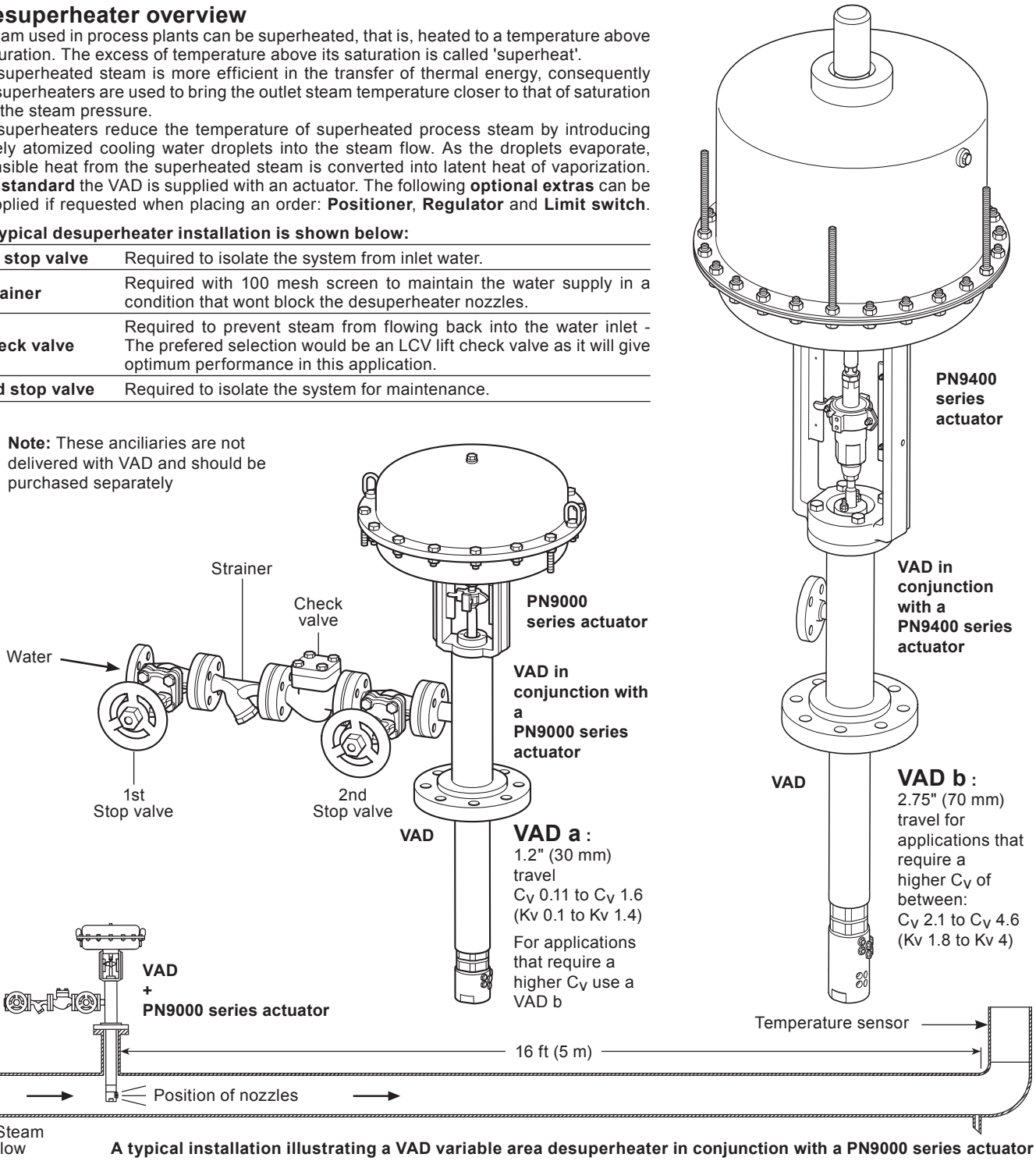
VAD
Variable Area Desuperheaters

Desuperheater overview

Steam used in process plants can be superheated, that is, heated to a temperature above saturation. The excess of temperature above its saturation is called 'superheat'.
Desuperheated steam is more efficient in the transfer of thermal energy, consequently desuperheaters are used to bring the outlet steam temperature closer to that of saturation for the steam pressure.
Desuperheaters reduce the temperature of superheated process steam by introducing finely atomized cooling water droplets into the steam flow. As the droplets evaporate, sensible heat from the superheated steam is converted into latent heat of vaporization.
As standard the VAD is supplied with an actuator. The following **optional extras** can be supplied if requested when placing an order: **Positioner**, **Regulator** and **Limit switch**.

