UNIT VI - PLUMBING

Lesson 3: Pipe Types and Size Requirements

Competency/Objective: Identify pipe types and determine size requirements.

Study Questions

1. What are the types of pipes and the characteristics of each?

2. How are pipes sized?

3. How is the pipe size needed to deliver a desired flow rate determined?

References

1. *Agricultural Structures (Student Reference).* University of Missouri-Columbia: Instructional Materials Laboratory, 1999, Unit VI.

2. Transparency Masters

   a) TM 3.1: Plastic Pipe Fittings
   b) TM 3.2: Copper Pipe Fittings
   c) TM 3.3: PVC Pipe Size Table

3. Activity Sheets

   a) AS 3.1: Pipe Usage

UNIT VI - PLUMBING

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TEACHING PROCEDURES

B. ***Review***

Lesson 2 described safety practices for working with plumbing. They are important because all agricultural operations require some plumbing. A variety of pipe materials that are easy enough for non-professionals to install exist for use in plumbing systems. This lesson explores the basics of pipe types and sizes.

C. ***Motivation***

1. Collect and display samples of different types and sizes of pipe. Hardware stores or plumbers may have short sections of pipe available that they would be willing to donate.

2. Take a field trip to a local hardware store to observe the different types of pipe available. If possible, have a clerk discuss the different types of pipe.

D. ***Assignment***

E. ***Supervised Study***

F. ***Discussion***

1. Discuss the different types of pipe and their characteristics. Use the pipe samples from the motivation or pictures as examples. TMs 3.1 and 3.2 can be used to illustrate some common types of pipe fittings that will be used with these plastic and copper pipes. Hand out AS 3.1 to the class. Point out that as they investigate the types of pipe used, they may see galvanized metal pipe in older structures.

What are the types of pipe and the characteristics of each?

a) Plastic pipe
   1) Most popular plumbing material for agricultural structures
   2) Durable and readily available in various forms and diameters
   3) Less expensive than copper pipe
   4) Easier to work with; requires few specialized tools or skills
   5) Brittle and more easily broken at low temperatures
   6) Crushed more easily
   7) Five basic types
      (a) Polyvinyl Chloride (PVC)
         (1) Common rigid white plastic pipe seen around construction sites
         (2) Generally is either 1 inch or ¾ inch in diameter
         (3) Comes in lengths of 10 to 20 feet
         (4) Used for cold water supply and waste disposal lines
         (5) Not recommended for hot water because of its chemical composition
      (b) Chlorinated Polyvinyl Chloride (CPVC)
         (1) Off-white or cream in color
         (2) Recommended for temperatures up to 180 degrees Fahrenheit
         (3) Most commonly found in ½- to ¾-inch diameters and 10 foot lengths

(4) Common choice for hot water lines

(c) Acrylonitrile-Butadiene-Styrene (ABS)

(1) Hard black plastic pipe used mostly for drain and sewer lines

(2) Commonly available in sizes ranging from 1¼ inches to 6 inches in diameter and in lengths of 10 to 20 feet

(d) Polyethylene (PE)

(1) Flexible black plastic tubing

(2) Comes in coils from 100 to 300 foot in length

(3) Available in diameters of ¾ inch to 2 inches

(4) Cannot withstand heat and so is only useful for handling cold water

(5) Primarily used for installing underground water service lines

(e) Polybutylene (PB)

(1) Flexible plastic pipe, usually gray in color

(2) Uses with cold or hot water

(3) Most commonly _ inch or ¼ inch in diameter

(4) Flexible enough to go around corners or objects without having to be cut and joined

(5) Have been prone to leaks, especially around fittings

b) Copper pipe

1) Very durable

2) Not difficult to work with, but does require more skill and specialized equipment

3) More expensive than plastic pipe

4) Available in two forms, hard and soft copper

(a) Rigid hard copper pipe

(b) Flexible soft tubing

5) Available in sizes of ¼ inch to 12 inches in diameter

6) Generally comes in 20-foot lengths for hard copper and coils varying in lengths from 45 to 100 feet for soft copper

7) Four weights

(a) K

(1) Thickest walls of the four types

(2) Available in hard and soft copper forms

(3) Color coded green

(4) Used for underground supply lines

(b) L

(1) Slightly thinner than K

(2) Available in hard or soft forms

(3) Color coded blue

(4) Used above ground, for general interior work

(c) M

(1) Slightly thinner than L

(2) Available in hard form only

(3) Color coded red

(4) Commonly used for above ground interior water supply, waste, or drainage lines

(d) DWV

(1) Thinnest of the four types of copper pipe

(2) Available only in the hard form

(3) Color coded yellow

(4) Used above ground for drainage, waste, or vent pipes

2. Discuss pipe sizes with the class.

How are pipes sized?

a) All types of pipe are referred to by their diameter.
b) Standard pipe sizes are ½, ¾, 1, 1¼, 1½, 2, 2½, 3, 4, 5, 6, and 8 inches.
c) Pipe sizes are measured to the nearest fraction of an inch.
d) 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.

