PROBLEMS IN PRACTICE

1 ● What is the common method of determining the size of mains in a distribution system?

On the basis of pressure drop: The initial pressure and the minimum permissible terminal pressure are specified, and the pipe sizes are so chosen that the maximum estimated amount of steam may be transmitted without exceeding this pressure difference. The steam's velocity is disregarded and it may reach a magnitude in excess of 35,000 fpm which is not considered high.

2 ● a. What are the advantages and disadvantages of a low pressure distribution system?

b. High pressure?

a. The advantages of a low pressure distribution system include:

1. Smaller heat loss from the pipes.
2. Less trouble with traps and valves.
3. Simpler problems with pressure reducing equipment at the buildings.
4. No danger to building heating equipment from high pressure through failure of the reducing valves.

The disadvantages of a low pressure system are:

1. Larger pipe sizes.
2. Decreased field of usefulness owing to small pressure range.

b. The advantages of a high pressure system are:

1. Smaller pipe sizes.
2. Greater adaptability of the steam to various uses other than building heating.

The disadvantages of a high pressure system are:

1. Large heat loss from the pipes.
2. The high pressure traps and valves required often give more trouble than low pressure traps and valves do.
3. Extra heavy fittings are required.
4. Usually two reducing valves or some form of emergency relief is necessary to protect the building piping system.

3 ● Determine the size of pipe from the following data using Unwin's formula:
Length of pipe, 600 ft.
Steam to be carried, 90,000 lb per hour, dry saturated.
Initial pressure, 100 lb per square inch, gage.
Final pressure, 40 lb per square inch, gage.

Using the formula:

$$P = \frac{0.0001306\ W^2 L \left(1 + \frac{3.6}{d}\right)}{y\ d^5}$$

The pressure drop $P = 100 - 40 = 60$ lb per square inch.

The weight of steam per minute $W = \frac{90{,}000}{60} = 1500$.

The length of pipe in feet $L = 600$.

The average density of steam y in pounds per cubic foot, taken from Keenan's Table:

At 100-lb gage, $y = 0.2578$
At 40-lb gage, $y = 0.1285$
Average, $y = 0.1932$

The diameter of the pipe in inches $= d$.

Substituting the values in the formula:

$$60 = \frac{0.0001306 \times 1500^2 \times 600 \left(1 + \frac{3.6}{d}\right)}{0.1932 \times d^5}$$

$$d = 7.35 \text{ in.}$$

Therefore, an 8-in. pipe should be used.

4 ● What points should be borne in mind when laying out an underground steam conduit?

The conduit should be reasonably waterproof, able to withstand earth loads and to take care of the expansion and contraction of the piping without strain or stress on the couplings, or without affecting the insulation or the conduit. Expansion of the piping must be carefully controlled by means of anchors and expansion joints or bends so that the pipes can never come in contact with the conduit.

5 ● What is considered the proper pressure for a hydrostatic test before completing the conduit?

In the case of any underground piping which is to be buried or otherwise made inaccessible, the assembled lines shall first be tested hydrostatically at a pressure of one and one-half times the maximum allowable service pressure and held for a period of at least two hours without evidence of leakage. In any case the hydrostatic pressure should not be less than 100 lb per square inch.

6 ● What factors should be considered before determining the route of a steam line?

1. The line should be so located that it will bring in the greatest revenue (or supply the most steam) with the least cost.
2. The ultimate length and size of services and branches necessary with each possible location should be estimated, for mains should be run near to the big loads.
3. The location of the boiler room or piping center of present and future buildings to be served should be considered.
4. Where possible, make the lines straight between manholes.
5. Avoid such obstructions as other lines, sewers, ducts, curb drains, manholes, valve boxes, catch basins, fire hydrants, and poles; especially avoid electric ducts and water lines.
6. Avoid locating lines near where pile driving and foundation construction for new buildings will take place.
7. Consider construction difficulties such as traffic, hard rock, and wet earth, which increase time and labor.
8. Consider the economies of using available sidewalk vaults of buildings. Weigh the advantage of less excavation against the cost of obstruction removal.
9. Consider all operating difficulties.
10. Consider the difficulties of negotiating agreements for lines on private property where public and private rights-of-way are available.
11. Consider the effect of proposed municipal and other improvements.
12. Consider municipal regulations.

7. ● State the advantages and disadvantages of tunnels over conduits.

The advantages of pipe tunnels over conduits are:

1. Accommodation for miscellaneous services other than steam.
2. Provision of an underground passage between buildings.
3. Easy installation of additional pipes and easy replacement of existing pipes with larger sizes.
4. Easy inspection and maintenance of pipes.