A typical desuperheater installation is shown below:

1st stop valve	Required to isolate the system from inlet water.
Strainer	Required with 100 mesh screen to maintain the water supply in a condition that wont block the desuperheater nozzles.
Check valve	Required to prevent steam from flowing back into the water inlet - The prefered selection would be an LCV lift check valve as it will give optimum performance in this application.
2nd stop valve	Required to isolate the system for maintenance.



A typical installation illustrating a VAD variable area desuperheater in conjunction with a PN9000 series actuator

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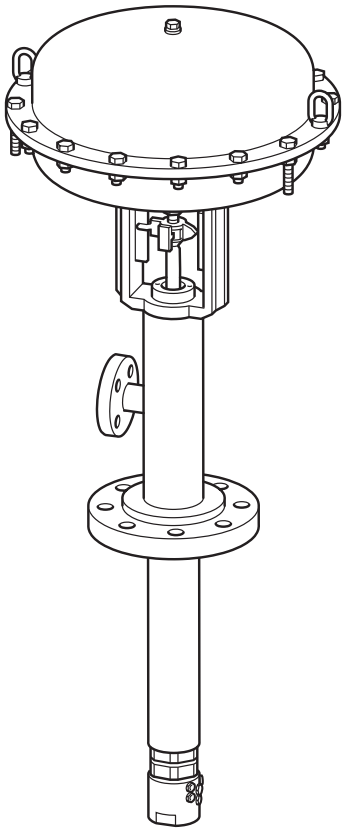
General description

Spirax Sarco VAD variable area desuperheaters reduce the temperature of superheated steam by spraying atomized water through a variable area nozzle, producing near-saturated steam for a wide steam turndown ratio (max 50:1). There are two VAD options available depending on the C_V value and control rangeability required for the application.

VAD a

in conjunction with a PN9000 series actuator

1.2" (30 mm) travel C_V 0.11 to C_V 1.6 (Kv 0.1 to Kv 1.4)



Description

The **VAD a** variable area desuperheater has been designed to perform between a C_V of 0.11 to C_V 1.6 (Kv 0.1 to Kv 1.4)

The main advantages of the Spirax Sarco VAD is its full modularity, as the components can be adjusted to meet each individual application needs; on site if needed. The nozzle can also be replaced to accommodate a change in flow requirement. The cooling water is atomized through a number of nozzles which are successively opened by the linear movement of a plug controlled by the actuator.

As standard, it is designed and coupled with the PN9000 Series actuator 1.2" (30 mm) travel.

The steam branch line connection is 3" (DN80) as standard, but could be customized at the required dimension.

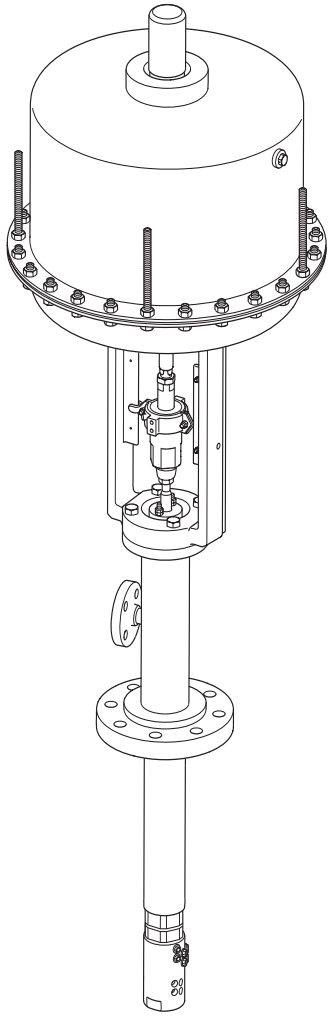
The water connection is ½" (DN15) as standard, but could be customized.

The standard dimensional lengths of the top and bottom pipe extensions of the desuperheater, as well as the position of the water connection, are shown on the corresponding pages, but please note that these can be customized to meet any specific application to meet your needs.

VAD b

in conjunction with a PN9400 series actuator

2.75" (70 mm) travel C_V 2.1 to C_V 4.6 (Kv 1.8 to Kv 4)



Description

As standard, the **VAD b** is designed to and coupled with the PN9400 Series actuator. The water atomization is done through up to 18 nozzles which are successively opened with the linear move of the plug.