3. Ask students what factors concerning pipes might affect the flow rate. Discuss how to determine the proper pipe size. TM 3.3 can be used to demonstrate the use of pipe size tables.

How is the pipe size needed to deliver a desired flow rate determined?

a) For complex construction projects where the pipes must be sized exactly to deliver the desired flow rate
    1) Two pieces of information are required.
        (a) Desired flow rate in gallons per minute
        (b) Amount of resistance due to friction between the water and the surface of the pipe.
    2) Determine the desired flow rate by adding the typical flow rates for different water outlets that will be operating at the same time.
    3) Select a pipe size that will allow the desired flow rate while limiting losses in pressure due to friction to 5 pounds per square inch or less.
b) A less exact method for less complex structures like homes and agricultural buildings
    1) Use pipe size tables to choose the correct pipe size given the pipe system length and the desired flow rate.
    2) Add ten percent to the measured length of the system to make up for losses due to fittings when using the table.

G. ***Other Activities***

Ask a plumber or plumbing sales representative to come and speak to the class concerning pipe materials and sizing considerations.

H. ***Conclusion***

Plastic and copper pipes are commonly used because they are relatively easy to work with. These materials are available in a variety of forms and sizes that serve many different functions. Many factors can affect the size of the pipes used in a plumbing system. One way that the necessary pipe size can be determined is by looking at the amount of water needed and the amount of friction between the water and the surface of the pipe.

I. ***Answers to Activity Sheet***

J. ***Answers to Evaluation***

1. c
2. b
3. d
4. a
5. b
6. b
7. d
8. c

9. Answers may include any two of the following: ½, ¾, 1, 1¼, 1½, 2, 2½, 3, 4, 5, 6, and 8 inches.

10. 1½ inch pipe

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EVALUATION

Circle the letter that corresponds to the best answer.

1. How many common forms of plastic pipe are available for plumbing?

   a. Three
   b. Four
   c. Five
   d. Six

2. The plastic pipe suitable for hot water is called:

   a. CPV.
   b. CPVC.
   c. PVC.
   d. ABS.

3. When sizing pipe, a size must be selected that will allow the desired flow rate while limiting losses to:

   a. 2 pounds per square inch or less.
   b. 3 pounds per square inch or less.
   c. 4 pounds per square inch or less.
   d. 5 pounds per square inch or less.

4. Which is the thinnest form of commercial copper pipe?

   a. DWV
   b. M
   c. L
   d. K

5. Pipe sizes are referred to by their:

   a. Radius.
   b. Diameter.
   c. Length.
   d. Volume.

6. Which type of copper pipe is used for general interior work?

   a. K
   b. L
   c. M
   d. DWV

7. The hard black plastic pipe mostly used for drain lines is:

a. PVC.
b. PE.
c. CPVC.
d. ABS.

8. What is the plastic tubing used for underground water service lines?

a. CPVC
b. PVC
c. PE
d. ABS

Complete the following short answer questions.

9. What are two standard pipe sizes?

a.

