Schutte & Koerting

Desuperheater Sizing Data

Advantages

- **Efficient, evaporated cooling water adds to steam load**
- **Various types, configurations and sizes**
- **No moving parts**
- **No special supports**
- **No thermal liner required (except for emergency dump application)**

S & K has provided desuperheaters for over 70 years. Desuperheating, sometimes called “attemperation” or “steam conditioning”, is the reduction of gas temperature. Its most common application is the reduction of temperature in a steam line through the direct contact and evaporation of water.

Principal of Operation

Most incorporate the venturi design which uses the velocity of the steam to atomize the cooling water. In addition, ejector atomizing, attemperator, surface absorption and mechanical atomizing designs are available. In most types, water pressure required is the same as the steam line pressure.

Applications

- Pulp and Paper
- Chemical
- Petrochemical
- Utility
- Food
- Pharmaceutical

Desuperheaters are found in many other industries as well. Essentially, they can be used in any plant location where steam is present.

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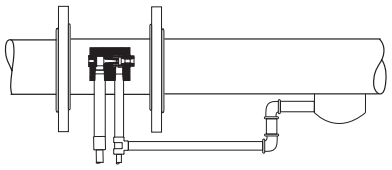


Fig. 6970
Ejector Atomizing
Desuperheater

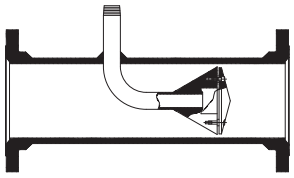


Fig. 6985
Annular Venturi
Desuperheater

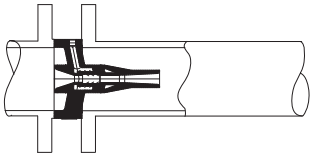


Fig. 6952
Attemperator
Desuperheater

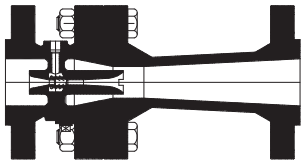


Fig. 6940
Venturi
Desuperheater

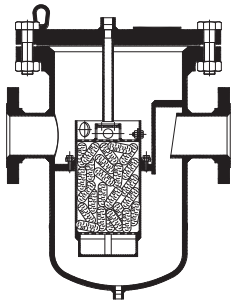


Fig. 6910
Surface Absorption
Desuperheater

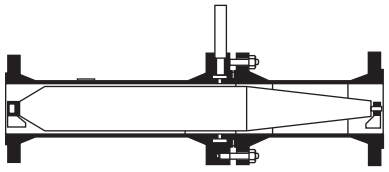


Fig. 6980
Annular Venturi Orifice
Desuperheater

Determination of Required Water Flow

A simple heat balance is used to determine required water flow. Calculation is as shown in the following example. Given 50,000 pph steam at 300 psig and 600° F, reduce pressure* to 50 psig and temperature to 340° F (42 superheat). To solve, check steam tables to find enthalpy of both conditions. The enthalpy for 50,000 pph, 300 psig, 600° F is 1313.6 Btu per pound. The enthalpy for 50 psig, 340° F is 1202.0 Btu per pound. To find the heat that must be removed from the steam, subtract the enthalpy of steam at 50 psig and 340° F from the enthalpy of steam at 300 psig and 600° F, as 1313.6 - 1202.0 = 111.6 Btu to be removed per pound. Given available water at 50 psig (water pressure must equal steam pressure)** and 200° F, determine the enthalpy of the water from available tables as 168.0. To find the heat to be gained by the water, subtract the enthalpy of the water from the enthalpy of the desired steam condition, such as 1202.0 - 168.0 = 1034.0 Btu. Use the following to determine pph water required to reduce steam to desired temperature.

$$\frac{\text{Btu to be removed X steam qty.}}{\text{Btu to be gained by water}} = \text{pph water required}$$

To convert pph to gpm, divide pph water by 500 x Sp. Gr., 5400 ÷ [500(.965)] = 11.2 gpm water required.

* *To reduce pressure, a reducing valve should be used not less than 5 pipe diameters upstream of the desuperheater.*

** *For Type 6910, 10 psi maximum above steam pressure.*

NOTE: Consult capacity table in Bulletin 6D-E for proper atomizing head size for Type 6970 Desuperheater.

Refer to curve on this page for required pipe size versus steam load for Types 6910, 6940, 6950, 6952, 6953, 6970, 6980, and 6985.

