table 802.7.2 as follows:

Start with 750 gallons, then, according to Table 802.7.2, add 150 gallons for each bedroom.

Tank size = 750 gallons + (150 gallons x 72 bedrooms)
= 750+ 10,800
= 11,550 gallons

Obviously, you may use 6–2000 gallon tanks

Practice Questions

Chapter 2
Definitions

1. A circuit vent may vent up to _____ traps.
2. A three-compartment sink is an example of a _____ fixture.
3. A drain serving two or more fixtures that discharges to another drain or stack is called a_____?
4. Lead free solder cannot contain more than _____% lead.
5. An interceptor located inside a building and having a flow rate less than 50 gpm is a_____ .
6. In order to be defined as a branch interval the vertical distance between horizontal branches must be at least_____feet.
7. When a pipe discharges indirectly into a receptacle below the flood level rim, the space between the receptacle and pipe is called a_____ .
8. Installing air conditioning condensate piping is practicing plumbing. True or false?
9. Water service piping must terminate _____ a feet outside the foundation wall.
10. A vent stack is a stack. True or false?
11. To be defined as a swimming pool, it must have a depth of at least_____feet at some point.
12. For water to be considered hot, its temperature must be at least _____degrees.
13. A pipe, inside a building, that conveys storm water from the roof is a _____.
14. A lavatory, located in a hotel room, is considered a public fixture. True or false?
15. A pipe making an angle of 45 degrees is considered a horizontal pipe. True or false?

Chapter 2
General Regulations

16. The maximum size opening on a strainer plate is_____ inche.
17. The minimum R factor for insulating pipes in unconditioned areas is .
18. Waste and soil piping leaving a building must have a minimum cover of_____ inches.
19. If rock is encountered in trenching, it must be removed to a minimum depth of _____ inches below the installation level.
20. A 2" diameter hole may be drilled in any 2x4 stud. True or false?
21. PVC pipe must be supported horizontally by hangers not less than every _____feet.
22. All public water closets must be enclosed in a compartment. True or false

23. A construction site with 50 workers must have _____ toilets and _____ urinals.
24. For testing the rough in drainage system on a single family house, water must fill the piping to a level of _____ feet above the highest drainage fixture.
25. A copper water distribution system may be tested under water pressure not less than 100 psi. True or false?
26. A storm drain, within a building must be water tested with a minimum of _____ foot of head.

Chapter 4
Fixtures, Faucets and Fixture Fittings

27. Individual urinals may be substituted with trough urinals. True or false?
28. Pay toilets are prohibited by the Code. True or false?
29. Unisex/disable restrooms are not required in shopping malls with gross area less than square feet.
30. If 100 males occupy an office building, how many water closets may be substituted with urinals? _____
31. The gross area of an exhibition facility is 90,000 square feet. How many persons are used to calculate facilities? _____
32. From the above question, how many persons are female? _____
33. A wash basin that is 12 feet in circumference is equivalent to_____ lavatories
34. A 2500 square foot leased area in a mall within 200 feet of a public does not have to provide employee facilities within the leased area. True or false?
35. How many lavatories must a manufacturing plant have with 50 employees exposed to irritating materials?_____
36. Separate facilities shall not be required in sit down hot dog stand with _____ or less employees and customers.
37. What is the maximum classroom size for 11th graders? _____
38. A school with 45 classrooms, has how many teachers and staff? _____
39. Temporary modular classrooms may omit toilet facilities for grades K-8, if sufficient capacity facilities are located within 450 feet of horizontal travel distance. True or false?
40. How many females would occupy a crowd of 120 people in a lounge? _____
41. There shall be at least _____ inches clearance in front of a water closet.
42. Plastic floor flanges for water closets must be at least _____inch thick.
43. A minimum 12" x 12" access panel must be provided for concealed screwed joints. True or false?
44. Floor drains shall have a minimum _____inch diameter.
45. Commercial food grinders may be connected to a sink drain. True or false?
46. The opening of a shower strainer must not be larger than ____ inch.
47. The height of a waterproof wall in a shower compartment must be at least _____inches above the drain.
48. Shower liners made of PVC must be _____inch thick and turn up at all edges at least ____ inch.

49. Outlets to lavatories must be a minimum _____ inch diameter, while that of sinks must be _____ inch diameter.
50. The maximum water temperature for any shower is_____degrees.
51. A flush tank ball cock backflow preventer must be located at least ___ inch above the full opening of the overflow pipe.

Chapter 5 Water
Heaters

52. _____ Water, heated to temperatures in excess of _____ degrees, requires a tempering valve.
53. Water heaters installed in garages, shall be elevated such that the ___ _____ is not less than 18“.
54. A water heater installed in an attic with 6 feet of headroom above the passageway has no restriction on its distance from the access opening. True or false?
55._____ The maximum temperature setting on a relief valve is _____ degrees.
56. A plastic drain pan may be place under a gas water heater. True or false? 57. The pan shall be drained by an indirect pipe, having a minimum diameter of, inch.

_____

Chapter 6
Water Supply and Distribution

58. The minimum diameter of a water service pipe shall be ____.
59. A PVC sewer pipe may occupy the same trench as a water pipe. True or false?
60. _____ The maximum flow rate for a shower is _____ gpm @ 80 psi.
61. _____ Fixture supply pipe must terminate within _____ inches from the point of connection to the fixture.
62. _____ A water pressure reducing valve must b installed when the supply pressure exceeds psi.
63. A manifold, designed to handle 10 gpm demand @ 4 fps would have an internal diameter of _____inch/inches.
64. _____ The maximum lead content of a water valve is_____ %.
65._____ The minimum pressure rating of water piping outside is _____ psi and inside _____ %.
66._____Unless otherwise approved, mechanical joints may only be installed where _____ .
67. Schedule 40 plastic pipe may be threaded. True or false?
68. “Lead free” shall mean a chemical composition equal to or less than % lead.
69._____ the primer color for CPVC shall be

_____and for PVC shall be .

70. _____ the bending radius shall not be less than_____ or the minimum coil radius for Polyethylene plastic pipe.
71. If the cut-off valve is locate outside the building, it must be within _____feet of the foundation wall.

