Lesson 3: Pipe Types and Size Requirements

As discussed in Lesson 2, both plastic and copper pipe is available for plumbing. These two types of pipe come in several varieties and sizes. Installing plumbing involves not only choosing the best type of plumbing for a particular purpose, but also choosing the correct pipe size. The size of the pipe must be adequate to deliver the required amount of water at the proper pressure.

Pipe Types and Characteristics

Plastic pipe is the most popular plumbing material for agricultural structures. This type of pipe is durable and readily available in various forms and diameters that will meet practically any plumbing need. It is less expensive than copper pipe. Plastic pipe is also easier to work with and requires few specialized tools or skills. However, plastic pipe does have a few disadvantages. It is brittle and more easily broken at low temperatures. Also, plastic pipe is crushed more easily than harder metal pipes.

Five basic types of plastic pipe are available: Polyvinyl Chloride (PVC), Chlorinated Polyvinyl Chloride (CPVC), Acrylonitrile-Butadiene-Styrene (ABS), Polyethylene (PE), and Polybutylene (PB). Each type of plastic pipe has a unique chemical composition that affects its suitability for a given situation.

Polyvinyl Chloride - PVC is the common rigid white plastic pipe seen around construction sites. The pipe size most generally used is either 1 inch or ¾ inch in diameter; the pipe comes in lengths of 10 to 20 feet. It is used for cold water supply and waste disposal lines. This material is not recommended for hot water because of its chemical composition.

Chlorinated Polyvinyl Chloride - CPVC is similar to PVC pipe, but it is off-white or cream in color and is recommended for temperatures up to 180 degrees Fahrenheit. This pipe is most commonly found in ½- to ¾-inch diameters and 10 foot lengths. CPVC is a common choice for hot water lines. Although CPVC will work for cold water supply lines, it is seldom used for this purpose because it is more expensive than PC pipe and because using similarly colored pipe for hot and cold lines can become confusing when installing or repairing lines.

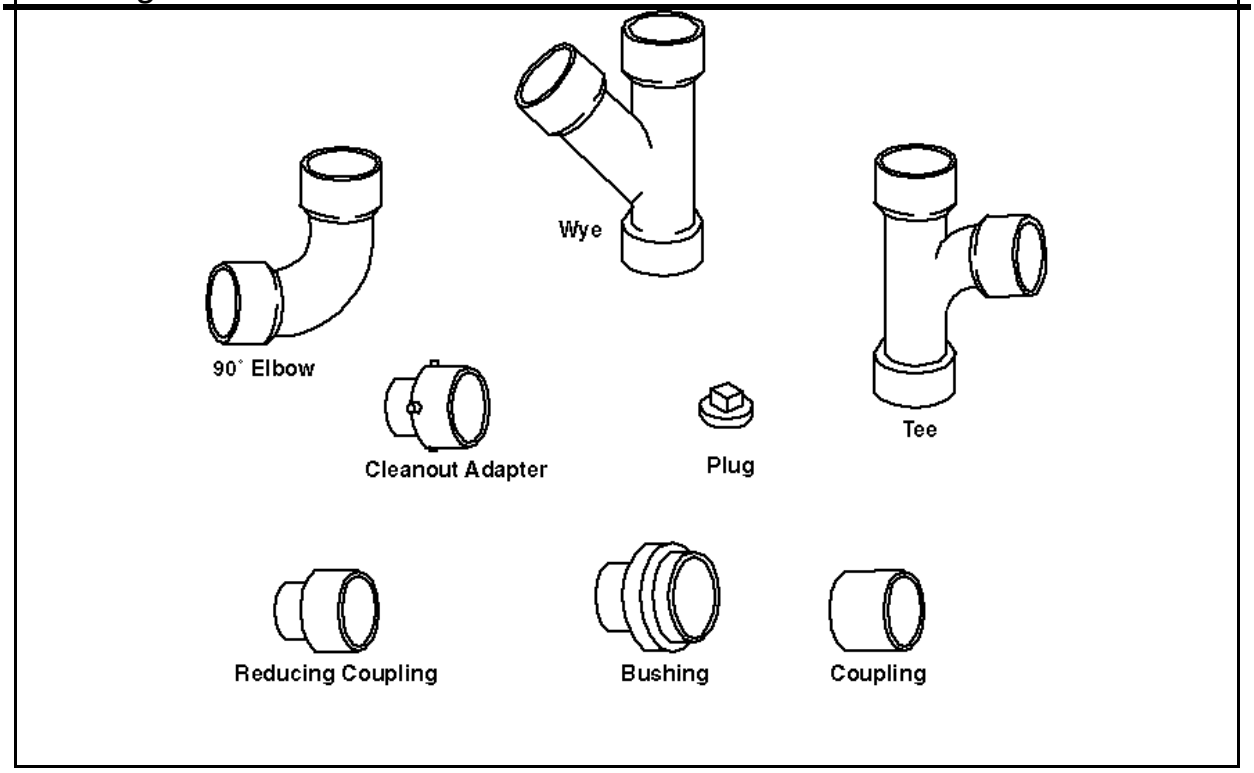
Acrylonitrile-Butadiene-Styrene - ABS is a hard black plastic pipe used mostly for drain and sewer lines. It is commonly available in sizes ranging from 1¼ inches to 6 inches in diameter and in lengths of 10 to 20 feet.