For sizing of Types 6905 and 6940M, consult factory.

Estimating Sizing Chart (Types 6910, 6940, 6950, 6952, 6953, 6970 & 6980)

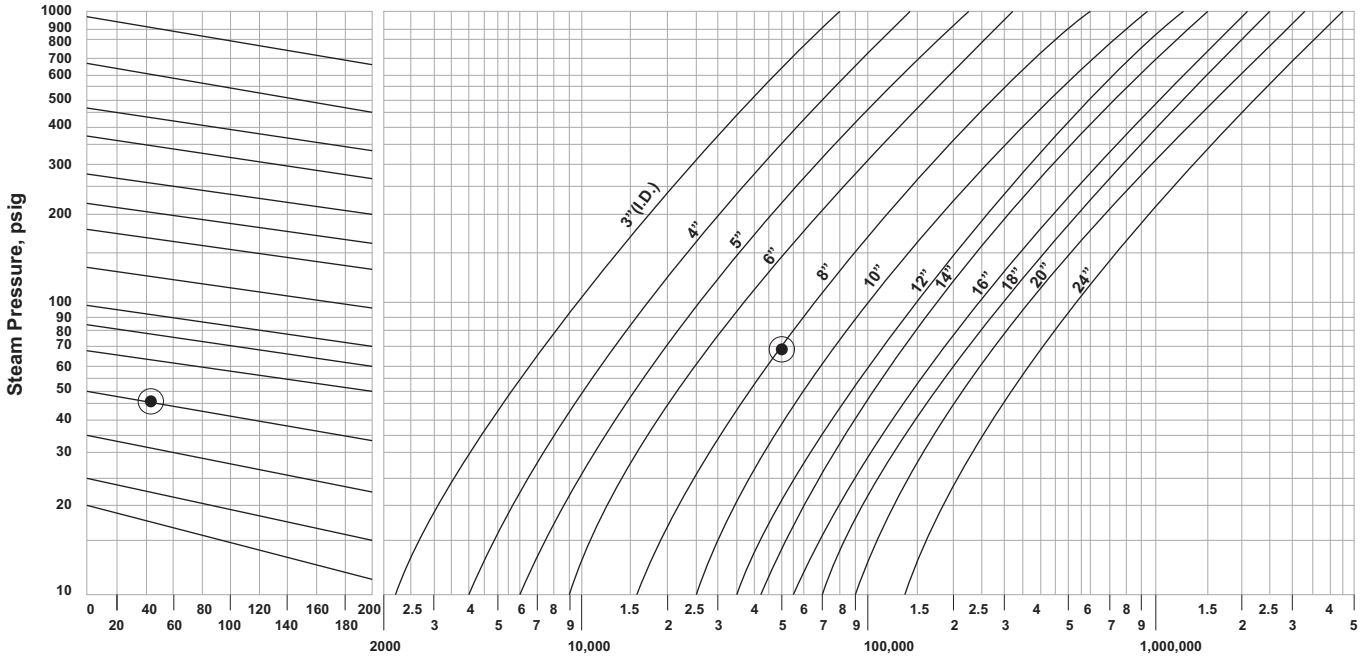


Fig. 1

These curves will help to select the proper main line for desuperheated steam. They include correction for superheated steam. Using same example as noted under water calculation, note the following:

To use the curves, find the steam pressure line (50 psig) and follow slanting superheat correction line until it intersects line representing 42° F superheat. Follow horizontal line across to right until it intersects line representing steam flow pph (50,000 pph). This point falls between 8" and 10" (pipe ID). A 10" * unit is required if Types 6910, 6940, 6950, 6952, 6953, 6985 is desired. A 10" pipe ring is required if Type 6970 is chosen.