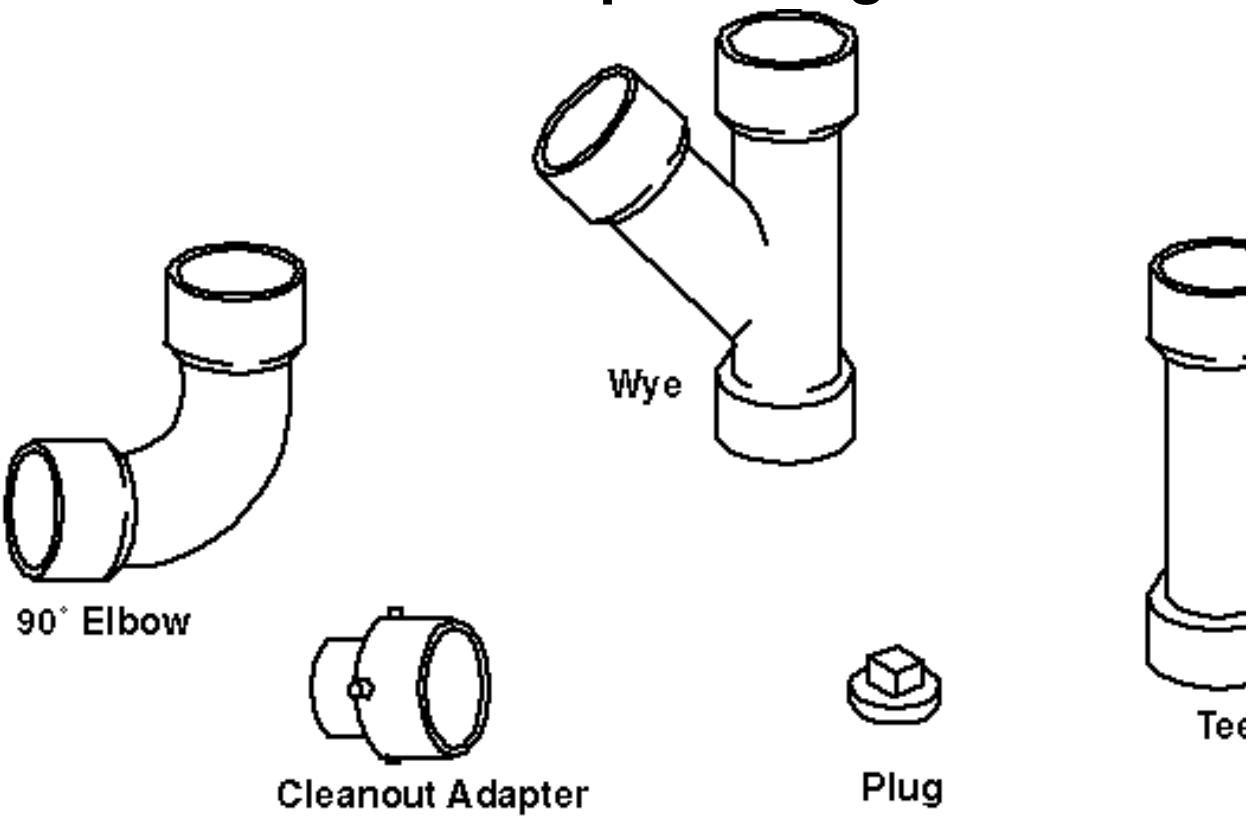
b.

10. What size of PVC pipe should be used for a pipe system that is 250 feet in length with a flow rate of 10 gallons per minute?

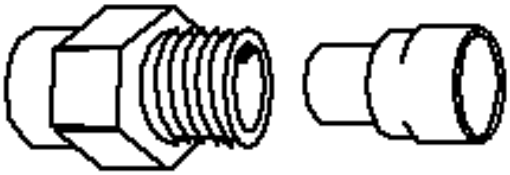
Distance in Feet*	Flow Rate (Gallons Per Minute)						
	2	3	5	7.5	10	15	20
Up to 25	½	½	¾	¾	1	1	1
50	¾	¾	¾	1	1	1¼	1¼
75	¾	¾	1	1	1	1¼	1½
100	¾	¾	1	1	1	1¼	1½
150	¾	¾	1	1	1¼	1½	1½
200	¾	1	1	1¼	1½	1½	2
300	¾	1	1	1¼	1½	2	2
400	1	1	1¼	1½	1½	2	2
500	1	1	1¼	1½	2	2	2

*Add 10 percent to the measured length to account for losses due to pipe fittings.

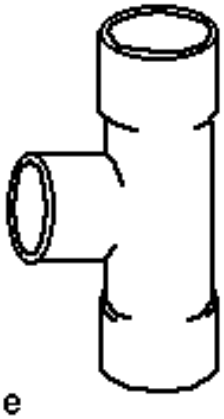
Plastic Pipe Fittings



Copper Pipe Fittings



Adapters

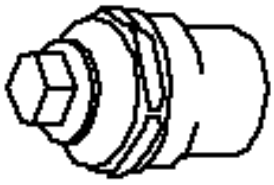


Tee

90

Coupling

Reducing
Coupling



Cleanout
with Plug

PVC Pipe Size Table

Distance in Feet*	Flow Rate (Gallons Per Minute)						
	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

*Add 10 percent to the measured length to account for losses due to pipe fittings.

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Pipe Usage

Objective: Identify where different types of pipes are used.

Look at the pipes in various structures, including your house, agricultural buildings, and school, as well as any other buildings to which you have access. Fill out the chart below, indicating the location of the pipes, what type of pipe was used, and why that type of pipe was chosen for that location. Then answer the questions about your observations.

Location	Type of Pipe	Reasons for Use