72. A shutoff valve is required on every fixture in a residence. True or false?
73. A water tank being supplied with 350 gpm requires a minimum overflow pipe of _____ inches.
74. Vacuum breakers for hose connections in health care areas shall not be less than _____feet off the floor.
75. A pressure vacuum breaker will prevent backsiphonage and backpressure. True or false?
76. In buildings where potable and nonpotable water systems exist, each system's piping must be labeled, colored and identified every _____feet.
77. Which of the following does not require backflow protection? Garden hose connection water heater drain boiler supply line beverage dispenser
78. In a health care facility, vacuum breakers shall be installed ____ inches above the flood level of the fixture

Chapter 7 Sanitary Drainage

79. Waste water when discharged into the building drainage system shall not be at a temperature higher than _____ degree F.
80. In lieu of using an approved continuous supporting system, cast iron pipes may be used for building sewers in unstable ground. True or false?
81. Which of the following joints may not be used above ground unless otherwise approved?Mechanical joints solvent cemented joints brazed joints
82. Joints between copper and galvanized steel pipe shall be made with a_____ _____ fitting or _____ fitting.
83. Saddle-type fittings are allowed in a drainage system. True or false?
84. Cleanouts inside a building must be installed at every fourth 45-degree bend, but no more than _____ feet apart.
85. All sanitary piping in a crawl space must have a cleanout extended to the outside. True or false?
86. 8" and larger sewers must have manholes installed at each change in direction and no more than _____ feet apart.
87. The minimum size cleanout for a six-inch pipe is .
88. The minimum clearance for a six-inch pipe is_____ .
89. A fixture with a continuous flow of 4 gpm is equal to_____ fixture units
90. The minimum size sump pit is _____ inches diameter and_____ inches deep.

Chapter 8 Vents

91. An air conditioner condensate line may drain into a plumbing vent. True or false?
92. Every building must have at least one stack venting to the outside, which is not less than 1/2 the size of the building drain but not less than _____ inches.
93. A vent stack is required in all buildings. True or false?

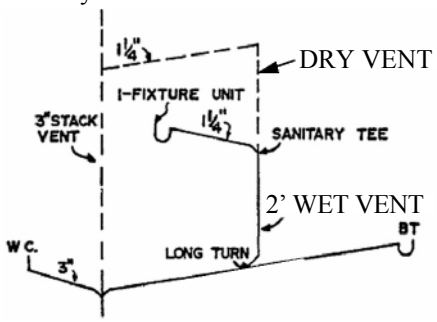
94. A vent stack is required for every drainage stack that is _____intervals or more.

95. The terminal of a vent must not be located directly below a door, openable window or air intake, nor within 10 horizontally, but may be located at least ____ feet above these openings.

A dry vent is a vent that is designed such that drainage will not enter the piping. It will always be clear as it's used only for venting. A wet vent may accept drainage and act as a vent. A bathtub, near a lavatory as illustrated below, may use the lavatory drain as a section of its vent

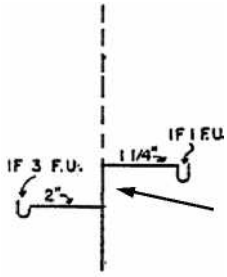
96. Every dry vent shall rise vertically to a minimum of_____ inches above the flood level rim of the fixture being vented.

97. When a water closet and lavatory share a common vent but are connected at different levels, the



lavatory shall be connected below the water closet. True or false?

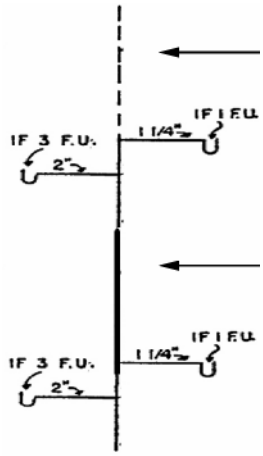
98.



The minimum size for this common vent is inches

99. A wet vent serving 5 dfu must be at least _____ inches in diameter.

100. Below is an example of a waste stack and waste stack vent (Section 910). Enter the requested sizes.

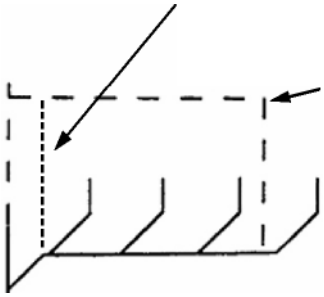


Waste stack vent size is _____

Waste stack size is _____

101. Size the circuit vent below.

Relief vent required for four or more water closets.



circuit vent

Each water closet is 4 fu

The minimum size drain pipe is_____ .

102. The vertical distance between a fixture drain outlet and the trap weir of a combination fixture must not me greater than _____inches.

103. A yoke vent must be used to vent horizontal offsets of drainage stacks when there are_____ or more branch intervals above the offset.

104. A stack vent with a total developed length of 40 feet is connected to a 3" waste stack serving 25 dfu. The minimum diameter of the stack vent shall be _____ inches

105. A branch vent, 50 feet in developed length, serving a 3" drain must be_____ inches diameter.

106. Air admittance valve shall be located a minimum of _____inches above insulation material.

Chapter 10

Traps, Interceptors and Separators

1 07.The maximum height of a washing machine standpipe measured from the trap weir is _____ inches

108.Generally, _____ inches is the maximum vertical distance allowable between a fixture drain outlet and the trap weir.

109.A single trap may be used on a three-compartment sink with drain openings 28 inches apart. True or false?

1 10.A grease trap may be used as a trap. True or false?

111 .The maximum depth a trap seal shall be ____ inches unless special circumstances dictate otherwise.

112.If necessary, a trap may be larger than the drain it connects to. True or false?

Appendix C
Gray water recycling systems

113 .Waste from a kitchen sink may discharge into a gray water recycling system. True or false?

1 14.A gray water reservoir, expected to receive 50 gallons per day shall have a minimum size of _____if the retention time is 2 days.

Appendix J
Rodent proofing

115. Foundation wall ventilators shall not have openings exceeding
inch.

ANSWER PAGE

1. 8
2. combination
3. fixture drain
4. .2
5. grease trap
6. 8
7. air break
8. false
9. 5
10. true
11. 2
12. 110
13. conductor
14. false
15. false
16. 1/2"- 304.2
17. 6.5- 305.6
18. 3- 305.6.1
19. 3- 306.2.2
20. false- 307.2.3 21.4--

-Table 308.5

22. false- 310.4, see exceptions
23. 2 toilets and 2 urinals- 311.1, one of each for each 40 workers
24. 3- 312.2 see exception
25. True- 312.5, **plastic pipe** must be tested with **water. All other material** may be tested with **either water or air.**
26. 10- 312.8
27. false- 401.2
28. false 403.2.2
29. 300,000 sq. ft.- 403.2.3
30. 1- Table 403.1 says, 76-125 males require 4 water closets, urinal column says, we may substitute urinals for water closets but 2/3 (67%) of the required water closets must remain.