The steam branch line connection is 3" (DN80) as standard, but could be customized at the required dimension.

The water connection is ½" (DN15) as standard, but could be customized or increased for a higher C_V than 4.6

The standard dimensional lengths of the top and bottom pipe extensions of the desuperheater, as well as the position of the water connection are shown on the corresponding pages, but please note that these can be customized to meet any specific application to meet your needs.

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Typical applications:

- To reduce the temperature of steam discharged from turbine by-pass systems on power plants for heat exchangers, and dump stations.
- To improve heat transfer of indirect contact heat exchangers - shell and tube, plate type, and reactor heating jackets.
- To reduce the temperature of steam on direct contact applications - food cooking kettles, in-line steam heaters, tobacco drying plant and paper mills.

Features:

- Low cost simple, robust design.
- Minimal steam pressure drop.
- Flexible design options.

Standards and approvals

Spirax Sarco desuperheaters are available built to ASME B 16.34 design code. Also available are ASME VIII Division 1.
This product fully complies with the requirements of the European Pressure Equipment Directive 97 / 23 / EC and carries the CE mark when so required.
Welding is in accordance with ASME IX.
Connections (EN 1092 or ASME B16.5) are sized to suit the process conditions.
Standard ASTM materials of construction include: Carbon steel, Stainless steel, and Chrome molybdenum steel.

Certification

The following certificates / documents can be supplied at an additional cost:

- Material certificates to EN 10204 3.1 with a corresponding material location diagram.
- NDT reports.

Air signal

The VAD lift should be controlled by use of a positioner, the maximum air pressure on the actuator should be limited to 60 psig (4 barg). **The fail safe position of the standard VAD** unit is in the shut off position, spring-retact and will shut off water when retracted. **Optionally**, if request at the point of order, the unit can be supplied in the fail safe open position and the unit nomenclature will be denoted by an 'E' (for spring-extend) in the description i.e. VAD a E.

Positioners

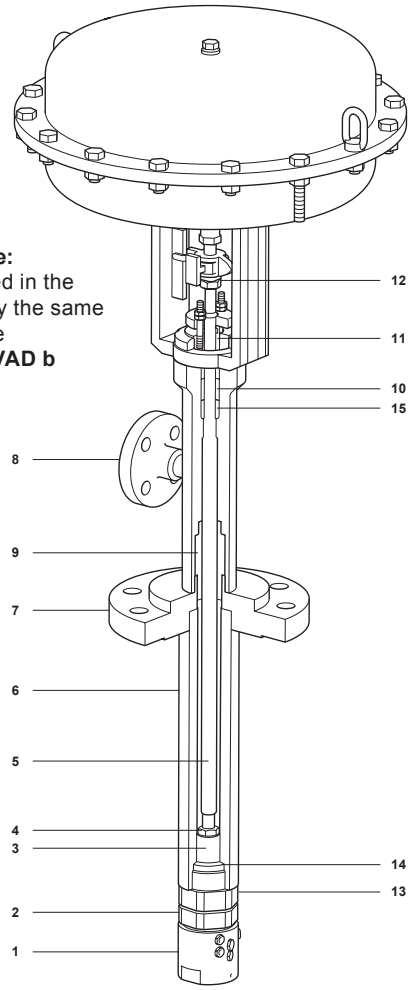
Compatible with PP5, EP5, ISP5, SP400 and SP500 positioners.

Material

No.	Part	Material	
1	Nozzle	Stainless steel	AISI 431
2	Seat	Stainless steel	AISI 431
3	Plug	Stainless steel	
4	Lock-nut	Stainless steel	
5	Stem	Stainless steel	AISI 431
6	Bottom pipe extension	Carbon steel	
7	Main steam flange	Carbon steel	ASTM A105N
8	Water flange	Carbon steel	ASTM A105N
9	Top pipe extension	Carbon steel	ASTM A105N
10	Packing	Graphite	
11	Packing bolting	Stainless steel	
12	Nut	Stainless steel	
13	Setting nut	Stainless steel	
14	Seat gasket	Graphite	
15	Stem bearing	Stellite Grade 6	

Alternative material: Depending on the condition of use, Spirax Sarco can change the carbon steel body material to alloy steel or stainless steel.

