Notes on Vacuum Systems.

1. It is not generally considered good practice to exceed ⅛ psi drop per 100 ft of equivalent run, nor to exceed 1 psi total pressure drop in any system.
2. Pitch of mains should not be less than ¼ in. in 10 ft.
3. Pitch of horizontal runouts to risers and radiators should not be less than ½ in. per ft. Where this pitch cannot be obtained, runouts over 8 ft in length should be one size larger than called for in the table.
4. In general, it is not considered desirable to have a supply main smaller than 2 in.
5. When necessary, the supply main, supply riser, or runout to a supply riser should be dripped separately through a trap into the vacuum return. A connection should not be made between the steam and return sides of a vacuum system without interposing a trap to prevent the steam from entering the return line.
6. Lifts should be avoided if possible, but when they cannot be eliminated they should be made in the manner described in this chapter.
7. No lifts can be used in orifice and atmospheric systems. In sub-atmospheric systems the lift must be at the vacuum pump.

SIZING PIPING FOR INDIRECT HEATING UNITS

Pipe connections and mains for indirect heating units are sized according to the quantity of steam condensed by each unit. The condensation per unit depends upon the entering temperature and the air velocity, and may be obtained from manufacturers' rating tables. Where two or more units are placed in series, the entering air temperature for any unit will be the leaving temperature for the preceding unit.

When the amount of condensation has been obtained for each unit, the pipe sizes should be based on the length of run and the pressure drop desired, as in the case of radiators. It is generally desirable to place the indirect heating units on a separate piping system rather than to connect them to the piping which supplies direct radiation. For type of connections see section on Connections to Heating Units.

PRESSURE REDUCING VALVES

While the illustrations given in Figs. 2 to 17 inclusive, indicate the various systems to be supplied by separate boiler plants, it is also possible to have steam supplied at high pressure by a boiler plant remotely located. In this case steam is supplied directly to the system or through a pressure reducing valve. Condensate can either be returned to the boiler plant or wasted to the sewer. The general arrangement of the systems fed through a pressure reducing valve will not vary from those illustrated with a boiler supply.

When high pressure steam is being supplied and lower steam pressures are required for heating, for domestic hot water, for utility services, etc., one or more pressure reducing valves (pressure regulators) are required.

These are used in two classes of service, one where the steam must be shut off tight to prevent the low pressure building up at time of no load, and the other where the low pressure lines will condense enough steam to offset normal leakage through the valve. In the latter case, double seated valves may be used in a manner that reduces the work required of the diaphragm in closing the valve and consequently, the size of the diaphragm. These valves also control the low pressures more closely under conditions of varying high pressures.

Valves that shut off all steam are called *dead end* type. They are single seated, and some of them have pilot operation that provides close control of the reduced pressure. If a thermostatically controlled valve is installed after, and near, a reducing valve in such a manner as to cut off the passage of steam, the dead end type should be used.

It is common practice, when the initial steam pressure is 100 psig or higher, to install two-stage reduction. If the radiation served is cast-iron, the *ASME* code requires two reducing valves when the inlet pressure exceeds 50 psig. This makes a quieter condition of steam flow, as it is apparent that with one reduction, as for example from 150 to 2 psig, there is a smaller opening with greater velocity across the reducing valve and, consequently, more noise. A two-stage reduction also introduces a source of safety, since if one reducing valve were to build up its discharge pressure, this excess pressure would not be so great as the case might be in a one-stage reduction.

If an installation requires single seated valves and the pilot type cannot be used, it is necessary to use two-stage reduction, as single seated valves require sufficient diaphragm area to overcome the unbalanced pressure underneath the single valve. In many cases the large diameter of diaphragm required would make it impractical in construction. With a two-stage reduction, the diaphragm diameter required would be reduced. If a one-stage reduction is desired, it is necessary to use a pilot controlled pressure reducing valve, where low pressures are to be maintained closely.

In making a two-stage reduction, allowance for expansion of steam on the low pressure side of the valve should be made by increasing the pipe size. This also allows steam flow to be at a more nearly uniform velocity. Separating the valves by a distance up to 20 ft is recommended to reduce excessive hunting action of the first valve.

When the reduced pressure is approximately 15 psig or lower, the weight and lever diaphragm valve gives the best results with minimum maintenance. Above 15 psig, spring loaded diaphragm valves should be used, because of the extra weights required on weight and lever type. Pressure equalizing lines should not be connected *too close to the valve*. They should be connected into the bottom of the reduced pressure steam main, to allow maximum condensate to exist in the equalizing lines, or the connection can be made into the top of the main if a water accumulator is used to reduce the variation of the head of water on the diaphragm.

Care should be exercised in selecting the size of a reducing valve. The safest method is to consult the manufacturer. It is essential that sizes of piping to and from the reducing valve be such that they will pass the desired amount of steam with the maximum velocity desired. A common error is to make the size of the reducing valve the same size as that of the service, or outlet pipe size. Generally, this will make the reducing valve oversized, and bring about wire-drawing of valve and seat, due to small lift of the valve seat.

On installations where the steam requirements are relatively large and variable in mild weather or reduced demand periods, wire-drawing may occur. To overcome this condition, two reducing valves are installed in parallel, with the sizes selected on a 70 and 30 percent proportion of maximum flow. For example, if 50,000 lb of steam per hour are required, the size of one valve is on the basis of 0.7 × 50,000 lb, or 35,000 lb, and the other on the basis of 0.3 × 50,000 lb, or 15,000 lb. During the mild or reduced demand periods, steam will flow through the smaller valve only. During the remainder of the season, the larger valve is set to control at whatever low pressure is desired, and the smaller one at a somewhat lower pressure. Thus, when steam flow is not at its maximum, the smaller valve is closed, but it opens automatically when the maximum