    2= .666 (rounded off= 67%)
    3

    .67 x 4 water closets = 2.68 water closets must remain(round up to 3)

    4 water closets – 3 water closets = 1 water closet may be substituted

31. 630- footnote 15, Table 403.1 says, net area to be 70% of gross area and fidure 1 occupant per 100 feet of *net* area.

    90,000 sq.ft. gross area x .70 = 63,000 sq.ft. net area

    63,000 = 630 people
    100

32. 252- footnote 15, Table 403.1 says, 40% of occupants are female. 630 people x .40 = 252

33. 8- Footnote 8, Table 403.1 says, 18 inches of circular basin equals one lavatory. 12 ft. x 12 in. = 144 in. circumference

144 in. = 8 lavatories
---
18 in

34. false- footnote 16, Table 403.1
35. 10- footnote 7, Table 403.1
36. 15- footnote 25, Table 403.1
37. 33- 403.3.1
38. 79- 403.3.1.3, 1.75 teachers and stall per class room
1.75 x 45 rooms = 78.75 T+S (round up to 79)

39. false- 403.3.2.5 only true for grades 9-12
40. 42- Table 403.4 says, 35% of occupants in lounge are female .35 x 120 = 42 females

41. 21- 405.3.1
42. .25-405.4.1
43. false- 405.8
44. 2-412.3
45. false- 413.3
46. .25- 417.3
47. 70- 417.4.1
48. .040 inch thick, turn up 2 inches- 417.5.5 + 417.5.2.1
49. lavatory 1.25"- 416.3 Sink 1.5"- 418.1
50. 120 degrees- 424.4
51. 1- 425.4.1
52. 140–501.2
53. source of ignition- 502.2
54. true- 502.5
55. 210 degrees- 504.5
56. false- 504.7
57. 1- 504.7.1
58. 3/4"- 603.1
59. true- 603.2 exception 2
60. 2.5- Table 604.4 (Table 604.3 is used to size *pipe* to fixtures)
61. 30- 604.5
62. 80- 604.8
63. 1- Table 604.10.1
64. 8- 605.3
65. 160- 605.4, and 100- 605.5
66. underground systems- 605.10.1

67. false –605.10.3
68. .2%- 60514.3 or definition chapter
69. orange- 605.15.2
70. 30 pipe diameters- 605.20.4
71. 5- 606.1 paragraph 2
72. false- 606.2 paragraph 1
73. 4- Table 605.5.4
74. 6- 608.3.1
75. false- backsiphonage only, Table 608.1
76. 25- 608.8.1
77. water heater drain- 608.15.4.2, exception 1
78. 6- 609.4
79. 140- 701.7
80. true 703.2
81. mechanical joints- 705.2.1
82. brass converter or dielectric- 705.16.2
83. false- 707.1
84. 100- 708.3.2
85. false- 708.4, only if crawl space is less than 24" high
86. 400-708.3.2
87. 4- 708.7
88. 18- 708.8
89. 8–709.3 says, 1 gpm of continuous flow is equal to 2 fixture units
90. 18" diameter, 24" deep-712.3.2
91. false- 901.4
92. 2-903.1
93. false- 903.2 only required if there are five branch intervals or more
94. 5- 903.2
95. 2- 904.5
96. 6 905.4
97. false- 908.3
98. 2- Table 908.3
99. 2 1/2"- Table 909.3

100. waste stack vent 1 1/2", waste stack 3" (Any waste stack with water closet must be at least 3", vent must be at least 1/2 diameter of waste stack. If the stack vent is the main stack vent and extends to out doors it must be minimum 2")

101. circuit vent is 2" (1/2 drain), drain is 4" (Table 710.1(2) footnote d)
102. 24"- 912.4.3
103. 5- 915.1 + 915.3
104. 2"- Table 916.1
105. 2"- 916.2 says vent to be 1/2 size of drain unless over 40 feet, then add one pipe size.
106. 6"- 917.4
107. 30- 802.4 (1001.1 directs reader to 802.4)

108. 24”- 1001.1
109. true- 1002.1, exception 2
110. true- 1002.1 exception 3, if designed to be used as a trap
111. 4-1002.4
112. false- 1002.5
113. false-C101.1
114. 200- C101.4 (2 x 50 gallonsx2 days =200)
115. 1/4” H101.2 Appendix J

INTERNATIONAL FUEL GAS CODE

Confined and unconfined spaces (Definitions)
In the Definition chapter, look up confined and unconfined space.

According to the definition is a room measuring 10' x 10' x 8'high with two 60,000 BTU}I furnaces confined or unconfined?

Answer: confined, less than 50 cu. ft. per 1000 BTU}I

The volume of the room is 800 cu.ft. (10' x 10' x 8' = 800 cu.ft.). The total capacity of the furnaces is 120,000 BTU}I (60,000 + 60,000 = 120,000). The definition says "per 1000 BTU}I", therefore we must divide 120,000 by 1000.

$$\frac{120{,}000}{1000} = 120$$

$$\frac{800 \text{ cu.ft.}}{120} = 6.66 \text{ cu.ft. per 1000 btuh}$$

Combustion Air (section 304)
Using the two opening method, how many sq. inches must each duct be if outside air is horizontally introduced into a confined space containing a 140,000 Btuh furnace?