**When the intersecting point falls between two ID's, always use the larger.*

Pressure Drop Chart

For Types 6910, 6940, 6950, 6980 and 6985 Desuperheaters

This nomograph can be used to estimate pressure drop through S & K Desuperheaters as shown in the example:

Example: If a Desuperheater is desired for a discharge capacity of 70,000 lb per hour steam at 100 psig, 100° F final superheat, the sizing chart, Figure 1, shows that 10" size is required. To determine the pressure drop: Identify 100 psig on the discharge pressure scale at the left of the nomograph and follow line (A) to the 100° F line. Draw a horizontal line (B) to the discharge pressure scale to determine equivalent saturated pressure. From this point draw line (C) to Desuperheater size (10"). From the point of intersection of line (C) with the pivot line, draw line (D) through inlet steam flow (70,000 lb per hour) to the pressure drop pivot line. From this point draw horizontal line (E). The points of intersection with the pressure drop lines indicate a pressure drop of 8.25 psi for Type 6910; 5.5 psig for Type 6940 and 6950 and 2.5 for Type 6980. By calculation, the inlet pressure to the desuperheater would be 108.25 psig for Type 6910; 105.5 psig for Types 6940 and 6950 and 102.5 for Type 6980.

If lower pressure drops are required, the next size desuperheater should be selected and the corresponding pressure drops determined.

NOTE: Pressure drop through Types 6952, 6953, and 6970 is negligible.

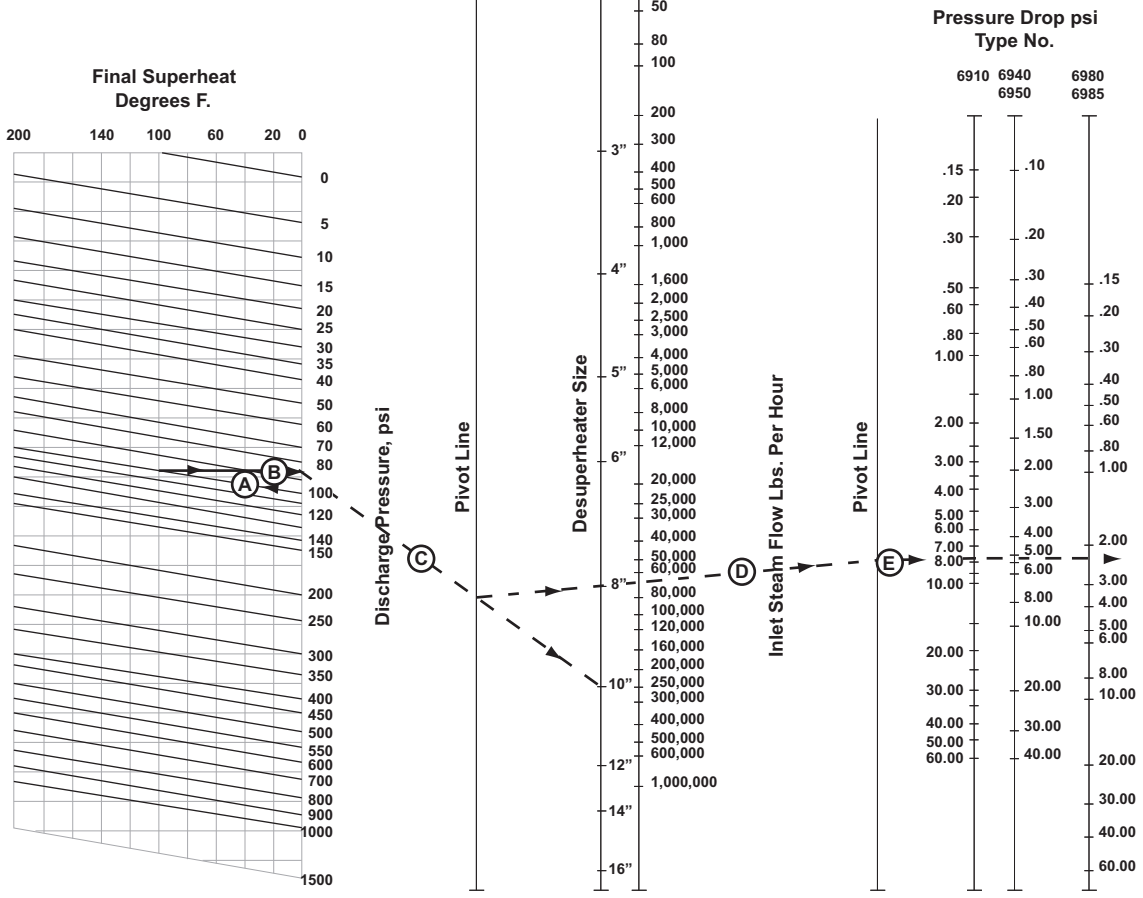


Fig. 2

Guidelines to Minimum Distance To Temperature Element Placement

Desuperheater piping arrangement, straight length requirements, upstream and downstream, and temperature element placement have become very important parameters in desuperheating stations.