Please note:
The parts identified in the illustration are exactly the same for both the **VAD a** and the **VAD b**



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Pressure / temperature limits:

The Spirax Sarco VAD variable area desuperheater has a carbon steel body as standard but can be produced in any material grade to special order.
'**4**' denotes a carbon steel desuperheater
'**6**' denotes an austenitic stainless steel desuperheater
'**8**' denotes an alloy steel desuperheater

Please note that the pressure and temperature limits for the VAD product range is governed by the flange connection of choice:

	Flanges	PMA psig @ °F (bar g @ °C)	TMA °F @ psig (°C @ bar g)
VAD4	ASME 150	284 @ 100°F (19.6 @ 38°C)	800°F @ 80 (425°C @ 5.5)
	ASME 300	746 @ 100°F (51.5 @ 38°C)	800°F @ 420 (425°C @ 28.8)
	ASME 600	1480 @ 100°F (102.1 @ 38°C)	800°F @ 835 (425°C @ 57.5)
	ASME 900	2220 @ 100°F (153.2 @ 38°C)	800°F @ 1250 (425°C @ 86.3)
	ASME 1500	3700 @ 100°F (255.3 @ 38°C)	800°F @ 2085 (425°C @ 143.8)
	ASME 2500	6170 @ 100°F (425.5 @ 38°C)	800°F @ 3475 (425°C @ 239.7)
VAD6 (316)	ASME 150	275 @ 100°F (19.0 @ 38°C)	1000°F @ 20.5 (538°C @ 1.4)
	ASME 300	720 @ 100°F (49.6 @ 38°C)	1000°F @ 365 (538°C @ 25.2)
	ASME 600	1440 @ 100°F (99.3 @ 38°C)	1000°F @ 725 (538°C @ 50.0)
	ASME 900	2160 @ 100°F (148.9 @ 38°C)	1000°F @ 1090 (538°C @ 75.2)
	ASME 1500	3600 @ 100°F (248.2 @ 38°C)	1000°F @ 1820 (538°C @ 125.5)
	ASME 2500	4000 @ 100°F (413.7 @ 38°C)	1000°F @ 3030 (538°C @ 208.9)
VAD8 (A182 F11 Cl.2)	ASME 150	285 @ 100°F (19.8 @ 38°C)	1000°F @ 20.5 (538°C @ 1.4)
	ASME 300	750 @ 100°F (51.7 @ 38°C)	1000°F @ 215 (538°C @ 14.9)
	ASME 600	1500 @ 122°F (103.4 @ 50°C)	1000°F @ 430 (538°C @ 29.8)
	ASME 900	2250 @ 122°F (155.1 @ 50°C)	1000°F @ 650 (538°C @ 44.7)
	ASME 1500	3750 @ 122°F (258.6 @ 50°C)	1000°F @ 1080 (538°C @ 74.5)
	ASME 2500	6250 @ 122°F (430.9 @ 50°C)	1000°F @ 1800 (538°C @ 124.1)

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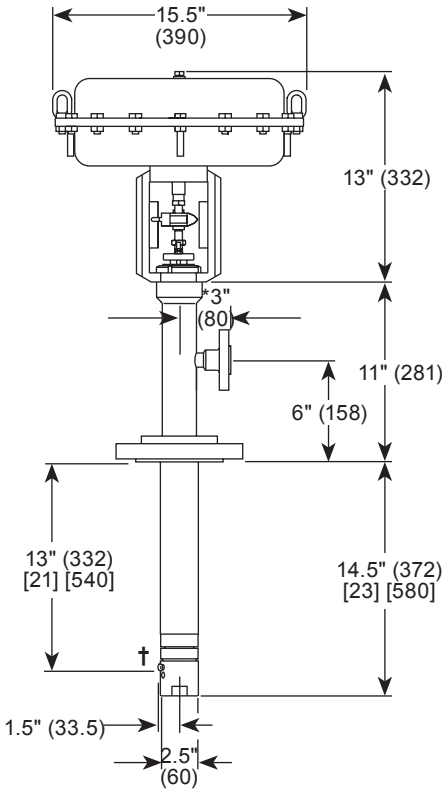
Dimensions / weights (approximate) in inches and pounds (mm and kg)