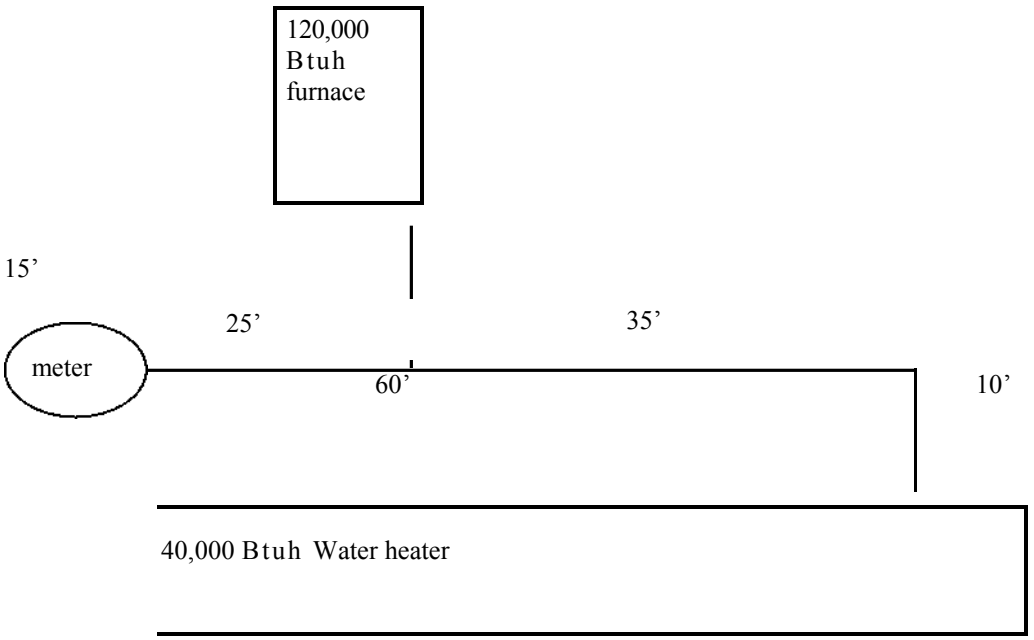
Answer: 70 sq, inches

$$\frac{140{,}000 \text{ btuh}}{2000 \text{ sq.in. per btuh}} = 70$$

Gas Pipe Sizing
Appendix A gives an example for gas pipe sizing. Simply measure the distance between the meter and the farthest appliance, let's call this the **distance factor** then use this distance factor to size each **run** off the main line. Each time part of the load is dropped off the **main line** resize the line using the remaining load and same distance factor.

The toughest part is making sure you use the correct sizing table. Pay attention to specifics. Is the gas pressure .5 psi, 2lbs.psi, or 5 lbs. psi.? Is the pipe copper, or stainless steel?

For the example below we will use Table 402.3(1)



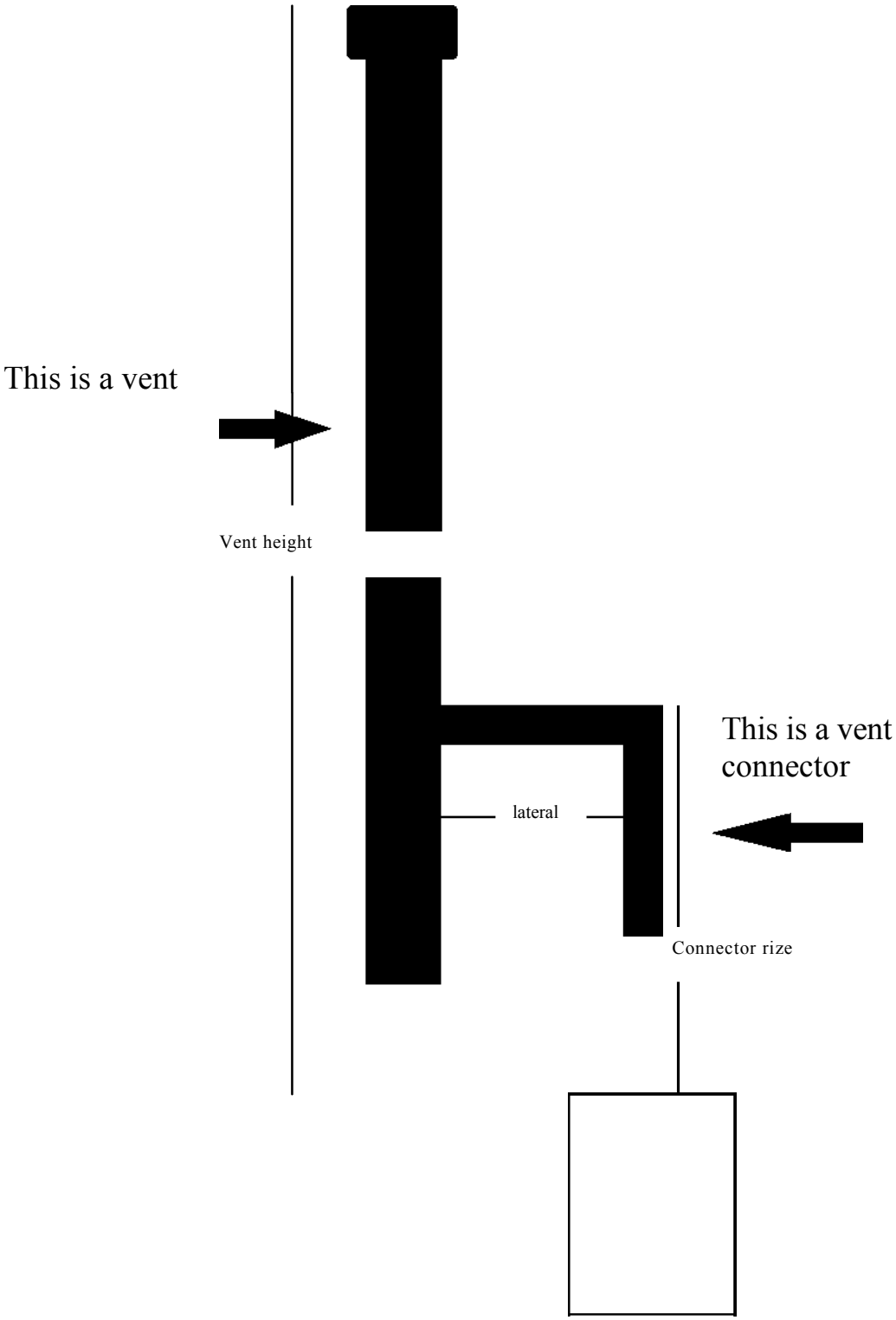
The distance from the meter to the farthest appliance is 70'(distance factor). Looking at Table 402.3(1) go to the 70 foot column (you will size all pipe using this column). The number 11 directly under 70 means 11,000 BTU (approx. 1000 BTU / cu. ft. nat. gas). To get pipe size slide your finger down until you find a pipe size large enough to handle the load.

