

# Desuperheater Manual

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## PART ONE



Schutte & Koerting  
Process Products & Systems  
Since 1876



*DESUPERHEATER MANUAL*



Schutte & Koerting Company presents this Desuperheater Manual as a tool to provide detailed information with respect to the sizing, design, installation, operation, and maintenance of desuperheaters.

S&K understands that a manual is not a substitution for personal contact with factory personnel. Therefore, questions pertaining to this manual should be directed as follows:

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# Table of Contents – Part One

<b>TABLE OF CONTENTS</b> .....	<b>3</b>
<b>INTRODUCTION</b> .....	<b>6</b>
<b>ABOUT DESUPERHEATERS</b> .....	<b>6</b>
VARIETY .....	6
<b>DESUPERHEATING BASICS</b> .....	<b>7</b>
BACKGROUND .....	7
HEATING .....	7
EQUIPMENT PROTECTION .....	7
APPLICATIONS .....	8
Direct Surface Contact – Figure 6910 .....	8
Mechanical Atomizing (Venturi) – Figures 6940, 6940M, 6950, 6952, 6953 & 6985 .....	8
Steam Assist Atomizing – Figures 6970 & 6972.....	8
Spray – Figure 6905.....	8
<b>PERFORMANCE PARAMETERS</b> .....	<b>9</b>
TURNDOWN .....	9
PIPING ARRANGEMENT.....	9
Notes.....	9
<b>DESIGN PARAMETERS</b> .....	<b>10</b>
RATINGS.....	10
WELDING .....	10
FINAL SUPERHEAT.....	10
<b>LOGIC DIAGRAM</b> .....	<b>11</b>
<b>INFORMATION CHART</b> .....	<b>11</b>
<b>SELECTION CHART</b> .....	<b>12</b>
<b>FIGURE 6905 MECHANICAL ATOMIZING DUMP DESUPERHEATER</b> .....	<b>13</b>
<b>FIGURE 6905 INFORMATION</b> .....	<b>14</b>
APPLICATION.....	14
PERFORMANCE .....	14
TURNDOWN .....	14
NOTE .....	14
CONSTRUCTION.....	14
INSTALLATION.....	14
NOTE .....	15
OPERATION .....	15
MAINTENANCE .....	15
CONTROLS.....	15
Option 1 .....	15
Option 2 .....	15
APPENDIX 2 .....	15

**FIGURE 6910 SURFACE ABSORPTION DESUPERHEATER .....16**

**FIGURE 6910 INFORMATION.....17**  
 APPLICATION.....17  
 PERFORMANCE.....17  
 TURNDOWN.....17  
 CONSTRUCTION.....17  
 INSTALLATION.....17  
 NOTE.....17  
 OPERATION.....17  
 MAINTENANCE.....18  
 CONTROLS.....18  
 APPENDIX 3.....18

**FIGURE 6940,6940M & 6950 VENTURI DESUPERHEATER .....19**

**FIGURE 6940,6940M & 6950 INFORMATION .....20**  
 APPLICATION.....20  
 PERFORMANCE.....20  
     Note.....20  
 TURNDOWN.....20  
 CONSTRUCTION.....20  
     Figure 6940.....20  
     Figure 6940M.....20  
     Figure 6950.....21  
 INSTALLATION.....21  
     Figure 6940, 6940M & 6950.....21  
     Note.....21  
 OPERATION.....21  
     Figure 6940, 6940M & 6950.....21  
 MAINTENANCE.....22  
     Figure 6940.....22  
     Figure 6940M.....22  
     Figure 6950.....22  
     Figure 6940 & 6950.....23  
     Note.....23  
 CONTROLS.....23  
 APPENDIX 4.....23

**FIGURE 6952 & 6953 ATTEMPERATOR DESUPERHEATER .....24**

**FIGURE 6952 & FIGURE 6953 INFORMATION .....25**  
 APPLICATION.....25  
 PERFORMANCE.....25  
 TURNDOWN.....25  
 CONSTRUCTION.....25  
     Figure 6952.....25  
     Figure 6953.....25  
 INSTALLATION.....26  
     Note.....26  
 OPERATION.....26  
 CURVE 74-S-200.....27  
 MAINTENANCE.....28

*DESUPERHEATER MANUAL*

CONTROLS .....28  
APPENDIX 5 .....28

**FIGURE 6970 & 6972 STEAM EJECTOR ATOMIZING DESUPERHEATER .....29**

**FIGURE 6970 & 6972 INFORMATION.....30**  
APPLICATION.....30  
PERFORMANCE .....30  
TURNDOWN .....30  
    Figure 6970.....30  
    Figure 6972.....30  
CONSTRUCTION.....31  
INSTALLATION.....31  
    Note .....31  
MANUAL OPERATION .....31  
AUTOMATIC OPERATION .....31  
MAINTENANCE .....31  
CONTROLS.....32  
APPENDIX 6 .....32

**FIGURE 6985 ANNULAR VENTURI DESUPERHEATER .....33**

**FIGURE 6985 INFORMATION.....34**  
APPLICATION.....34  
PERFORMANCE .....34  
TURNDOWN .....34  
CONSTRUCTION.....34  
INSTALLATION.....34  
    Note .....34  
OPERATION .....34  
MAINTENANCE .....34  
CONTROLS.....35  
APPENDIX 7 .....35

**PACKAGED UNITS WITH CONTROLS .....36**

# Introduction

## *About Desuperheaters*

75 Years of Service

Schutte & Koerting has manufactured desuperheating equipment for the power, process and petrochemical industries for over 75 years. Schutte & Koerting desuperheaters are designed to efficiently lower the temperature of steam, utilizing various mechanisms for cooling, based on the customer's available resources. High pressure liquid, low pressure liquid, and high pressure gas can be used to remove the necessary heat from steam or other gases.

## *Variety*

Schutte & Koerting desuperheaters are characterized by a wide variety of models, configurations, sizes and choice of materials. S&K Desuperheaters are also characterized by having no moving parts, thus providing easy maintenance; no special supports, allowing easy installation; and thermal liners are not required except in very special applications.

## ***Desuperheating Basics***

### ***Background***

Since the advent of superheated steam over 75 years ago the need for desuperheating of such steam has been required and since that time Schutte & Koerting has been filling this need.

Superheated steam is the most efficient means in producing mechanical work. The use of superheated steam was based in the power industry for the main turbines. The superheated steam contains large amounts of potential energy. The additional energy absorbed beyond the saturation point further excites the water molecules already in the gaseous state. When applied to a turbine, the potential energy stored in the excited molecules is transformed into kinetic energy as the steam expands. In addition, superheated steam is "dry". It doesn't contain any condensate droplets that would be highly detrimental to the turbine and other mechanical equipment.

Steam can be produced with energy from various sources, including waste heat and combustible by-products, and steam is an efficient way to transfer energy. Steam applications can be broken down into two primary categories: motive power and heat transfer.

As a source of motive power, steam can be used to drive turbines which drive generators, pumps, compressors, and similar types of rotating equipment. Steam can be used in this manner to do mechanical work directly or to generate electricity for use on site or for sale back to the power grid.

Steam is also used as a source of heat energy. Steam is used to heat process fluids, air, and water. Steam's popularity as a heating medium rests on the fact that water absorbs large amounts of energy when converted into steam, and gives that heat back up again when it turns from steam to condensate. This is known as the heat of vaporization.

However, the advantages realized from the use of superheated steam for mechanical applications do not carry over to heating applications. Also, there can be distinct disadvantages in situations when superheated steam is provided to equipment not readily capable of handling such steam.