Temperature element placement is, however, the most critical parameter of those listed. Table 1 should be used as a guide to minimum allowed distance to bulb, regardless of horizontal or vertical mounting.

S & K normally recommends that this distance be straight. However, as long as precaution is exercised, bend and curves can be made within 10' to 15' from unit discharge connection. S & K recommends five pipe diameters upstream of straight run if desuperheater is used in conjunction with pressure reducing valve.

Table 1.

Amount of Residual Superheat, ° F	Bulb Placement From Unit Discharge Connection, ft*
10	30
25	25
50	20
100	15
200	10
400	7
500	5

**For Types 6940, 6940M, 6952, 6953, 6970 and 6985.*

Calculation of Desuperheater Turndown Capacity

No desuperheater operates alone; it is always part of a system made up of many interacting components. Therefore, turndown - more properly, the ratio of maximum to minimum flows - of the desuperheater is no greater than that of the system control components.

To calculate preliminary desuperheater turndown available for Types 6940, 6950, and 6972, use the following calculation:

If mounted horizontally:

$$\text{T.D.} = \frac{\text{operating velocity}}{\text{min. desuperheating velocity}}$$

If mounted vertically:

$$\text{T.D.} = \frac{\text{operating velocity}}{15 \text{ fps}}$$

Noting that operating velocity =

$$\frac{\text{(max. steam flow) (specific volume)}}{25 \text{ (cross-sectional area of pipe)}}$$

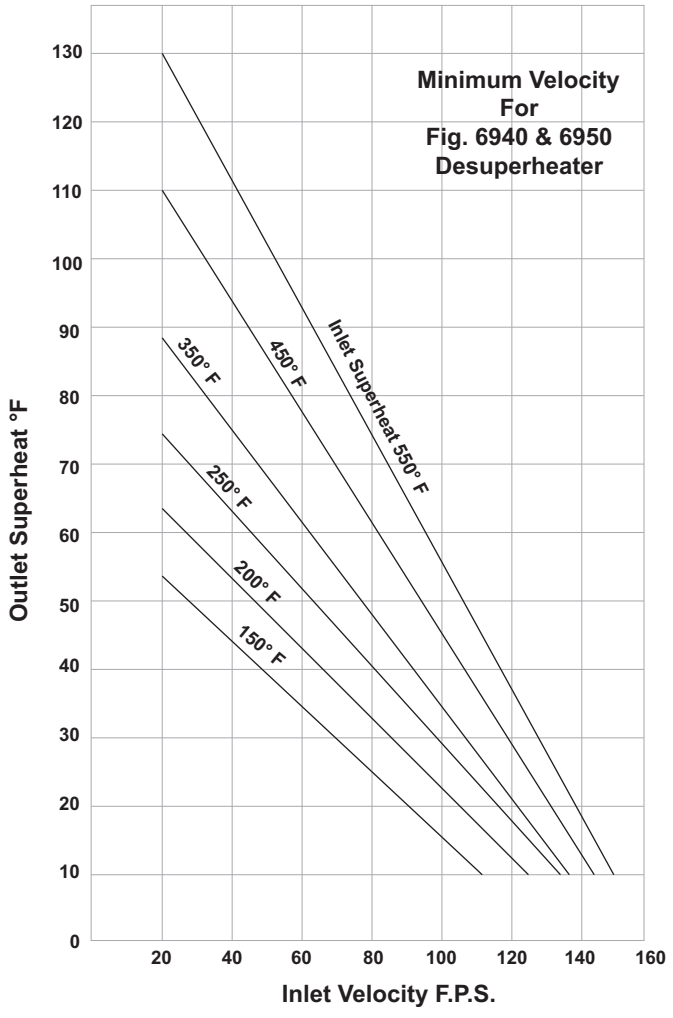
To calculate desuperheater turndown of the Type 6970 unit, it must be noted that turndown is not a function of velocity when using the recycle feature.

$$\text{T.D.} = \frac{\text{steam flow + atomizing steam flow}}{\text{atomizing steam flow}}$$

(limited to a maximum of 50 to 1.)

Turndown capacity available for other units (Types 6905, 6910, 6952, 6953, and 6985) are available from the factory.

Fig. 3



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