Polyethylene - PE is a flexible black plastic tubing that comes in coils from 100 to 300 feet in length. It is available in diameters of ¾ inch to 2 inches. Since it cannot withstand heat, PE is only useful for handling cold water. PE is primarily used for installing underground water service lines.

Polybutylene - PB is a flexible plastic pipe, usually gray in color, that is available for use with cold or hot water. It is most commonly _ inch or ¼ inch in diameter. PB has the advantage of being flexible enough to go around corners or objects without having to be cut and joined together with fittings. For this reason, it is useful in place of copper for fixtures such as sinks or toilets. Polybutylene pipes have been problematic, however; they have been prone to leaks, especially around fittings. Manufacturers are attempting to correct this problem with new types of connectors.

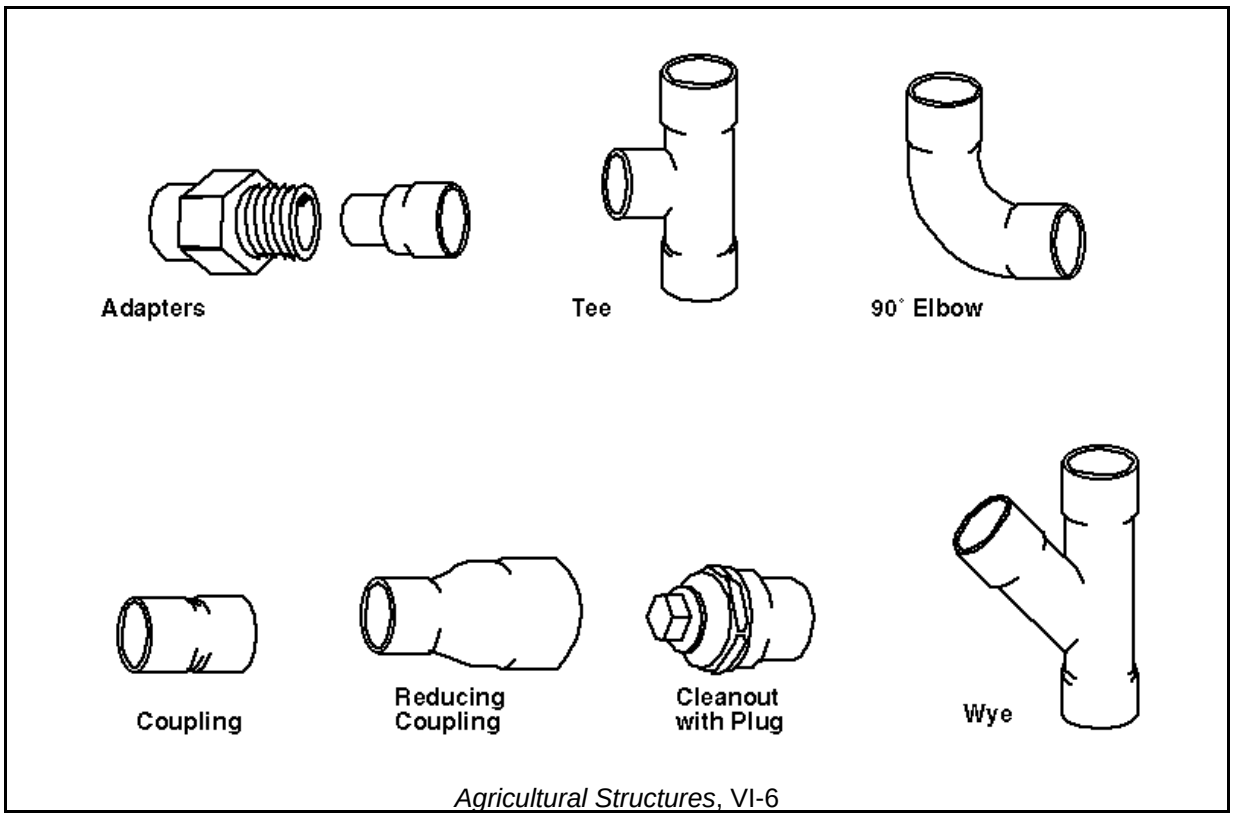
The other type of pipe most frequently used for plumbing is copper. Copper pipe is very durable. The pipe is not difficult to work with, but it does require more skill and specialized equipment to perform tasks like soldering joints and fittings. The main disadvantage of copper pipe is its cost; the pipe is more expensive than plastic pipe. Thicker pipe contains more copper and is more costly, although it is also more durable. The pipes are available in two forms, hard and soft copper; hard copper pipe is rigid, while soft tubing is flexible. Depending on the type of pipe, copper pipe is available in sizes of ¼ inch to 12 inches in diameter. Hard copper generally comes in 20-foot lengths, while soft copper comes in coils varying in lengths from 45 to 100 feet. Pipes come in four weights: K, L, M, and DWV.