### ***Heating***

The use of superheated steam in heating applications is extremely inefficient. This is apparent by the amount of heat liberated as a function of the temperature when the steam is in the superheated state. For example, assume that steam at 165 psia and 376°F is cooled 10°F, to its saturation temperature of 366°F. The total heat liberated is 6.4 BTU/lb. However, if it is cooled 10°F further, through the saturation region, condensation occurs and the total heat liberated is 867.7 BTU/lb.

Also note that energy is not being lost in the desuperheating process. Desuperheating simply creates more steam with fewer Btu's per pound by injecting water into the steam, which evaporates to produce steam with a lower enthalpy.

In summary, the process of desuperheating converts a given amount of superheated steam into a greater amount of steam closer to the saturation point, so that the resulting steam can more readily be used for heat transfer applications.

### ***Equipment Protection***

Another area where desuperheaters are critical is in the protection of equipment that cannot handle superheated steam; for instance, when the superheated steam to a turbine generator needs to be bypassed to the main turbine condenser. Since the main turbine condenser is not designed to handle the high temperatures associated with the superheated steam, damage is avoided with the use of a desuperheater. This same principle applies to many different types of equipment and applications.

## ***Desuperheating Basics***

### ***Applications***

Desuperheaters are commonly found in industries such as Chemical, Petrochemical, Pulp & Paper, Utility, Food, Pharmaceutical, and so on — essentially anywhere there is steam.

Specifically, desuperheaters are used on inlets to heat exchangers, in lines to jacketed vessels, on turbine extraction and bypass lines, in dormitory heating systems, in services with pressure reducing valves, in emergency exhaust systems and many other places.

Desuperheating is accomplished in one of the following ways:

### ***Direct Surface Contact – Figure 6910***

This method injects water over a large surface area, whereby steam passes over, around and through water wetted packing, effectively accomplishing heat transfer by pure temperature gradients across a large surface area.

### ***Mechanical Atomizing (Venturi) – Figures 6940, 6940M, 6950, 6952, 6953 & 6985***

This process, which is the most common, utilizes velocity to shear water particles, then introduces these particles into a turbulent region where heat transfer is accomplished.

The internal design produces a lower pressure region, essentially syphoning in the cooling water. This unique design means the required water pressure need only be as high as the steam line pressure.

### ***Steam Assist Atomizing – Figures 6970 & 6972***

This method uses high pressure steam to effectively shear the water particles and then suspends the mixture for a period of time within a venturi, thus allowing more vapor / water contact.

The internal design produces a lower pressure region, essentially syphoning in the cooling water. This unique design means the required water pressure need only be as high as the steam line pressure.

### ***Spray – Figure 6905***

This process utilizes higher water pressure and the corresponding pressure differential across a nozzle as a means to shear the water particles and introduce the water into the steam.



## Performance Parameters

### ***Turndown***

Turndown is defined as the ratio of maximum capacity versus minimum capacity of steam load that a unit can effectively desuperheat. Several factors can influence turndown such as: steam velocity, amount of inlet superheat versus residual outlet superheat, type of mounting (horizontal or vertical) and piping arrangement. The most effective method of increasing turndown is through the use of steam drains, traps and / or separators. This allows for the continual draining of the unvaporized excess water, thereby extending desuperheating capacity.

Over the years many methods have been devised to increase the overall efficiency of desuperheating. The most common way is vertical mounting, which allows more contact time for water particles that have not evaporated. These particles will fall back down into the turbulent area around the desuperheater where further evaporation occurs

### ***Piping Arrangement***

Desuperheater piping arrangement is very important and each application should be treated individually with the criticality of piping arrangement realized as soon as possible. Typically the piping arrangement is flexible enough and normally can be mutually agreed upon between S&K and the customer.

The most important point about piping arrangement is not pipe lengths but the appropriate placement of the temperature sensing element. If it is too close, water particles will collect on the element and cause the water valve to throttle. The following shows the importance of appropriate placement for proper operation:

<b>Amount of Residual Superheat</b>	<b>Sensor Placement from Point of Water Injection</b>
10°F	30'
25°F	25'
50°F	20'
100°F	15'

(Refer to Appendix 1 for Additional Information)

### ***Notes***

1. The above distances are valid for vertical and horizontal mountings.
2. Sensor placement is applicable for every unit except the 6910, which can be as close as 5 feet from the desuperheater regardless of residual superheat.

**Performance Parameters**

**Design Parameters**

**Ratings**

Design and construction codes such as ASME B&PV Code Section VIII, ASME B31.1 Power Piping, ASME B31.3 Process Piping, and Canadian Registration are available. S&K desuperheaters are available in the following standard ratings:

<b>Desuperheater Figure</b>	<b>Standard Unit Ratings</b>
6905	150#,300#
6910	150#,300#,600#
6940	150#,300#,600#
6940M	150#,300#
6950 & 6952	150#,300#,400#,600#
6953 A,C,D	150#,300#,600#
6970& 6972 A,C,D	150#,300#,600#
6985	150#,300#

Desuperheaters can be customized to meet higher pressure ratings.  
Contact the factory for more information.

**Welding**

All welding of S&K desuperheaters is performed by ASME B&PV, Code Section IX qualified welders. When required, the units are constructed with an ASME Code Stamp.