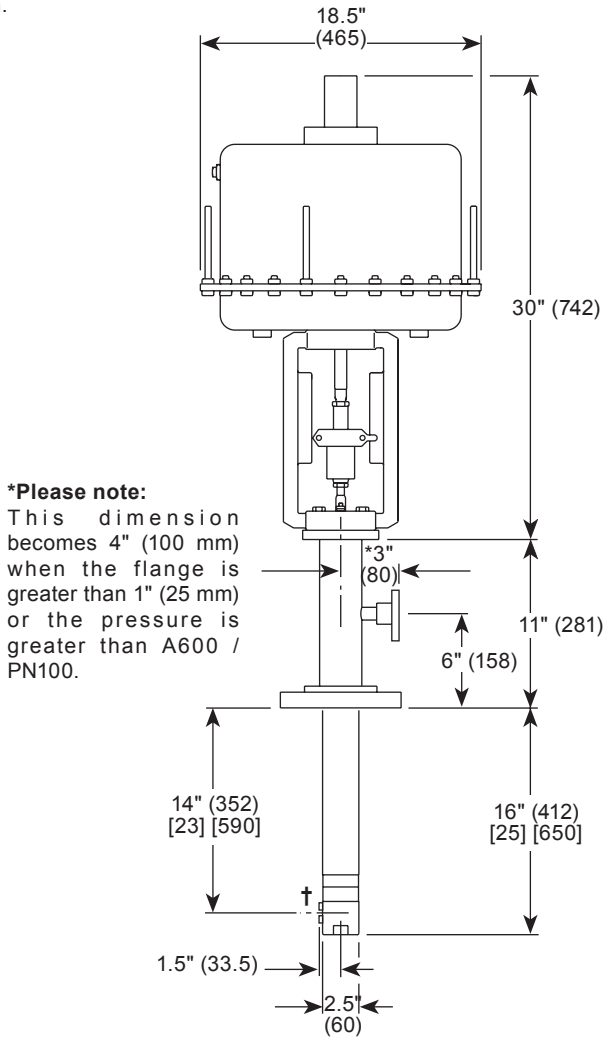
Dimensionally there are **two versions** available the '**Standard**' and the '**L**' version for use on larger pipelines of 12" (300 mm). **Please note** that the dimensions in brackets [ ] are for the 'L' version.

Weights

VAD a	80 lbs (35 kg)
VAD b	155 lbs (70 kg)



VAD a



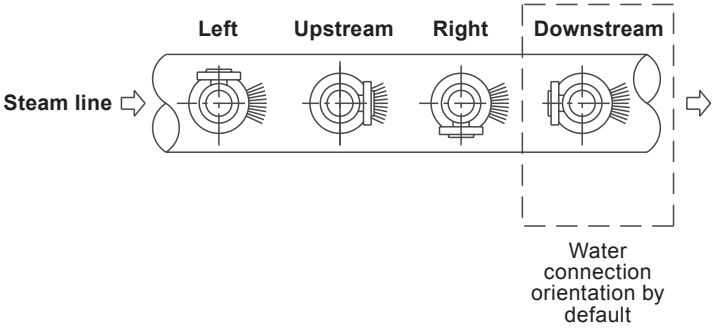
VAD b

***Please note:**
This dimension becomes 4" (100 mm) when the flange is greater than 1" (25 mm) or the pressure is greater than A600 / PN100.

† Please note - Nozzles

When installing the VAD into its application **the nozzles must face towards the direction of the steam flow**. To suit the layout of the water pipeline, the inlet water flange is available in 4 different locations, please see the orientation diagram below:

Orientation



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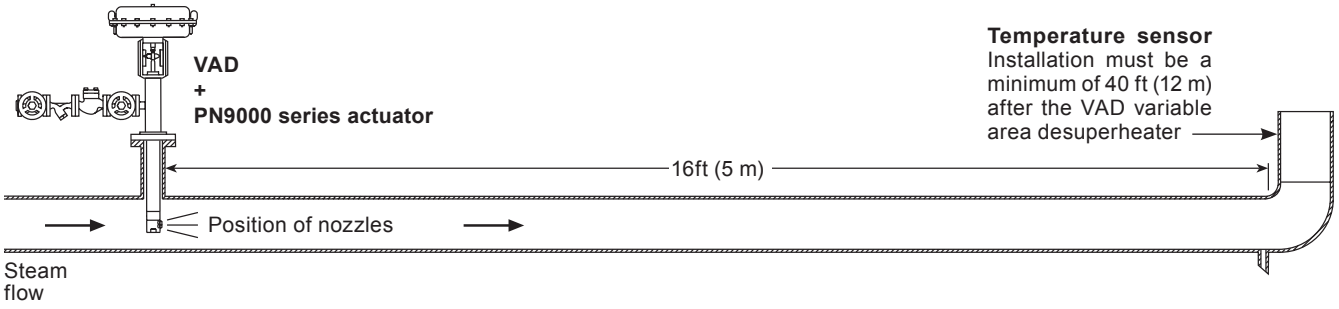
Safety information, installation and maintainance

For full details see the Installation and Maintenance Instructions that are supplied with the product.

