Heating Water With Steam Coils

When steam pipes or coils are submerged in water and the condensation is withdrawn as rapidly as it is formed, the rate of heat transfer may be determined by referring to the chart shown on the opposite page.

The values for brass and iron pipe given on this chart are based upon data prepared by the American Radiator Co., which were derived from tests. The figures given on the chart are one-half of the actual test results to allow for corrosion and fouling of the pipe.

Caution: It must be realized that when the size of a trap is to be recommended based on the values obtained from this chart, the pounds of steam condensed per square foot per hour, as given by the chart for the operating conditions, should be doubled.

The chart not only gives the B.t.u. loss per square foot per hour from copper, brass, and iron pipes, but also includes the pounds of steam condensed per square foot of pipe surface per hour for pressures ranging from 10 to 385 pounds per square inch gauge.

Example No. 1

A well insulated tank contains 10,000 gallons of water.

Given:

Quantity of water = 10,000 gallons = 10,000 x 8.33 = 83,300 pounds
Inlet temperature of water = 70° Fahr.
Final temperature of water = 140° Fahr.
Temperature of steam at 150 pounds per square inch gauge = 366° Fahr.
Size of pipe for coil = 1¼″
Material of pipe for coil = steel

Problem:

How many feet of 1¼″ steel pipe will be required for a coil large enough to raise the temperature of the water from 70° Fahr. to 140° Fahr. in one hour if the steam pressure available is 150 pounds per square inch gauge?

Procedure:

1. Determine the mean temperature difference.

$$\frac{(366 - 70) + (366 - 140)}{2} = 261° \text{ Fahr.}$$

2. Referring to the opposite page, enter the bottom of the chart at a mean temperature difference of 261° Fahr.; proceed upward to the intersection with the line for steel pipe and then horizontally to the left to the ordinate where it is noted that the heat transfer rate is 70,000 B.t.u. square foot per hour.

3. Determine the B.t.u. necessary to raise the water from 70° to 140° Fahr.

83,300 pounds x (140 — 70) = 5,831,000 B.t.u. per hour.

4. Divide this quantity by the rate of heat transfer to determine the square feet of pipe surface required.

$$\frac{5,831,000}{70,000} = 83.3 \text{ square feet}$$

5. The length of 1¼″ pipe which has one square foot of outer surface is equal to 2.301 feet.

6. Multiply the number of square feet required by the length per square foot to obtain the total length of 1¼″ pipe required.

83.3 x 2.301 = 191.7 feet of 1¼″ pipe.

Example No. 2

Given:

Steam pressure = 10 pounds per square inch, gauge.
Pipe size = 2-inch standard.
Pipe material = brass.
Inlet water temperature = 40° Fahr.
Required outlet water temperature = 170° Fahr.

Required:

Total number of B.t.u. transferred per square foot of pipe surface per hour.
Pounds of steam condensed per square foot of pipe surface per hour.

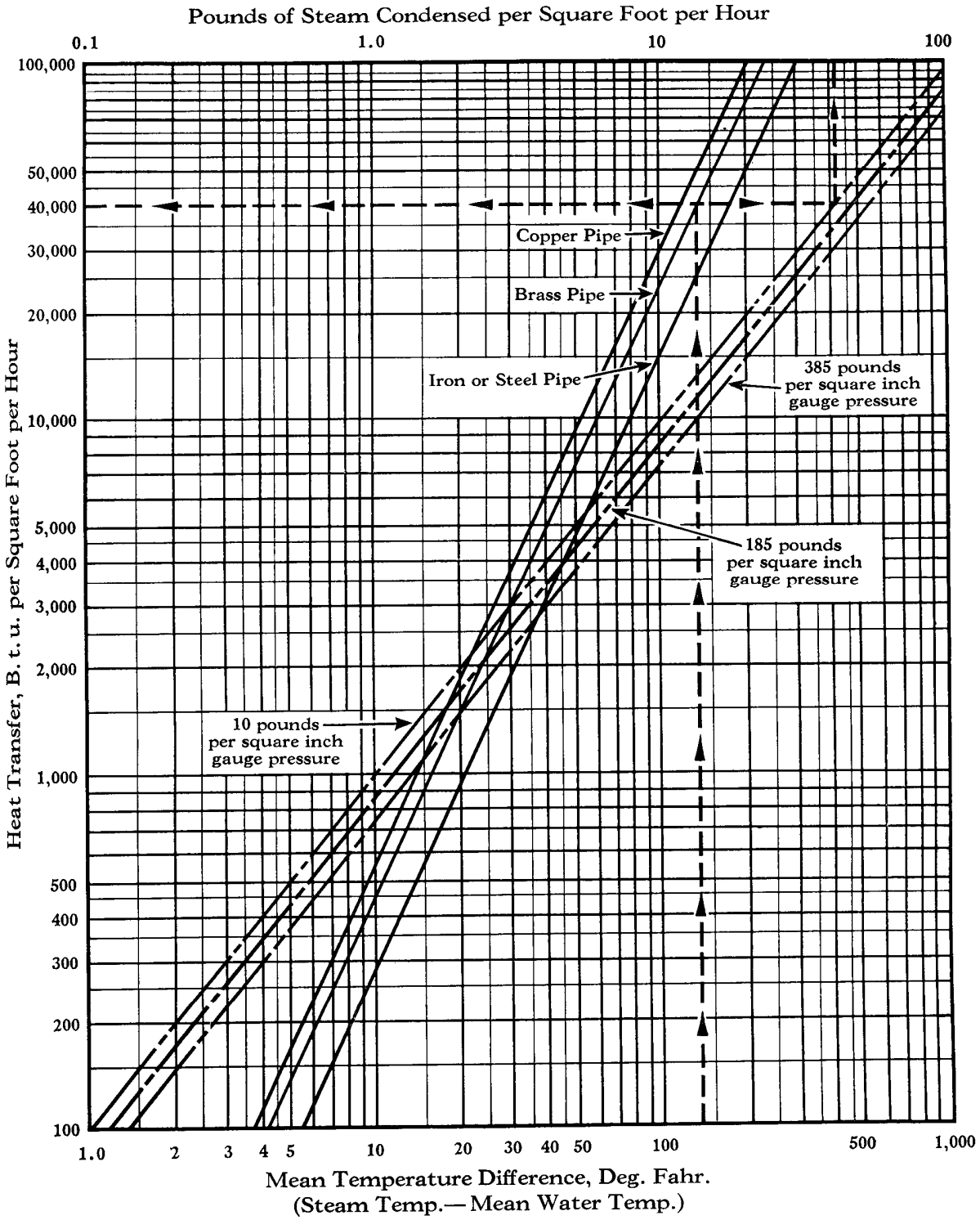
Procedure:

The temperature of saturated steam at 10 pounds per square inch gauge pressure is approximately 240° Fahr.

The mean water temperature is 105 deg. Fahr. which gives a mean temperature difference of 240 — 105 = 135° Fahr.

Entering the chart on the lower scale at a temperature difference of 135° Fahr. and proceeding upward to the intersection with the line for *Brass pipe* and thence left to the ordinate, it is found that the heat transfer is approximately 40,000 B.t.u. per square foot per hour. Proceeding horizontally to the right along the 40,000 B.t.u. line to the intersection with the dash line for 10 pounds per square inch gauge pressure and then upward to the top boundary line, it is determined that 42 pounds of steam are condensed by each square foot of outer pipe surface per hour.

Heating Water with Steam Coils (Cont.)



For typical problems involving the use of this chart, see the preceding page.