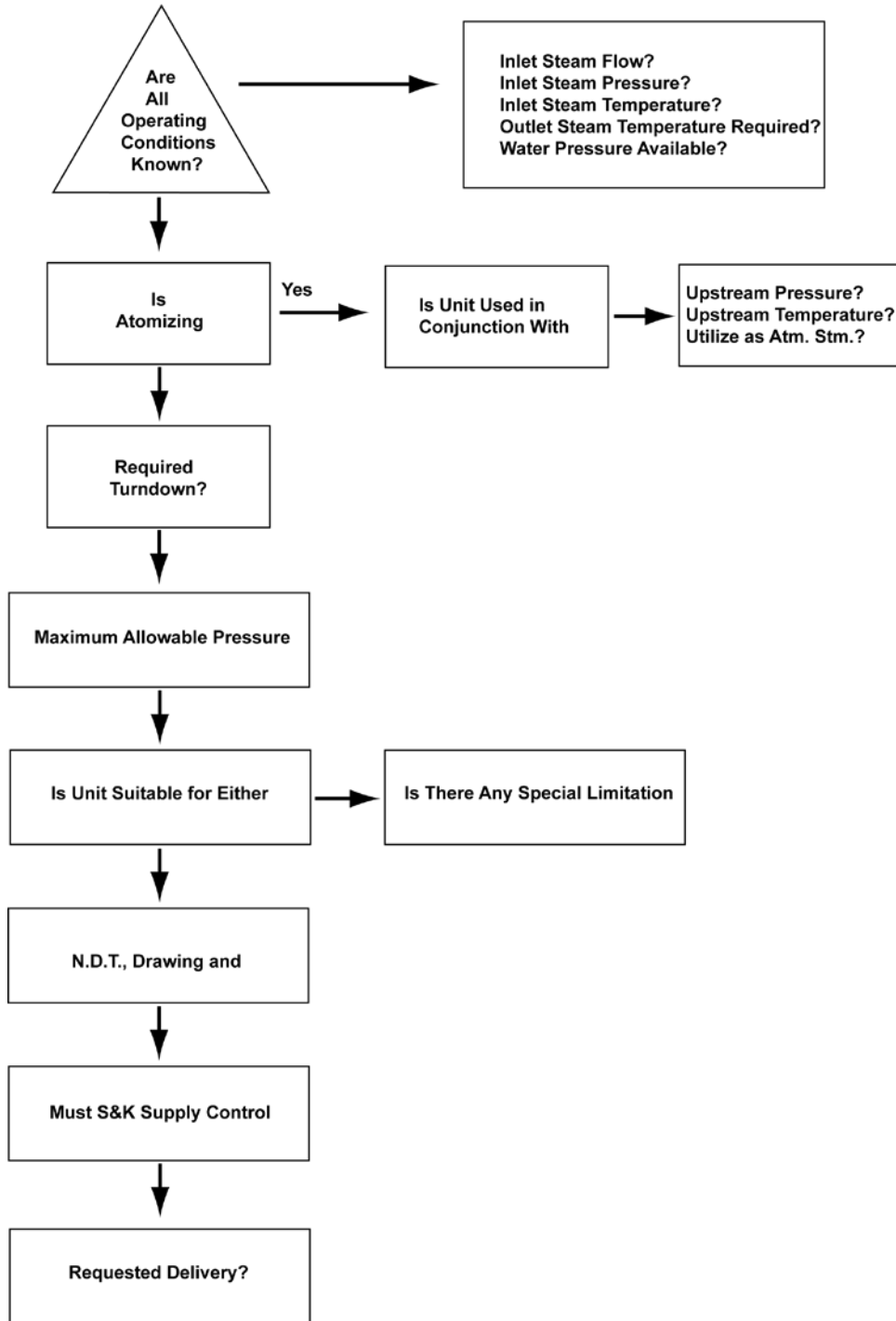
**Final Superheat**

A minimum of 10°F final superheat is recommended to allow for control.

# Logic Diagram

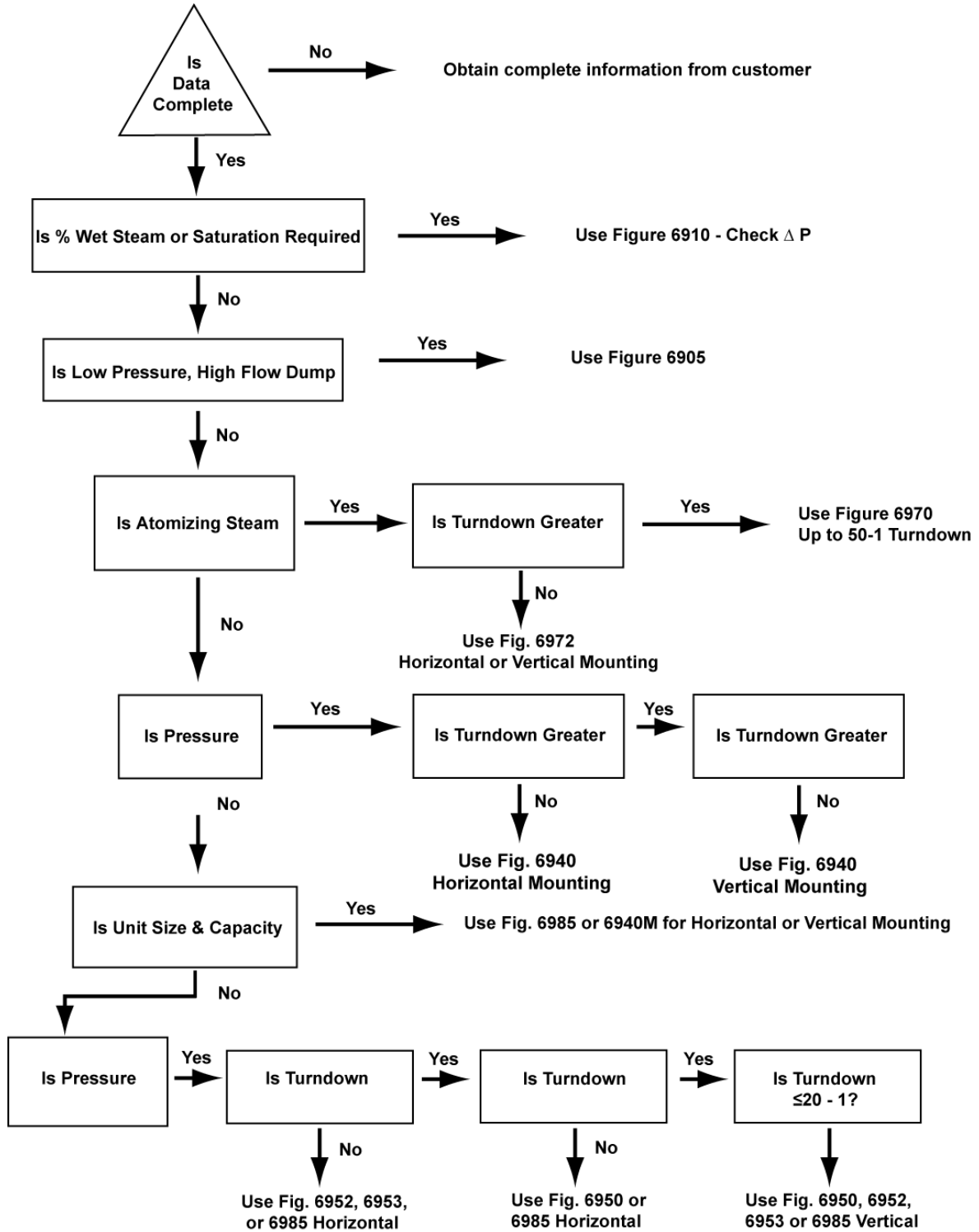
## Information Chart

Required Information Needed for Quotation



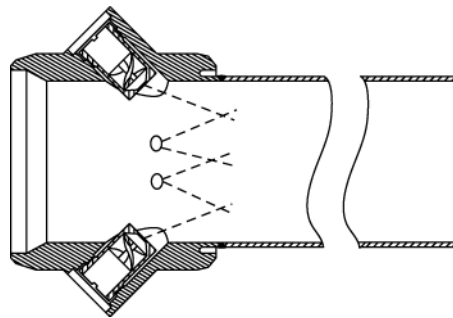
**Selection Chart**

Selection of Schutte & Koerting Desuperheaters  
(Refer to Appendix 1 for Sizing Data)



## Figure 6905 Mechanical Atomizing Dump Desuperheater

The Figure 6905 Mechanical Atomizing Dump Desuperheater is designed to be an emergency desuperheater, which protects main turbine condensers or similar types of equipment when steam dumps occur. The operating principle is that high pressure water / liquid is sent through radially located nozzles on a pipe carrying the gas to be cooled. The water is atomized and evaporated in the gas stream thus cooling the stream in amounts equal to the enthalpy change plus the vaporization value of the cooling medium.



### **Figure 6905 Information**

#### **Application**

The 6905 desuperheater was developed to economically desuperheat high steam flows in large steam lines; i.e., 20", 24", 30", 36", etc. Typically, precise desuperheating is not necessary and excess water flows are common. This unit is periodically used on emergency dump to condenser systems in power stations or on controlled over-pressure dump and bypass systems

#### **Performance**

The liquid used as the cooling medium in this application is required to be a minimum of 25 psi above the maximum superheated gas pressure such that enough pressure head is available to drive the cooling liquid. Due to the nature of the emergency dump and the fact that the steam temperature is normally above 800°F with large water droplets being ejected, a spray shield is typically used to protect the adjacent piping.

The quality of the steam on the discharge of the Figure 6905 desuperheater is typically not the primary concern since these desuperheaters are used in emergency situations. However, with the proper control package, the Figure 6905 desuperheater can be designed to obtain conditions within 10°F of saturation downstream of the desuperheater.