Size runs first- The water heater will be Y2".
The furnace will be 1"
Now size the main line-
Up to the furnace the main line must carry 160,000 BTUH (120,000 + 40,000 = 160,000). It will be 1"
After the furnace run the main only has to carry 40,000 Btuh. It will be Y2"

Size L-P gas piping the same way once you've passed the second stage regulator.
To size between the first stage regulator (at the tank) and the second stage regulator (at the house), use the distance between regulators as the distance factor and size according to total connected load. **Be sure to read and use the correct sizing Tables.**

Venting (section 503)
Look at **paragraph** 503.5.4 and **figure** 503.5.4. This requirement is for chimneys and single wall vents.

Look at figure 503.6.6. This requirement is for UL listed B and BW vents


This is a vent
Vent height
This is a vent connector
lateral
Connector rize

Single appliance -Table 504.2(2)

Sizing vents

What size vent is needed for a 160,000 BTU}I naturally ventilated appliance if the total vent height is 18' and the lateral 2'?

Answer: 6"
Under the height column you have to choose either 15' or 20'. **Remember this,** the taller the vent the more capacity it has, therefore, if the 20' row is used the vent may be under sized. **Always use the shorter height.** In this case use 15'. Now use the 2' lateral and select a vent size under NAT. A 5" vent will handle only1 49,000 BTU}I while a 6" vent will handle 224,000 BTU}I, therefore select a 6" vent.

Venting two or more appliances with a single vent –Table 504.3(1)

When connecting two or more appliances to a common vent, the smaller appliance should be connected above the larger appliance

This Table has two parts, the top section is for sizing **connectors,** and the lower section is for sizing the **vent.**

First, size the connector of each appliance using vent height and connector rise.
Second, size the vent using the total vent height and the total BTU}I of all appliances connected to it. The same rule as above applies to height; always select the shorted height on the chart.

Example:

A standard 40,000 btuh water heater with a connector rise of 3 feet and a 120,000 btuh fan assisted furnace with a 1 foot connector rise are connected to a 22 foot common vent. Size the vent system.

Solution

Using the upper section of the chart size the **vent connectors** of each appliance.

Water heater

Since the vent height is 22 ft. use 20 on chart. Locate 3 feet under the connector rise column and slide to the right until you find at least 40 under a NAT column. At the top, it indicates a 3" **connector** will handle 42,000 btuh.

Furnace

Again, at the 20 foot vent height row, choose 1 foot in the connector rise column. Slide to the right until you find at least 120 under the FAN/MAX column. At the top it indicates a 5" **connector** will handle 157,000 btuh.

To size the **common vent.**

Go to the lower section of the chart. Since one appliance is naturally vented and the other is fan assisted we will locate the 20 foot row and slide to the right until we reach 160,000 btuh (total of both appliances)

under FAN+NAT. A 5" common vent will work, as it will handle up to 183,000 btuh.

Be sure to read and apply to vent sizing Paragraphs 504.2.2 and 504.2.3.

GAS CODE QUESTIONS

1. THE DISTANCE FROM A METER TO A NATURAL GAS WATER HEATER (40,000 BTUH) IS30 FEET, 20 FEET FURTHER DOWN THE LINE ISA FURNACE (120,000BTUH). WHAT IS THE MINIMUM PIPE SIZE THAT MUST BE USED BETWEEN THE WATER HEATER AND FURNACE? (PRESSURE DROP =.05)
   - A. 3/8"
   - B. 1/2"
   - C. 3/4"
2. TWO NATURALLY VENTILATING APPLIANCES WITH A COMBINED CAPACITY OF 128,000 BTUH ARE CONNECTED TO A COMMON B-VENT 18' HIGH WITH TWO 90 DEGREE ELBOWS. WHAT SIZE COMMON VENT SHOULD BE USED?
   - A. 4"
   - B. 5"
   - C. 6"
   - D. 7"
   - E. 1"
3. THE MAXIMUM ALLOWABLE HOIZONTAL LENGTH OF A CATEGORY I APPLIANCE VENT CONNECTOR IS _____ FEET FOR EACH INCH OF IT'S DIAMETER.
   - A. 1/2
   - B. 1
   - C. 1.5
   - D. 2

4. THE MAXIMUM HORIZONTAL LENGTH OF A SINGLE WALL METAL CONNECTOR IS _____ % OF THE HIEGHT OF THE CHIMNEY OR VENT.
   - A. 50
   - B. 75
   - C. 100
   - D. 150
5. IN ORDER TO SUPPLY OUTDOOR COMBUSTION AIR USING THE TWO OPENING METHOD WITH HORIZONTAL DUCTS, WHAT SIZE WOULD EACH DUCT BE TO HANDLE A 140,000 BTUH FURNACE?
   - A. 7"X10"
   - B. 3.5"X10"
   - C. 14"X10"
   - D. 8.5"X10"

6. GAS APPLIANCE CONNECTORS SHALL NOT PASS THROUGH ANY OF THE FOLLOWING EXCEPT:
   - A. WALLS
   - B. APPLIANCE HOUSINGS
   - C. FACTORY BUILT FIREPLACE INSERTS
   - D. FLOORS

ANSWERS

1. C- Fuel Gas Code. Table 402.3 (2). The farthest appliance from the meter is 50 Ft. (30 Ft. + 20 Ft.= 50 Ft.). Use column labeled 50. The section between water heater and furnace has to carry 120,000 BTUH (The water heater load has been dropped off). Go down the column until you find 120 (120,000) or greater. You should see 138 (138,000). To the right is 3/4"

2. C- In appendix B, look at figure B-12. It shows two appliances connected to a common vent with one offset (two 90 degree bends). Now turn to section **504.3.5, Common vertical vent offset.** This paragraph says to reduce the capacities listed in the tables by 20 %. The lower section of Table 504.3 (1), **common vent capacity,** is the table we'll use to size the common vent. First, we have to determine which height to use, 15 ft. or 20 ft. As stated earlier, if the height of a vent falls between two choices, use the lower choice (15 ft.). To the right of 15 ft., look under each NAT + NAT column until you see 128 (128,000) or greater. The chart indicates a 5" vent will handle 144,000 btus, however, because of the offset, we must reduce this figure to 115, therefore a 6" vent must be chosen.

   Note: Be sure to consult all paragraphs under **Section 504, SIZING OF CATEGORY 1 APPLIANCE VENTING SYSTEMS** before making a final determination of vent sizes.