Installation note:

Desuperheaters may be installed either horizontally or vertically with the steam flowing upwards.
Spirax Sarco strongly advizes against installations in which the steam flow is vertically downwards.
In the case of a horizontal installation the cooling water connection should ideally point downstream, as this gives the best orientation for drainage of fluids in a shutdown situation. Other orientations are acceptable for satisfactory operation, but drainage is not as effective.
In a vertical installation we recommend that, the cooling water pipework should be brought to the desuperheater from below the corresponding connections on the desuperheater. This will provide the best layout for drainage of fluids on shutdown.
The VAD must be sited in location on the pipeline that offers a stable flow - An unstable flow will affect the mixing efficiency of the VAD.



The **temperature sensor** should be located a minimum distance of 40 ft (12 m) after the VAD, however for optimum temperature control it is recommended that it be installed at the point of use.
A **minimum length of 16 ft (5 m)** should be present before a pipe elbow. A thermal sleeve is recommended to protect the elbow from corrosion and erosion.
The **steam pipeline** should be of at least 6" (DN150). At steam line sizes up to and including 20" NB, we recommend the thermal sleeve is manufactured from pipe which is one size smaller than the steam line. Above 20" NB steam line size, we recommend the thermal sleeve is two sizes smaller.
Pipe size should ensure a minimum 16 ft/sec (5m/s) velocity in each flowrate, in case of lower value please contact Spirax Sarco.
Water must be supplied with more than 45 psi (3 bar) differential pressure to the steam.

Disposal

The product is recyclable. No ecological hazard is anticipated with disposal of this product, providing due care is taken.

The location of the VAD in the pipeline must be such that it offers a stabilized flow. Unstabilized flow will affect the mixing efficiency.

The VAD must be sited in location on the pipeline that offers a stable flow - Unstabilized flow will affect the mixing efficiency.

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How to order

Please send the following process data to Spirax Sarco so that we can select the optimum solution for your application.

Minimum information required to size the desuperheater:

- Maximum and minimum superheated steam condition (Pressure, temperature and flowrate).
- Required outlet steam temperature.
- Available water condition (Pressure and temperature).

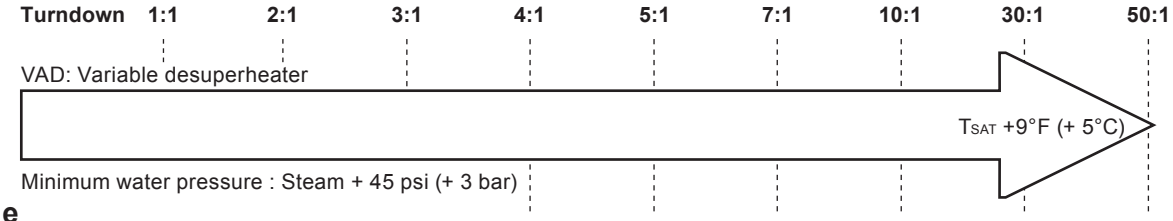
		Minimum	Nominal	Maximum
Superheated steam	Pressure			
	Temperature			
	Flow			
Steam outlet	Temperature			
Water	Pressure			
	Temperature			

Additional information	Please state if you require any of the following, the number(s) required and nomenclature if known:	**Positioner(s)**	**Air regulator(s)**	**Limit switch(s)**

Further information, that if supplied, will help in selecting the optimal solution for your application:

Design pressure	
Design temperature	
Superheated steam size	
Required flanged desuperheaters flange	
Required flanged water flange	
Fail safe position - Specify either Open or Closed	

Selection chart



Cv (Kv) table

Desuperheater	VAD a	VAD b
Travel	1.2 (30 mm)	2.75 (70 mm)
Rangeability	1 : 20	1 : 40
Maximum turndown	50 : 1	50 : 1
Cv (Kv) standard	1.6 (1.40)	4.6 (4.0)
	1.15 (1.00)	4.3 (3.7)
	0.7 (0.60)	3.8 (3.3)
	0.6 (0.54)	3.3 (2.9)
	0.5 (0.45)	2.9 (2.5)
	0.45 (0.40)	2.4 (2.1)
	0.25 (0.20)	2.1 (1.8)
	0.11 (0.10)	

Note: For lower or higher C_V please contact Spirax Sarco

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