#### **Turndown**

Turndown on this unit is primarily dependent on available water pressure. The nozzle used to atomize the water flow must have a minimum of 5 psi pressure drop across the orifice to properly atomize the water stream. When water flow reduces to such a flow as to cause the pressure drop across the orifice to reduce to 5 psi, the coincident steam flow is the minimum flow.

$$T.D. = \frac{\text{Water capacity of nozzle @ } \Delta P \text{ specified}}{\text{Water capacity of nozzle @ } \Delta P \text{ of 5 PSI}}$$

#### **Note**

Turndown on the 6905 may be increased by separately controlling each nozzle and/or by using 2 or 3 different nozzles in the unit.

#### **Construction**

The Type 6905 consists of a body, spray shield, and nozzle assembly. Bodies are normally cast carbon, alloy, or stainless steel with butt weld ends. Stainless steel nozzles are removable from body nozzle bosses. The spray shield is stainless steel pipe or rolled plate. (Refer to Appendix 2 for outline drawings.)

#### **Installation**

The Type 6905 should be installed in a horizontal pipe line. Applications having continuously high pipe line steam velocities may be installed vertically.

It is suggested that separators/traps be installed downstream of the desuperheater in order to drain condensate from the steam line during shut down and remove any excess cooling water from the line during desuperheater operation. Due to coarse droplets and typical higher temperatures, a spray shield is recommended.

If multiple water lines are utilized, make sure proper water control line is used with the proper nozzle connections.

### ***Figure 6905 Information***

#### ***Note***

Schutte & Koerting suggests that the desuperheater be totally insulated upon installation.

#### ***Operation***

Drain steam line before main steam valve to desuperheater and drain desuperheater line.

Open water line slightly and crack steam valve. Bring both flows up to rated flow simultaneously.

If automatic controls are used, complete Step 1 above and then open steam valve. With the controllers properly energized (air or electric), the desuperheater will maintain the control set point temperature downstream as the steam flow is increased.

#### ***Maintenance***

There is no anticipated planned maintenance for this unit; however, there may be the need to ultimately clean the nozzles of any dissolved solids build-up. As long as the water supply line is clean, clogged water spray nozzles should not be a problem.

#### ***Controls***

The control scheme used on the Figure 6905 Desuperheater has two options.

##### ***Option 1***

The desuperheater is predominantly used as an emergency dump station and as such the controls regulating water flow should be initiated when the high gas temperature is sensed upstream of the desuperheater. This will allow for water flow to initiate prior to the arrival of the high temperature gas to the downstream piping.

##### ***Option 2***

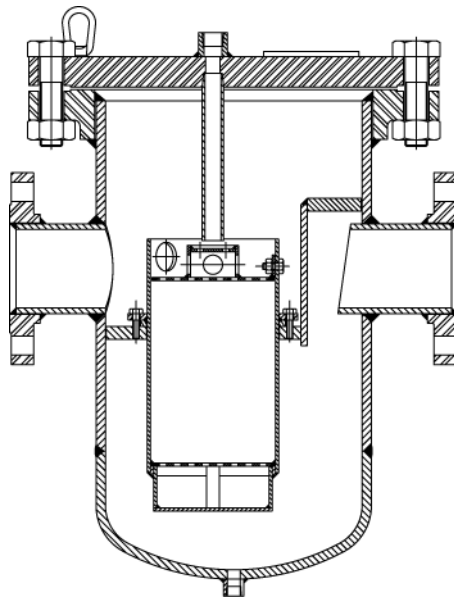
The second option on controls for the Figure 6905 is the traditional downstream temperature control. In this instance the desuperheater is utilized to control temperature during normal operation and as such the controlling parameter would be the condition of the gas downstream of the desuperheater.

### ***Appendix 2***

1. Figure 6905 outline dimensional drawings.
2. Piping & Instrumentation Diagram. Option 1 Option 2

## Figure 6910 Surface Absorption Desuperheater

The Figure 6910 Surface Absorption Desuperheater is a unique unit in a compact design that allows for almost infinite turndown (large flow rate variation) and saturated characteristics on the discharge. The operating principle is that water is injected into the desuperheater onto a baffle plate, which distributes water across the reaction rings. The reaction rings provide a large surface area over which the hot vapor is forced to pass. The hot gas is then cooled by absorption of the water when contacting the reaction rings. The saturated vapor flows out of the desuperheater outlet and excess water drains through the bottom and is removed through a trap. The reaction rings in the Type 6910 unit extend the cooling water surface, a feature not available in other S&K manufactured units.





### **Figure 6910 Information**

#### **Application**

Generally used where space limitations and requirements of minimum water carryover are stipulated. The almost infinite turndown, guaranteed saturation conditions and minimal maintenance make this unit ideal for the marine (space) food processing (turndown), drying (saturated conditions) industries, and steam turbine bypass lines to protect main turbine condenser bundles.

#### **Performance**

A number of parameters must be considered to achieve proper performance.

1. Horizontal installation only.
2. Water pressure is required at 10 psi above the main line steam pressure to ensure enough pressure head.
3. Maximum steam velocity is 250 ft/sec.
4. Must consider maximum water flow rate and maximum pressure drop for each size to ensure proper performance.

#### **Turndown**

The 6910 has the capability of nearly infinite turndown due to the draining feature.

#### **Construction**

Units are fabricated but are also available in a cast design. Carbon steel is used for the body and cover as a standard with the internal reaction rings and deflector plate constructed of 304 Stainless Steel. Standard unit sizes range from 2" to 12" and pressure ratings up to 300 psi. Special designs in sizes 2" to 12" and ratings to 2500# can be accommodated. Carbon steel is used for temperatures below 800°F while alloys such as stainless steel, chrome moly and other materials are used above 800°F.

#### **Installation**

The Type 6910 desuperheater must be installed in a horizontal position. A strainer, which prevents foreign matter from clogging the control mechanism, should also be installed in the water line before the water valve controlling the flow to the desuperheater. Drain traps installed on the desuperheater drain line should be sized 1 1/2 to 2 times the maximum water flow.

Temperature sensors are typically located 5 feet downstream of the desuperheater.

#### **Note**

Schutte & Koerting suggests that the desuperheater be totally insulated upon installation.

#### **Operation**

1. Set controller to steam temperature desired.
2. Turn on air pressure to controller. Set air pressure reducing valve as per manufacturer's instructions.
3. Drain steam line before main steam valve to desuperheater and also drain desuperheater line.
4. Open water supply valve.
5. Open main steam valve slowly until desired flow is obtained.

***Figure 6910 Information***

***Maintenance***

The only maintenance necessary to keep the unit in good operating condition is the removal of scale due to evaporation. In order to do this:

1. Remove desuperheater cover.
2. Lift the basket by means of the holes provided.
3. Clean or replace reaction rings by removing perforated plate in the top of the basket.
4. Water deflector cannot be removed but can be cleaned in position.

Maintenance is not typically required and need only be performed if a marked increase in water flow is occurring.

***Controls***

The control scheme used on the Figure 6910 Desuperheater is rather simple due to the operating nature of the Figure 6910. The temperature sensor is suggested to be located as close as 5 feet of the desuperheater discharge.

Appendix 3 contains the control configuration for this desuperheating option.