3. C- Fuel Gas Code, 503.10.9
4. B-Fuel Gas Code, 504.3.2

5. A- Fuel Gas Code, 304.11.1

   Calls for 1 sq. inch per 2000 BTUH for *each* duct $\frac{140{,}000}{2000}$ = 70 sq. inches

   10" x 7" duct = 70 sq. inches

6. C-Fuel Gas Code, 411.1.2

CONTRACTING BUSINESS

Joey's Story

Profit

While Joey was walking down the street he found a yo-yo. On the following corner a friend saw it and purchased it from Joey for $1.25. Joey was delighted, as he had just made 100% profit. His cost was $0, his sale was $1.25, therefore, *all* the money (100%) he received was profit.

Joey thought he stumbled on a great money making idea; if he could only get a hold of more yo-yos he might get rich. So he went to yard sales and bought up all the yo-yos he could find for 60 cents each. Again he sold them for $1.25 each. This time he made only 65 cents per yo-yo or 52% profit.

sales price	$1.25
cost	- .60
profit	**$ .65**

Joey's percent of profit is calculated below:

$$\textbf{Percent of profit} = \frac{\textbf{\$ Profit}}{\textbf{Sales price}} = \frac{\$.65}{\$1.25} = \textbf{.52 or 52\%}$$

Note: Joey cannot make any more than 100% profit. In the business world there is no such thing as 150%, 1000% or any other wild percentage above 100.

Joey was on to something big. He thought if he would manufacture his own yo-yos. His material cost would be $1.50, but since they would be new yo-yos he'd get $4.00 each. Therefore his profit would be $2.50 each, increasing his percentage of profit to 63%.

$$\textbf{Percent of profit} = \frac{\textbf{\$ Profit}}{\textbf{Sales price}} = \frac{\$2.50}{\$4.00} = \textbf{.63 or 63\%}$$

Well, Joey went into the yo-yo manufacturing business. He rented a building, bought a delivery truck, got a telephone, had the lights turned on and purchased a wood lathe. He hired a secretary to send out sales letters, keep the books and answer the telephone. Soon he was overwhelmed with orders and had to hire part-time labor to help make yo-yos. At the end of his first year he had sold 10,000 yo-yos @ $4.00 each and his profit and loss statement **(Income Statement)** looked like this:

Joey's Yo-Yo Company
Income Statement

Revenue (sales)- $4.00 x 10,000	$40,000	
Direct costs		
Material- $1.50 x 10,000		$15,000
Labor		5,000
Total direct cost		$20,000
Gross profit (sales – direct cost)		$20,000
Overhead		
Secretary salary		5,000
Rent		3,600
Telephone		1,200
Depreciation-lathe		1,500
Depreciation- truck		3,000
Office supplies (stamps, envelopes, etc)		600
Total overhead		$14,900
Total costs and overhead		$34,900
Net income (net profit)		
Revenue – direct cost – overhead		$ 5,100

Joey studied his income statement to find ways to increase income. He calculated the **direct costs** to be **50% of sales**

$$\frac{\$20,000}{\$40,000} = .50$$

Direct costs are those costs directly associated with producing the product you are selling. In Joey's case, his cost of material and labor increase or decrease depending on his sales volume, therefore material and labor are direct costs.

His **gross profit** is **50% of sales.**

$$\frac{\$20,000}{\$40,000} = .50$$

His **overhead** was **37.25% of sales.**

$$\frac{\$14,900}{\$40,000} = .3725$$

Overhead costs are costs or expenses that are incurred whether or not Joey does any business. He has to pay for insurance, secretary, phone bill, rent, etc, even if there are no orders for yo-yos.

His **total costs and overhead expenses** were **87.25% of sales**

$$\frac{\$34,900}{\$40,000} = .87.25$$

And his **net profit** was **12.75% of sales.**

$$\frac{\$5100}{\$40,000} = .1275$$

How can Joey increase profit?

When he looked at sales he had two choices to increase profit; (1) raise the price of the yo-yo or (2) sell more yo-yos at the same price.

Looking at direct cost, he had no choice because these costs increase or decrease directly as the sales volume fluctuates. Direct costs will always remain 50% of sales.

Overhead is relatively constant. He stands a good chance of increasing sales without increasing overhead or possibly increasing profit by cutting overhead. But reducing overhead expenses is tough, as overhead expenses occur whether or not he sells anything.

Lets see what happens if Joey decides he wants to increase his income by raising prices 10%. He would use the following method:

(1) *Gross* profit = 50% (37.25% overhead + 12.75% *net* profit)
(2) New sales with 10% increase = $44,000 (110% x $40,000)
(3) New gross profit = $22,000 (.50 x $44,000)
(4) Since overhead remains constant at $14,900, the new *net* profit is:
$22,000 - $14,900 = $7100
Joey's income increased by $2000 or 39%
$2000! $5100 = .39
On the income statement
His new net profit would be 16.1% of sales
$7100! $44,000 = .161
His overhead would be reduced to 3 3.9%
$14,900 ! $44,000 = .339

Another question Joey might ask himself is, "What would my sales have to be if I wanted to make $60,000 **gross profit** (gross profit does not include overhead) to cover both overhead and profit?

If Joey's gross profit is traditionally running 50% (12.75% + 37.25%) of sales, as his income statement indicates, then he would use the following formula:

$$\text{Sales} = \frac{\text{\$ gross profit desired}}{\text{\% traditional gross profit}}$$

$$= \frac{\$60{,}000}{.50}$$

$$= \$120{,}000$$

Up to this point, Joey was keeping his books on a notebook he kept beneath the trash on the floorboard of his truck. He was beginning to accumulate a lot of customers who owed him money (account receivables) and he had a lot of suppliers whom, he owed money (accounts payable). It was becoming difficult to keep up with these accounts, so he Sally, a bookkeeper (more overhead). As **daily** orders and bills came in Sally would enter the amounts in a **general journal** or day sheet. When she had time, perhaps once a week, she would transfer the information in the journal to **ledgers.** The ledgers were books containing a page for each account that he did business with. If the account were a customer she would enter the **amount owed to Joey** in the debt column of the **accounts receivable** ledger. When the customer paid, she would enter the amount paid in the credit column. If the account were a supplier, she would enter the **amount Joey owes** in the credit column of the **accounts payable ledger.** When Joey paid the bill, she would enter the amount paid in the debt column. Each ledger had a third column in which a balance was kept. At the end of the month she would send a statement with the balance to each customer and a check for the balance to each supplier.

