In using this method experience indicates that no pipe carries a velocity above the critical value of 20 ft. per second where steam and condensate flow in opposite directions, or above 50 ft. per second elsewhere on account of noise and entrainment difficulties.

7. In order to get uniform distribution of steam throughout the entire system, it is necessary to control the flow by reducing the riser sizes nearer the boiler. The nearer the riser is to the boiler, the greater will be its drop in pressure per 100 ft., since the total drop at the top of all risers should be practically the same.

8. Pipe sizes are figured on a pressure drop basis for steam and water flowing in the same direction or on a critical velocity basis when flowing in the opposite directions.

9. Due to the high rate of condensation in heating up a cold system the critical velocity should be figured at not over 20 ft. per second which will give velocities considerably below the critical velocity once the system is heated.

PIPE SIZES

Table 33 gives the numerical value of the four factors of the Babcock formula for various sizes and lengths of pipe and various initial pressures and pressure drops. By multiplying together the four factors for any set of conditions the pounds of steam per minute which will flow through the pipe may be found, as illustrated in the example accompanying the table.

Table 34 is a basic table giving the theoretical capacities of pipe in square feet of direct cast iron radiation (based on ¼ lb. steam per hour per square foot) for various pressure drops in ounces per 100 ft. length of pipe or equivalent length and with an initial steam pressure of 1 lb. gage. This table does not allow a factor of safety for variation in pipe size, condensation in the pipe or other variables and should not be used without taking these factors into consideration.

Table 35 is the same as Table 34 except that it allows a 20 per cent factor of safety to take care of condensation within the pipe itself, variation in size and roughness in the pipe due to blisters, scaled corrosion and other factors. This table is recommended for general use.

In determining the length of pipe used in any system, the actual length must be increased for the various fittings, and values in determining the equivalent length before applying any of the tables given. Table 36 gives the length in feet to be added to the actual length of pipe for various fittings and values in determining the equivalent length. If it is desired to determine the capacity of a pipe for any other length than 100 ft. or for any initial pressure other than 1 lb. such capacity may be found from either Table 34 or 35, by multiplying the capacities found in those tables by constants given in Table 37.

Example.—What is the capacity of a 140 ft. 4 in. pipe with an initial pressure of 1 lb. and pressure drop of 2 oz. in the 140 ft.?

Solution.—From Table 35 it is found that the capacity of a 100 ft. 4 in. pipe with 1 lb. initial pressure and 2 oz. pressure drop, is 2780 sq. ft. Multiplying this value by 0.841 the constant for a 140 ft. length as given in Table 37 gives 2337 the capacity for the given conditions.

Example.—What is the capacity of a 100 ft. 4 in. pipe with 2 lb. initial pressure and pressure drop of 1 oz.?

Solution.—From Table 35 find, 1926, the capacity of this pipe with a 1 lb. initial pressure. Multiplying this by 1.03 for a 2 lb. initial pressure as given in Table 37 gives 1984 the capacity for the given condition. By using the capacities given in Table 34 rather than Table 35 in examples 1 and 2, the capacities for the given conditions without allowing for a factor of safety of 20 per cent may be obtained.

Table 38 gives the capacities of various sized pipes for parts of systems based upon stated conditions. Column B gives the capacities of various sizes, of supply mains, branches to risers which are dripped, down-feed risers, or any other part of any system where steam and the condensation either from radiation or from the pipe itself flow in the same direction, based upon 1 lb. initial pressure and a drop of 1 oz. per 100 ft. and allowing a 20 per cent factor of safety. These capacities apply particularly to two-pipe steam and two-pipe vapor systems.

Column C gives the capacity of supply mains, branches to risers not dripped, up-feed risers, or any other part of any system where steam and condensate flow in opposite directions, based upon a steam velocity of 16 ft. per second. These capacities apply particularly to a one-pipe system and those parts of any two-pipe system where the condensate from radiators or from the pipe itself are expected to flow in the opposite direction to the steam.

Column D gives the capacity of branches to radiators based upon steam velocities of 12 and 16 ft. per second respectively for such branches with ¼ in. and 1 in. pitch per 10 ft. length.

Table 39 gives the capacity in square feet and pressure drop in ounces for various sized pipe and various steam velocities ranging from 12 to 40 ft. per second.

Tables 40, 41 and 42 give the capacities of return mains, return risers and radiator connections, for vacuum systems. The capacity of supply mains and risers for vacuum systems may be taken directly from Table 35 if the allowable pressure drop is greater than 1 oz. per 100 ft. or from Table 38, Column B, if a pressure drop of only 1 oz. per 100 ft. is to be allowed.

Table 43 gives the pounds of steam which will flow per minute through standard pipe at 4000 ft. velocity, and the resulting pressure drop in pounds per 100 ft. equivalent length. This table is particularly applicable to transmission mains and should not be used without particular consideration in designing distribution systems.

Either capacity of a pipe in any part of a system is limited either by the allowable pressure drop along the pipe, or by the steam velocity through the pipe or both. If condensate, either from radiation supplied or from the pipe itself, is to return counter to the flow of steam the velocity of the steam must not exceed certain critical values. If the velocity exceeds the critical value the system may continue to operate, but will be noisy. If the velocity exceeds a higher maximum value the condensate will cease to return counter to the steam and will be carried along with it clogging the radiator if it has a one-pipe connection, or passing through the radiator if it has a two-pipe connection.

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