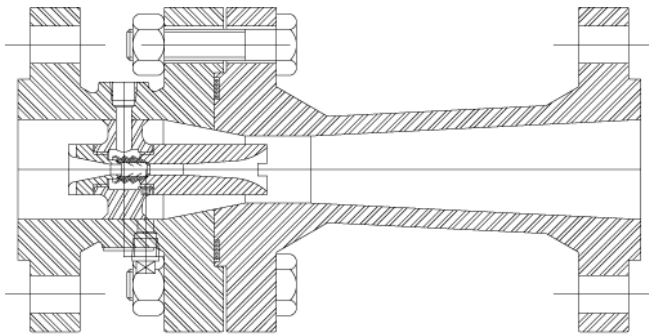
***Appendix 3***

1. Figure 6910 outline dimensional drawings.
2. Piping & Instrumentation Diagram.

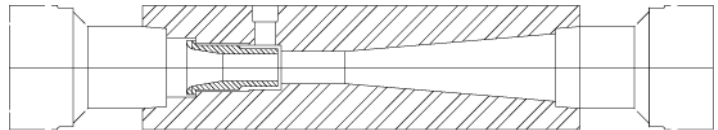
## Figure 6940,6940M & 6950 Venturi Desuperheater

Figures 6940 and 6950 are venturi desuperheaters. Water entering the desuperheater is preheated in the circulatory chamber around the water diffuser tube and is introduced in many small jets to assist final atomization by the steam flow through the center of the throat. When leaving the throat, the mixture of steam and water enters the reduced pressure venturi section for turbulent mixing prior to entering the main steam line in a fog-like condition without contacting the sidewalls. This provides maximum desuperheating effectiveness and a minimum of wear in the discharge piping.

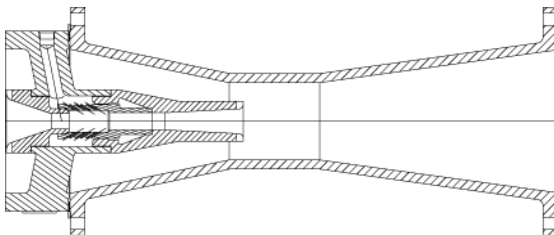
The Figure 6940M Desuperheater is a miniature version of the Type 6940. It was developed to handle small quantity steam applications found in heating, air conditioning and process industries.



**Figure 6940**



**Figure 6940M**



**Figure 6950**

### **Figure 6940,6940M & 6950 Information**

#### **Application**

Venturi Desuperheaters reduce steam temperature by bringing superheated steam into direct contact with water. The steam is cooled through the evaporation of the water. Recommended for use under a wide range of conditions, including steady and variable flows. The unit can be installed with flow either horizontally or vertically up. When installed vertically up, turndown ratios can be increased substantially.

#### **Performance**

Turndown ratio is dependent upon a wide variety of factors such as horizontal or vertical position, amount of residual superheat and piping.

Depending on exact flow conditions, units are capable of 50% to 5% flow variation and the pressure drop varies between 2 psi and 10 psi.

The water pressure required need only be as high as the operating steam pressure, due to the internal syphoning action.

#### **Note**

The limitations for Figures 6940, 6940M and 6950 are:

- Maximum velocity on water inlet connection 15 ft/sec.
- Desuperheats to within 10°F of saturation temperature.
- Normally used in areas where atomizing steam is not available.
- Figure 6950 not recommended for pressures above 600 psig and/or temperatures above 800°F.

#### **Turndown**

Venturi units have the tightest requirements on turndown as a result of sizing the units based on critical areas. Turndown follows the form:

$$T.D. = \frac{\text{Calculated Steam Velocity}}{*}$$

\*Minimum steam velocity in a vertical installation is 15 fps. Minimum steam velocity in a horizontal installation with 10°F residual superheat is 75 fps. Minimum steam velocity can be lowered by increasing the outlet steam temperature.

#### **Construction**

##### **Figure 6940**

The 6940 Desuperheaters are constructed of carbon steel for Figure 6940 temperatures below 800°F and various alloys above 800°F. The 6940 consists of a body and tail piece joined by flanges and flanges are provided at each end for connection to the steam line. The body, furnished in carbon or alloy steel, has a threaded water connection. The nozzle and combining tube-throat are 304 stainless steel. Cast units are available in ratings up to 1500 lb. for 2" through 6" sizes and for ratings up to 900 lb. through the 12" size. Larger sizes and higher ratings are fabricated.

##### **Figure 6940M**

The 6940M, due to its small physical size, is designed and machined Figure 6940M from barstock. The 6940M is available in sizes 1/2" to 1½" and is available in ratings up to 600 lb. with NPT, socket weld or flanged connections.

**Figure 6940, 6940M & 6950 Information**

**Figure 6950**

The 6950 is designed with flanges on the inlet and outlet of the tail piece. The body is clamped between the tail piece and customer's flange on the pipeline. Except for the noted differences in construction and dimensions, it is similar to the Type 6940 in all other respects. Type 6950 is available in 2" to 6" cast carbon or alloy steel in ratings to 900 lb. The 8" to 16" unit with ratings of 150 lb. or 300 lb. have fabricated tails. Tails are cast for the 600 lb. units. The Figure 6950 unit is not recommended for pressures above 600 psig and / or temperatures above 800°F.

**Installation**

**Figure 6940, 6940M & 6950**

It is recommended that a strainer be installed in the water line before the water valve controlling the flow to the desuperheater. This prevents clog-up from foreign matter in the control mechanism.

The temperature sensor should be installed according to the recommendations found in Appendix 1.

It is important that the sensor be exposed to steam flow to obtain an even temperature control.

**Note**

Schutte & Koerting suggests that the desuperheater be totally insulated upon installation.

**Operation**

**Figure 6940, 6940M & 6950**

1. Set controller to steam temperature desired.
2. Turn on air pressure to controller. Set air pressure reducing valve as per manufacturer's instructions
3. Drain steam line before main steam valve to desuperheater and also drain desuperheater line.
4. Open water supply valve.
5. Open main steam valve slowly until desired flow is obtained.

**Figure 6940,6940M & 6950 Information**

**Maintenance**

**Figure 6940**

The only maintenance necessary to keep the unit in good operating condition is the removal of scale due to evaporation. In order to do this, the desuperheater must first be removed from the line.

Remove steam nozzle by inserting flat plate in grooves provided. Clean scale from nozzle and throat and reassemble the nozzle.

It is advisable to use a new gasket when reassembling the body to the tail before installing the unit in the pipe line.

The simplicity of the venturi type desuperheater presents no operating difficulty. If controller oscillates or hunts to obtain a constant steam temperature it will be necessary to adjust the sensitivity (throttling range) and reset the instrument in accordance with the controller manufacturer's instructions.

**Figure 6940M**

The only maintenance necessary to keep the unit in good operating condition is the removal of scale from the desuperheater internals. The scale forms from evaporation of the desuperheating water.

After removal of the desuperheater from the steam line, remove nozzle from body. Removal all foreign materials from both parts and reassemble.

**Figure 6950**

The only maintenance necessary to keep the unit in good operating condition is the removal of scale due to evaporation. In order to do this, the desuperheater must first be removed from the line.

Remove steam nozzle by inserting flat plate in grooves provided.

Clean scale from nozzle and throat and reassemble the nozzle.

It is advisable to use a new gasket when reassembling the body to the tail before installing the unit in the pipe line.

The simplicity of the venturi type desuperheater presents no operating difficulty. If controller oscillates or hunts to obtain a constant steam temperature it will be necessary to adjust the sensitivity (throttling range) and reset the instrument in accordance with the controller manufacturer's instructions.

***Figure 6940,6940M & 6950 Information***

***Figure 6940 & 6950***

It is also suggested that the following procedure for bolt tightening be followed:

Install the gasket on the gasket seating surface and bring the mating flange in contact with the gasket.