To keep up with each employees compensation, taxes, profit sharing, etc she would keep a **payroll ledger.**

In order to keep up with the money she would keep a **cash receipts and disbursement ledger.** Whenever the company received money, she would debt cash in the ledger and whenever the company paid out money, for any reason, she would credit cash in the journal. It was like keeping a checkbook.

At the end of the month, Sally would prepare a **balance sheet** to let Joey know how much he owned (**assets),** how much he owed (**liabilities)** and how much he was worth (**equity).** In addition, she prepared an income statement to let Joey know where his money was going and if he was making a profit. The **income statement** included his total sales (**revenue),** labor and material costs (**direct costs),** overhead (**general and administrative expenses)** and his net profit (income).

Now that Joey has all these financial tools, he can use them to plan his business strategy.

If he wants to make $75,000 and he knows his net profit is running about 12.75% then he would have to increase sales to $588,235

$$\text{Sales} = \frac{\text{Net income}}{\text{Net profit \%}}$$

$$= \frac{\$75{,}000}{.1275}$$

$$= \$588{,}235$$

END OF JOEY'S STORY

Now that you know Joey's story, lets look at the contracting business.

***How to price a job.**

Suppose you purchase a gas water heater for $350 and it costs $150 for venting and piping plus $140 labor and $35 for a permit. If your company overhead is 15% what will the sales price of the job be if you want to make 20% net profit.

First, you need to calculate the cost of the job.

Water heater	$350
Venting and piping	$150
Labor	$140
Permit	$ 35
Total job cost	**$675**

Second, you must calculate a price that will include your: cost + overhead + profit. We know the cost is $675 and we know the overhead and profit will be 35% (15%+ 20%) of the sales price.

To calculate sales price:

1. Subtract your overhead and profit from 100%.
   1.00-.15-.20=.65or65%
2. Divide the cost by the above answer.
   $675 / .65 = **$1038.46 sales price**

Note: Most students would add 35% to the cost or multiply the cost by 135% and come up with $911.25. <u>This is not correct.</u>

***What if?**

If you were working on a net profit of 15%, what would your annual sales have to be to make $75,000?

Solution

$$\text{sales} = \frac{\text{Target profit amount}}{\text{Profit \%}}$$

$$= \frac{\$75{,}000}{.15}$$

$$= \mathbf{\$500{,}000}$$

If you increase your % **net profit** to 25%, what would your sales have to be?

$$\frac{\$75{,}000}{.25} = \mathbf{\$300{,}000}$$

Moral: The above contractor increases his prices by 10% and only has to do 60% of the work he used to do.

*** Similar problems will likely be on the test**

INCOME STATEMENT

An income statement is an orderly accounting of where the revenue came from, what were the expenses and what is the gross and net profit or loss. The figures entered in the statement may based on an **accrual** or **cash basis.** An accrual basis means your accounting system uses income and expenses that are expected to be received or incurred, while a cash basis uses income and expenses that have actually occurred. If Joey sells $1000 worth of yo-yos on credit, on an *accrual basis* he will show $1000 as income, on a *cash basis* he will show no income, as he has not received the funds yet. Once you select a basis for your accounting method you must continue using it. You cannot switch back and forth from year to year. Below are items found on an income statement.

Revenues
Revenues are the same as *sales* of the product your company is primarily involve in. If you sell an air conditioner, the money received is revenue (sales). If you sell a surplus truck, which is not your primary business, then the money received is considers a *gain (or loss) on sale of asset.* See under Other Income/Expenses.

Direct Costs
Any money you spend (usually labor and material) to complete a particular job is considered *direct costs.* Job A might require $2600 (direct costs) in labor and material, while Job B requires $4800 (direct costs) in labor and material.

Project Overhead
Project overhead is money spent just to do the job but does not contribute to its completion. Examples would be superintendent's salary, vehicles used for the job, special insurance, repairs on job equipment or office trailer rent.

Cost of construction
The total of **direct costs and project overhead** is called **cost of construction.** In accounting terms it is sometimes called *cost of goods sold.*

Gross profit
Gross profit is revenue (sales) minus cost of construction (cost of goods sold). On the income statement, the revenue is $1,077,760. If you deduct the cost of construction (which includes direct cost and job overhead), of $842,460 from the revenue we would have $235,300 gross profit.

If you purchase an air conditioner for $600 and pay $150 labor to install it, the total cost of construction would be $750. If you sell it for $1400, your gross profit would be $650.

General and administrative expenses
Also called company **overhead,** general and administrative expenses are any monies spent to keep the doors open and bring in business, whether you do any business of not. Your salary, the office salary, stamps, insurance, telephone, rent and advertising are examples.

Depreciation – Most expenses are cut and dry. If you spend $160 on utilities then the expense is $160. Depreciation, on the other hand, must be calculated. Page 8-16 shows two common methods used to calculate depreciation, the **straight line** and the **accelerated depreciation** method. What the illustration is demonstrating is two ways to figure depreciation if you purchase a backhoe in July for $19,500. Under the **straight line method,** $5000 was estimated to be the salvage value (what you think you can sell it for at the end of five years), therefore $14,500 is to be depreciated evenly though out a five-year period. Each of the five years you may deduct $2900. Since you purchased the backhoe in July and your *fiscal year* ends in December, you are only entitled to six months depreciation the first year, which is Y2 year or $1450. The fifth year of ownership will fall on July so you will also get Y2 of that year's depreciation ($1450).

The second column illustrates the accelerated tax method. The IRS has a formula dictating the yearly percentage you may use for depreciation $3900 represents 20% of $19,500 for the first year, $6240 represents 32% for the second year and so on, until the backhoe is fully depreciated and it's salvage value is $0. There is no salvage value.

What happens if the backhoe is sold after six years for $3500? If, you used the straight line method you will have to show $1500 as a *loss on sale of assets* under other income/expenses on your income statement, because the books are showing it is worth $5000. If you used the accelerated depreciation method $3500 would show up as a *gain in sale of assets,* because the books are showing it to be worth $0

Net income
This is the profit made after every conceivable expense has been deducted from revenue. A corporation (except S type) will also deduct taxes as an expense. Proprietorships, S type corporations and partnerships do not deduct taxes on their income statements. Taxes on these type organizations are paid as ordinary income taxes.
Using the example above where you made $650 gross profit on the air conditioner, your net income or net profit would be what is left after deducting your overhead (gas, cost of invoice, insurance, truck depreciation, etc.)