K - This pipe has the thickest walls of the four types. It is available in hard and soft copper forms. For the purposes of identification, K is



color coded green. The pipe is used for underground supply lines.

L - This type of pipe is slightly thinner than K and is available in hard or soft forms. Its color code is blue. Type L must be used above ground; it is used for general interior work.



M - Type M is slightly thinner than L. It is available in hard form only and is color coded red. Common uses are for above ground interior water supply, waste, or drainage lines.

DWV- DWV is the thinnest of the four types of copper pipe and is available only in the hard form. It is color coded yellow. This type of pipe is used above ground for drainage, waste, or vent (allowing gases in a waste line to escape) pipes.

Pipe fittings join pipes together and allow them to branch, change direction, be reduced in size, or be capped. Fittings called elbows allow the pipe lines to make 45 or 90 degree turns. Couplings join two sections of pipe of the same size. Reducers connect pipes that differ by one size, such as a ½-inch pipe and a ¾-inch pipe. Bushings reduce the size of the opening in a large pipe into which a smaller pipe passes; in contrast to reducers, they allow a broader range of pipe sizes to be joined and can be used with larger pipe sizes. A tee is a branch fitting that makes a 90 degree turn; a wye makes a 45 degree turn. Cleanouts are fittings that allow entry into the pipe line in the event a clog occurs. End caps block off the end of a pipe. Figures 3.1 and 3.2 show different types of plastic and copper fittings.