2. Install all bolts, making sure they are free of dirt and grit, and are well lubricated.
3. Run up all nuts finger tight.
4. Develop the required bolt stress in a minimum of three steps, following a traditional alternating bolt tightening procedure. It is important to make certain that no more than 50% of the required bolt stress is achieved on the initial set. Should this occur, serious damage can be done to the spiral wound gasket and subsequent tightening cannot offset the damage. Once a complete cycle of stressing has been achieved, it is not necessary to follow the exact bolting sequence recommended. However, we emphasize the importance for following the sequence in the first application of pre-tightening.

***Note***

Schutte & Koerting suggests that the desuperheater be totally insulated upon installation.

***Controls***

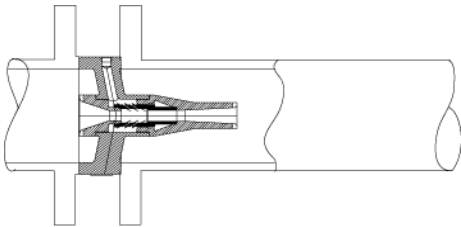
The control scheme used on the Figure 6940, 6940M & 6950 Desuperheaters is described in Appendix 4.

***Appendix 4***

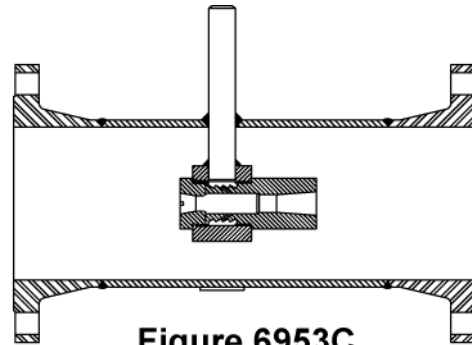
1. Figure 6940, 6940M and 6950 outline dimensional drawings.
2. Piping and Instrumentation Diagrams.

## Figure 6952 & 6953 Attemperator Desuperheater

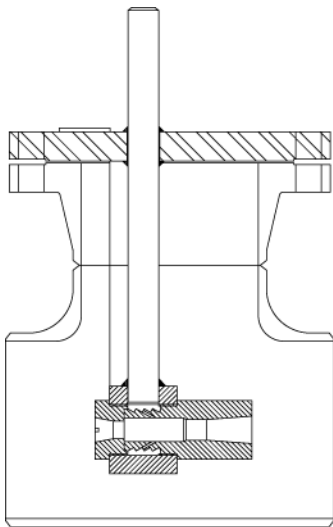
The Figure 6952 and 6953 are attemperator (partial venturi) desuperheaters. Water entering the desuperheater is preheated in the circulatory chamber around the water diffuser tube and is introduced in many small jets to assist final atomization by the steam flow through the center of the throat. When leaving the throat, the mixture of steam and water enters the reduced pressure venturi section for turbulent mixing prior to entering the main steam line in a fog-like condition without contacting the sidewalls which provides maximum desuperheating effectiveness and a minimum of water in the discharge piping.



**Figure 6952**



**Figure 6953C**



**Figure 6953D**



## **Figure 6952 & Figure 6953 Information**

### **Application**

Attenuator Desuperheaters reduce steam temperature by bringing superheated steam into direct contact with water. The steam is cooled through the evaporation of the water.

The unit can be mounted either horizontally or vertically and is normally used for relatively steady load conditions where pressure losses must be minimized. They also offer increased turndown when mounted vertically up.

### **Performance**

Although the Figure 6952 and 6953 is less costly and has negligible pressure losses, it normally does not have the rangeability of the venturi-type units. Actual turndown ratio is dependent upon a wide variety of factors such as installation, amount of residual superheat downstream, piping, etc.

Normal flow variation is 75% to 15% of flow.

The water pressure required need only be as high as the operating steam pressure, due to the internal syphoning action.

### **Turndown**

Minimum velocity in a horizontal run and 10°F superheat is 100 fps (slightly higher than the Venturis), but the unit can be used for velocities as close to 300 fps as is possible. The formula for turndown is:

$$\text{T.D.} = \frac{\text{Calculated Steam Velocity}}{\text{Minimum Steam Velocity}}$$

There is a limitation on the amount of water that can be effectively atomized for a given pipe size, as shown on Curve 74-S-200 on page 28.

Minimum velocity in a vertical installation is 15 fps.

### **Construction**

#### **Figure 6952**

This desuperheater is available in sizes 2" through 24" in cast carbon or alloy steel construction. Internals are stainless steel. Units are limited to applications of 600 psig and for 800°F.

#### **Figure 6953**

This desuperheater is available in sizes 3" through 24" in fabricated carbon or alloy steel construction with pipe, forgings, flanges, etc., in ratings up to 1500 lb. Internals are stainless steel. Carbon steel is used for temperatures below 800°F. Alloy steel is used for temperatures above 800°F.

***Figure 6952 & Figure 6953 Information***

***Installation***

Figure 6952 & 6953 desuperheaters may be installed in a horizontal line or in a vertical line with flow upwards, as determined in the performance guarantee.

A water strainer should be installed in the water line before the water valve controlling the flow to the desuperheater. This prevents foreign matter from clogging the control mechanism.

To install automatic control apparatus use instructions furnished by the manufacturer.

The temperature sensor should be installed according to the recommendations found in Appendix 1.

It is important that the bulb be exposed to steam flow to obtain an even temperature control.

***Note***

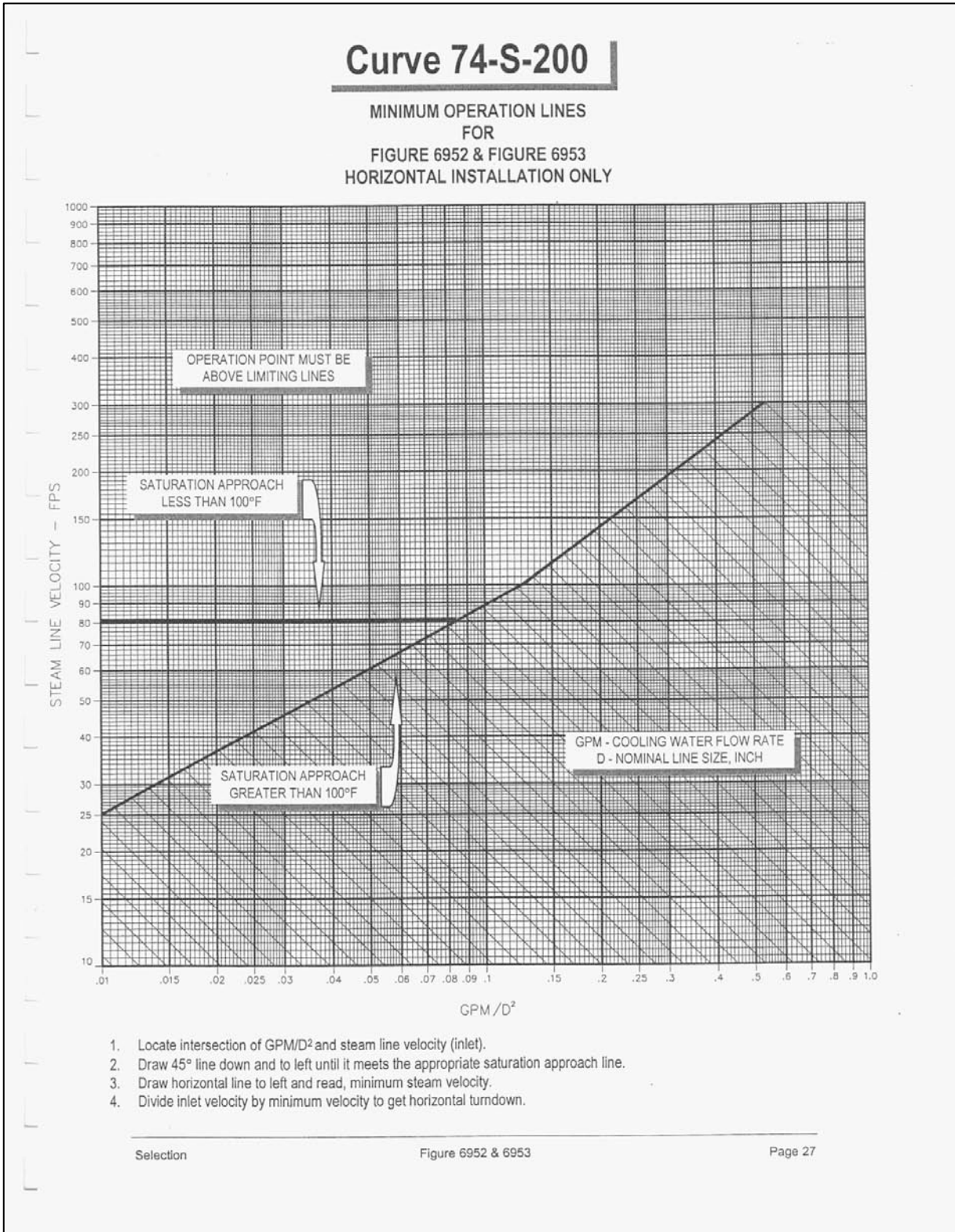
Schutte & Koerting suggests that the desuperheater be totally insulated upon installation.