Financial ratios
Many exams will ask you to calculate financial ratios. Usually study guides are provided by each individual state and contain numerous financial formulas.

Test questions may give you more information than you need but will be specific in what is being asked.

Example: Acme Heating has annual revenue of $875,000. Its total debt is $125,000 and its equity is $145,000. What is the Debt/Equity Ratio?

Solution: Looking at one popular business guide, *Business and Project Management for Contractors,* you will see the formula for Debt/Equity Ratio. The formula only needs two figures, **total debt** and **equity.** The revenue figure ($875,000) is not needed.

$$\frac{\$125,000}{\$145,000} = .872 \text{ Debt/Equity}$$

Payroll taxes

Three federal tax items are withheld from employee's income.

1. Income tax from circular E chart.
2. Social security tax (employees share = 6.2%. (0% after $87,000earnings).
3. Medicare tax (1.45%)

Using the information and tax tables on the next page figure the net take home pay of a married employee with 3 allowances (dependents) making $483 weekly. **Be sure to take out all three items above.**

Solution: using the circular E table on the next page, go down the first two columns to find the employees' pay range 480-490. Slide your finger to left to column under 3 withholding allowances. You should see $19.

MARRIED Persons—WEEKLY Payroll Period

(For Wages Paid in 2003)

If the wages are—		And the number of withholding allowances claimed is—										
At least	But less than	0	1	2	3	4	5	6	7	8	9	10
		The amount of income tax to be withheld is—										
$0	$130	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
130	135	1	0	0	0	0	0	0	0	0	0	0
135	140	1	0	0	0	0	0	0	0	0	0	0
140	145	2	0	0	0	0	0	0	0	0	0	0
145	150	2	0	0	0	0	0	0	0	0	0	0
150	155	3	0	0	0	0	0	0	0	0	0	0
155	160	3	0	0	0	0	0	0	0	0	0	0
160	165	4	0	0	0	0	0	0	0	0	0	0
165	170	4	0	0	0	0	0	0	0	0	0	0
170	175	5	0	0	0	0	0	0	0	0	0	0
175	180	5	0	0	0	0	0	0	0	0	0	0
180	185	6	0	0	0	0	0	0	0	0	0	0
185	190	6	0	0	0	0	0	0	0	0	0	0
190	195	7	1	0	0	0	0	0	0	0	0	0
195	200	7	1	0	0	0	0	0	0	0	0	0
200	210	8	2	0	0	0	0	0	0	0	0	0
210	220	9	3	0	0	0	0	0	0	0	0	0
220	230	10	4	0	0	0	0	0	0	0	0	0
230	240	11	5	0	0	0	0	0	0	0	0	0
240	250	12	6	0	0	0	0	0	0	0	0	0
250	260	13	7	1	0	0	0	0	0	0	0	0
260	270	14	8	2	0	0	0	0	0	0	0	0
270	280	15	9	3	0	0	0	0	0	0	0	0
280	290	16	10	4	0	0	0	0	0	0	0	0
290	300	17	11	5	0	0	0	0	0	0	0	0
300	310	18	12	6	1	0	0	0	0	0	0	0
310	320	19	13	7	2	0	0	0	0	0	0	0
320	330	20	14	8	3	0	0	0	0	0	0	0
330	340	21	15	9	4	0	0	0	0	0	0	0
340	350	22	16	10	5	0	0	0	0	0	0	0
350	360	23	17	11	6	0	0	0	0	0	0	0
360	370	25	18	12	7	1	0	0	0	0	0	0
370	380	26	19	13	8	2	0	0	0	0	0	0
380	390	28	20	14	9	3	0	0	0	0	0	0
390	400	29	21	15	10	4	0	0	0	0	0	0
400	410	31	22	16	11	5	0	0	0	0	0	0
410	420	32	23	17	12	6	0	0	0	0	0	0
420	430	34	25	18	13	7	1	0	0	0	0	0
430	440	35	26	19	14	8	2	0	0	0	0	0
440	450	37	28	20	15	9	3	0	0	0	0	0
450	460	38	29	21	16	10	4	0	0	0	0	0
460	470	40	31	22	17	11	5	0	0	0	0	0
470	480	41	32	24	18	12	6	0	0	0	0	0
480	490	43	34	25	19	13	7	1	0	0	0	0
490	500	44	35	27	20	14	8	2	0	0	0	0
500	510	46	37	28	21	15	9	3	0	0	0	0
510	520	47	38	30	22	16	10	4	0	0	0	0
520	530	49	40	31	23	17	11	5	0	0	0	0
530	540	50	41	33	24	18	12	6	0	0	0	0
540	550	52	43	34	26	19	13	7	1	0	0	0

Base pay	$483.00
Fed income tax from table	-19.00
Social security ($483 x .062)	-29.94
Medicaretax($483x.0145)	- 7.00
Take home pay	$427.06

Business Q's

1. IF A CONTRACTOR WORKS ON 15% NET PROFIT, WHAT WILL HIS SALES HAVE TO BE TO MAKE $75,000?

a $500,000
b $112,500
c $862.500
d $600,000

2. A CONTRATORS PAYS $750.00 FOR A FURNACE PLUS 7% SALES TAX. WHAT WILL HIS SALES PRICE BE IF HE WISHES TO MAKE 30% GROSS PROFIT

a.$1 028
b.$1 043
c.$ 975
d.$1 146

answers

A- $\frac{\$75,000}{.15} = \$500,000$

D- $750.00 cost
+ 52.50 tax(.07x $750)
$802.50 total cost

$$\text{Profit} = \frac{\text{cost}}{1.00 - \text{markup}}$$

$$\frac{\$802.50}{1.00-.30}$$

$$\frac{802.50}{.70}$$

$1146.42

International Accessibility Code

The accessibility code is relatively cut and dry. Almost all answers to questions dealing with handicap or disability issues will be found in Chapters 1, 11,12,13,18, 28 30 or 39.

Chapter 1 lists all the occupancy groups required to be made usable by persons with disabilities. The other chapters deal with specifics. **Do not forget to use the index,** as it is very detailed.