Pipe Sizes

All types of copper and plastic pipe are referred to by their diameter. Standard pipe sizes are ½, ¾, 1, 1¼, 1½, 2, 2½, 3, 4, 5, 6, and 8 inches. Pipe sizes are measured to the nearest fraction of an inch. The measurement most often approximates the inside diameter (ID) of small pipes of less than six inches and the outside diameter (OD) on large pipes. Most pipes, especially plastic pipes, will have the size and either ID or OD clearly marked. If in doubt, the end of a section of pipe can be measured.

Pipe Size and Flow Rate

After choosing a particular type of pipe, the next step is determining the proper pipe size for a given use. The size of pipe can be affected by many factors. The distance the water travels from the source to the end point, the pressure the water is under, the slope the water must travel up or down, the resistance of the surface of the pipe, the number and sharpness of the bends in the pipe, the number of fittings, and expansion and contraction of the pipe due to temperature all affect the amount of water delivered in a given situation. Because of the complexity of these factors, overestimating pipe size and water delivery rates in order to avoid problems is common.

For complex construction projects where the pipes must be sized exactly to deliver the desired flow rate, two pieces of information are required, the desired flow rate in gallons per minute and the amount of resistance due to friction between the water and the surface of the pipe. The desired flow rate can be determined by adding the typical flow rates for different water outlets that will be operating at the same time. Once this number is obtained, a pipe size must be selected that will allow the desired flow rate while limiting losses in pressure due to friction to 5 pounds per square inch or less. Information on typical flow rates and friction losses for different sizes and types of pipe can be obtained from plumbing supply centers.

A less exact method is frequently used for less complex structures like homes and agricultural buildings. Pipe size tables like that shown in Table 3.1 on the following page can be obtained for different types of pipe. They are used to choose the correct pipe size given the pipe system length and the desired flow rate. When determining the pipe size needed, ten percent must be added to the measured length of the system to make up for losses due to fittings. For example, if the length of a system is 380 feet, the length to look at is 418 feet (380 + 38). For a system with this length and a flow rate of 5 gallons per minute, the correct pipe size is 1¼ inches.

Summary

Plastic and copper pipes are most commonly used in plumbing today. These materials are available in a variety of forms and sizes. The size of the pipes used in a plumbing system is determined by looking at the amount of water needed and the amount of friction between the water and the surface of the pipe.

Table 3.1 - PVC Pipe Size Table

	Flow Rate (Gallons Per Minute)						
Distance in Feet*	2	3	5	7.5	10	15	20
Up to 25	½	½	¾	¾	1	1	1
50	¾	¾	¾	1	1	1¼	1¼
75	¾	¾	1	1	1	1¼	1½
100	¾	¾	1	1	1	1¼	1½
150	¾	¾	1	1	1¼	1½	1½
200	¾	1	1	1¼	1½	1½	2
300	¾	1	1	1¼	1½	2	2
400	1	1	1¼	1½	1½	2	2
500	1	1	1¼	1½	2	2	2
600	1	1	1¼	1½	2	2	2
700	1	1¼	1¼	1½	2	2	2½
800	1	1¼	1½	1½	2	2	2½
900	1	1¼	1½	2	2	2½	2½
1,000	1	1¼	1½	2	2	2½	2½
1,500	1¼	1¼	1½	2	2	2½	2½
2,000	1¼	1½	2	2	2½	2½	3
3,000	1¼	1½	2	2	2½	3	3

Credits

Annis, William H. *Basic Plumbing Skills*. Athens, Ga: American Association for Vocational Instructional Materials (AAVIM), 1989.

McConnell, Charles. *Plumbers and Pipe Fitters Library.* Vol. 3, *Water Supply · Drainage · Calculations*. New York: Macmillan, 1989.

Phillips, Richard E. *Farm Buildings: From Planning to Completion*. St. Louis: Doane-Western, 1981.