***Operation***

1. Set controller to steam temperature desired.
2. Turn on air pressure to controller. Set air pressure reducing valve as per manufacturer's instructions.
3. Drain steam line before main steam valve to desuperheater and also drain desuperheater line.
4. Open water supply valve.
5. Open main steam valve slowly until desired flow is obtained.

Figure 6952 & Figure 6953 Information

Curve 74-S-200



## **Figure 6952 & Figure 6953 Information**

### **Maintenance**

#### **Figure 6952 & 6953**

The only maintenance necessary to keep the unit in good operating condition is the removal of scale due to evaporation. In order to do this, the desuperheater must first be removed from the line.

Remove steam nozzle by inserting flat plate in grooves provided. Clean scale from nozzle and throat and reassemble the nozzle.

It is advisable to use a new gasket when reassembling the body to the pipe line.

The simplicity of the Figure 6952 and 6953 desuperheaters presents no operating difficulty. If controller oscillates or hunts, to obtain a constant steam temperature it will be necessary to adjust the sensitivity (throttling range) and reset the instrument in accordance with the controller manufacturer's instructions.

It is also suggested that the following procedure for bolt tightening be followed:

1. Install the gasket on the gasket seating surface and bring the mating flange in contact with the gasket.
2. Install all bolts, making sure they are free of dirt and grit, and are well lubricated.
3. Run up all nuts finger tight.
4. Develop the required bolt stress in a minimum of three steps, following a traditional alternating bolt tightening procedure. It is important to make certain that no more than 50% of the required bolt stress is achieved on the initial set. Should this occur, serious damage can be done to the spiral wound gasket and subsequent tightening cannot offset the damage. Once a complete cycle of stressing has been achieved, it is not necessary to follow the exact bolting sequence recommended. However, we emphasize the importance for following the sequence in the first application of pre-tightening.

### **Controls**

The control scheme used on the Figure 6952 & 6953 Desuperheater is described in Appendix 5.

### **Appendix 5**

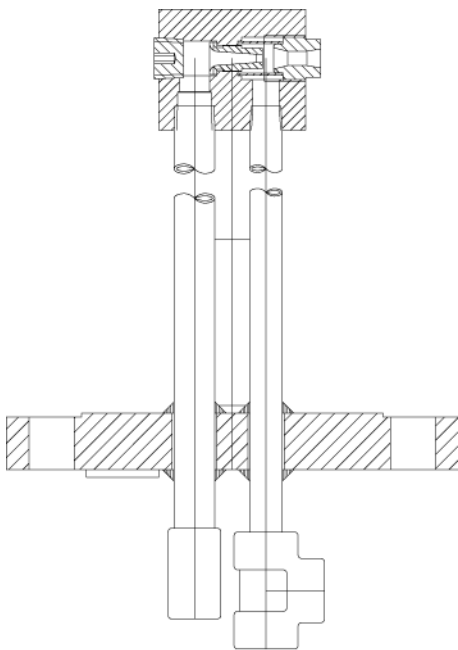
1. Figure 6952 and 6953 outline dimensional drawings.
2. Piping and Instrumentation Diagram.

## Figure 6970 & 6972 Steam Ejector Atomizing Desuperheater

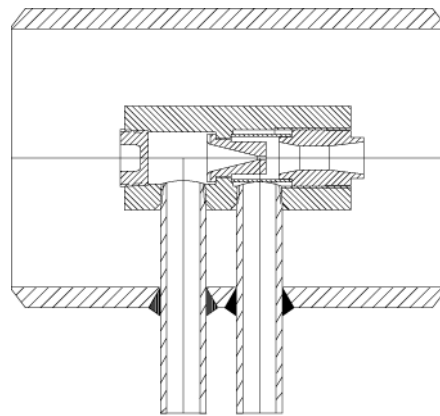
The Figure 6970 & 6972 are ejector-type steam atomizing desuperheaters utilizing steam at pressures higher than the line steam pressure to atomize water. The ejector action of the 6970 is used to entrain condensate from the pipeline.

The 6970 unit employs a recycle system to improve turndown performance to 50:1.

The 6972 unit does not include the recycle feature and thus allows for vertical installation; however, the turndown is considerably lower.



**Figure 6970**



**Figure 6972**

### **Figure 6970 & 6972 Information**

#### **Application**

The Type 6970 serves a wide range of applications. This unit, with adequate controls, provides dependable operation with turndown ratios as high as 50 to 1 depending on exact operating conditions.

The 6970 is recommended for use where sufficient high pressure steam is available to provide the atomizing steam supply. The most frequent application would be in combination reducing-desuperheating stations. The minimum atomizing steam pressure ratio required is 1.4 times the absolute steam pressure through the desuperheater with a minimum atomizing pressure of 50 psig. The required amount is constant.

There are few problems encountered when operating desuperheaters at normal pipeline velocities. But it has been proven conclusively that at low pipeline velocities encountered at  $\frac{1}{50}$  up to  $\frac{1}{4}$  normal flow, when it is desired to approach saturation temperature within 10°F, unvaporized liquid will 'settle out' of a horizontal stream. To overcome this problem, the Type 6970 recycles excess water back into the atomizing device.

The Type 6972 desuperheater is a 6970 unit without the recycle arrangement. It will not provide as high turn-down ratios as Type 6970, but costs less to install and is competitive in cost with other steam atomizing types. Water can be varied over wide flow ranges without affecting atomization. Since spray angle is narrow, there is less impact on piping than with other type nozzle. This unit has negligible pressure drop. Steam is required at a minimum of about 1.4 times the desuperheater absolute pressure with a minimum of 50 psig.

#### **Performance**

This unit has many selling points which include high turndown ratios in which 50:1 and greater can be achieved (for Type 6970 only). It also has a low initial cost, no moving parts and no thermal sleeve is required. The water pressure required need only be as high as the steam pressure, due to the internal syphoning action.

#### **Turndown**

##### **Figure 6970**

Turndown in the atomizing type units is independent of velocity. It is strictly a function of steam flows.

Turndown is typically 50:1, but should not exceed:

$$\frac{\text{Steam Flow}}{\text{Atomizing Steam Flow}}$$

Normal control valves are commercially suitable for about 10:1 maximum water turndown.

##### **Figure 6972**

Turndown on this unit is dependent upon velocity as it is for the Figure 6952. Minimum velocity mounted vertically is 15 fps.

## **Figure 6970 & 6972 Information**

### **Construction**

In the Type 6970, the water preheating and distributing device is installed in a short pipe section with weld neck flanged ends or butt weld ends. This unit can also be mounted on a blind flange for insertion through a nozzle connection. It is recommended that the unit be mounted so that the atomizing steam and water inlet pipes enter the unit from the bottom.

All ratings and materials can be accommodated with these units.

### **Installation**

The 6970 desuperheater must be installed in a horizontal steam line. The atomizing steam and water pipes for the 6970 desuperheater must enter through the bottom of the main steam line.

The 6972, which does not include the recycle feature, may be installed vertically.

The recycle piping should be installed if the expected minimum steam flow is less than 50% of the design maximum flow. The collection pot diameter should be nominally 1/2 the diameter of the main steam line. It is recommended that the pot be installed 10 feet downstream of the desuperheater.

It is suggested that strainers be installed in the water line before the water valve controlling the flow to the desuperheater. This prevents any foreign matter from clogging the control mechanism.

The atomizing steam and water valves should be installed as close to the desuperheater as practical.

The temperature sensor should be installed according to the recommendations found in Appendix 1.

### **Note**

Schutte & Koerting suggests that the desuperheater be totally insulated upon installation.

### **Manual Operation**

1. Drain steam line before main steam pressure reducing valve, if used, as well as the desuperheater line.
2. Open atomizing steam valve fully, cracking the water valve at the same time. Note that the atomizing steam flow is constant, and cannot be throttled with the water flow.
3. Open main steam valve, increasing flow slowly. The water flow should be increased at the same time if desuperheating is desired during the startup.
4. When desired steam flow is reached, adjust water valve to give the desired discharge steam temperature.

### **Automatic Operation**

1. Open all stop valves.
2. Follow instructions for manual startup omitting Step #2.
3. Set control apparatus per instructions provided by the manufacturer.

### **Maintenance**

The unit should not require periodic planned maintenance; however, it may be necessary to remove scale formed by evaporation of water. To do this you must remove unit from steam line. Loosen setscrew and unscrew throat from body. Combining tube should fall out. Remove pipe plug and unscrew nozzle. Clean scale from all parts and reassemble.

***Figure 6970 & 6972 Information***

***Controls***

The control schemes used on the Figure 6970 & 6972 Desuperheaters is described in Appendix 6.

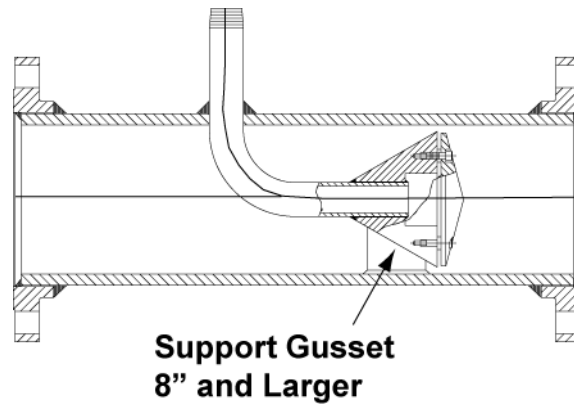
***Appendix 6***

1. Figure 6970 and 6972 outline dimensional drawings.
2. Piping and Instrumentation Diagram.



## Figure 6985 Annular Venturi Desuperheater

The Figure 6985 is an annular venturi desuperheater. Superheated steam is directed by the cone into the annular area between the cone and pipe wall, increasing both velocity and turbulence. Cooling water is introduced through a narrow slot (or small jets in the 1" and 1½" sizes) in the cone at the point of maximum velocity. The combination of velocity and turbulence improves atomization and produces maximum desuperheater effectiveness. The water pressure required should equal the operating steam pressure.



## **Figure 6985 Information**

### **Application**

Annular Venturi Desuperheaters reduce steam temperature by bringing superheated steam into direct contact with water. The steam is then cooled through the evaporation of water. These desuperheaters are recommended for use under a wide range of conditions, including steady and variable flows. They can be installed either horizontally or vertically up. When installed vertically up, turndown ratio can be increased substantially.

### **Performance**

The Type 6985 desuperheater is normally used where atomizing steam is not available. The turndown ratio is dependent on factors such as horizontal or vertical installation, amount of residual superheat and piping. This unit is capable of 2% to 20% flow variation and pressure drop varies between 2 psi and 10 psi.

### **Turndown**

The turndown ratio on the 6985 is dependent on factors such as horizontal or vertical installation, the amount of residual superheat and piping.

### **Construction**

Available in sizes 1" through 4" in stainless steel. 150 or 300 lb. stainless steel R.F. flanges.

Sizes 6" through 16", carbon steel with stainless steel water pipe and venturi cone. Flanged units have 150 or 300 lb. R.F. flanges. Stainless steel units have all stainless steel wetted parts and carbon steel lap joint flanges. Units can also be supplied with butt weld connections.

### **Installation**

The Type 6985 desuperheater may be installed horizontally or vertically up. It is recommended that a strainer be installed in the water line before the water valve controlling the flow to the desuperheater.

The Thermostatic Control Bulb should be at least thirty (30) feet from the discharge end of the desuperheater. It is important that the bulb be exposed to steam flow to obtain an even temperature control. This distance can be reduced with a higher amount of final superheat.

### **Note**

Schutte & Koerting suggests that the desuperheater be totally insulated upon installation.

### **Operation**

1. Set controller to steam temperature desired.
2. Turn on air pressure to controller. Set air pressure reducing valve as per Manufacturer's instructions.
3. Drain steam line before main steam valve to desuperheater and also drain desuperheater line.
4. Open water supply valve.
5. Open main steam valve slowly until desired flow is obtained.
6. Set water pressure reducing valve to required pressure.

### **Maintenance**

The only maintenance necessary to keep unit in operating condition is the removal of scale due to evaporation. In order to do this, grind off tack welds, remove the setscrews in the cone end cap and the end cap. Clean both surfaces, end cap and base cone. To reassemble, replace the end cap setting the proper spacing with shim washers and replace

***Figure 6985 Information***

set screws.

***Controls***

The control scheme used on the Figure 6985 Desuperheater is described in Appendix 7.

***Appendix 7***

1. Figure 6985 outline dimensional drawings.
2. Piping & Instrumentation Diagram.

## Packaged Units with Controls

Schutte & Koerting offers complete control packages for all desuperheaters. The controls offered include all of the following:

- ◆ Steam Pressure Regulators
- ◆ Steam Pressure Control Valves
- ◆ Water Control Valves
- ◆ Temperature Indicators / Transmitters
- ◆ Pressure Indicators / Transmitters
- ◆ Temperature Controllers
- ◆ Pressure Controllers
- ◆ Water and Steam Shutoff Valves
- ◆ Draw Traps
- ◆ Thermowells

All instrumentation is offered as components or integrated into a control package where minimal customer connections are required. Each Appendix contains the recommended control scheme for S&K desuperheaters.

Schutte & Koerting is familiar with and offers a variety of Instrumentation and Valve equipment to compliment the desuperheating equipment. These include:

- Fisher
- Baumann
- Leslie

Since a desuperheater is not a single piece of equipment that succeeds or fails on its own, the complete system design and engineering is critical. S&K offers the entire desuperheat and control package based on 75 years of desuperheating knowledge and experience.