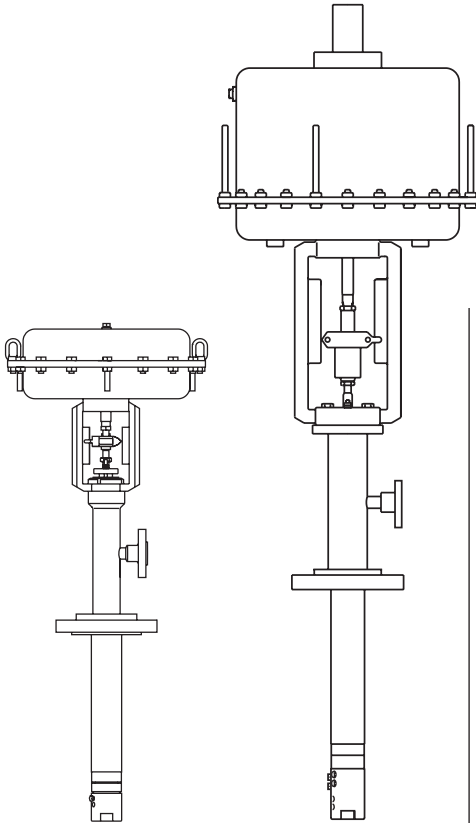


VAD

Variable Area Desuperheaters

Installation and Maintenance Instructions



VAD
+
PN9000
series actuator

VAD
+
PN9400
series actuator

1. Safety information
2. General product information
3. Installation
4. Operation
5. Commissioning
6. Maintenance and spare parts
7. Troubleshooting

1. Safety information

Safe operation of these products can only be guaranteed if they are properly installed, commissioned, used and maintained by qualified personnel (see Section 1.11) in compliance with the operating instructions. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.


Unit inspection and performance confirmation

Receiving the unit and inspection: Spirax Sarco carries out full inspection of all units before despatch, however damage may have occurred during transit. On receipt of the unit, a visual inspection will highlight any external damage and hence indicate any internal damage that may have occurred. If this is the case please contact us immediately.

User's rating inspection: Before installing the VAD, the user must ensure the mechanical rating of the unit is suitable for the intended application. Details of the mechanical rating can be found on the name-plate and associated documentation for the unit.

1.1 Intended use

Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended use/application.

The products listed below comply with the requirements of the European Pressure Equipment Directive 2014/68/EU and carry the  mark when so required.

It should be noted that products rated as 'SEP' are required by the Directive not to carry the mark. The products fall within the Pressure Equipment Directive categories as shown below:

	Product	Group 2 Gases	Group 2 Liquids
VAD	PN16, PN25	1	SEP
	ASME 150		
	PN40 - PN400	1	SEP
	ASME 300 - ASME 2500		

- i) The products have been specifically designed for use on water/condensate which are in Group 2 gases and liquids of the above mentioned Pressure Equipment Directive. They could also be used on Group 1 gases and liquids. The products use on other fluids may be possible but, if this is contemplated, Spirax Sarco should be contacted to confirm the suitability of the product for the application being considered.
- ii) Check material suitability, pressure and temperature and the maximum and minimum design pressure and design temperature values on the product name-plate. If the maximum operating limits of the product are lower than those of the system in which it is being fitted, or if malfunction of the product could result in a dangerous overpressure or over-temperature occurrence, ensure a safety device is included in the system to prevent such over-limit situations.
- iii) Determine the correct installation situation and direction of fluid flow.
- iv) Spirax Sarco products are not intended to withstand external stresses that may be induced by any system to which they are fitted. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimise them.
- v) Remove protective covers from all connections and protective film from all name-plates, where appropriate, before installation on steam and water lines.

1.2 Access

Ensure safe access and if necessary a safe working platform (suitably guarded) before attempting to work on the product. Arrange suitable lifting gear if required.

1.3 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

1.4 Hazardous liquids or gases in the pipeline

Consider what is in the pipeline or what may have been in the pipeline at some previous time. Consider: flammable materials, substances hazardous to health, extremes of temperature.

1.5 Hazardous environment around the product

Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits), dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery.

1.6 The system

Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolation valves, electrical isolation) put any other part of the system or any personnel at risk?

Dangers might include isolation of vents or protective devices or the rendering ineffective of controls or alarms. Ensure isolation valves are turned on and off in a gradual way to avoid system shocks.

1.7 Pressure systems

Ensure that any pressure is isolated and safely vented to atmospheric pressure. Consider double isolation (double block and bleed) and the locking or labelling of closed valves. Do not assume that the system has depressurised even when the pressure gauge indicates zero.

1.8 Temperature

Allow time for temperature to normalise after isolation to avoid danger of burns.

1.9 Tools and consumables

Before starting work ensure that you have suitable tools and/or consumables available. Use only genuine Spirax Sarco replacement parts.

1.10 Protective clothing

Consider whether you and/or others in the vicinity require any protective clothing to protect against the hazards of, for example, chemicals, high/low temperature, radiation, noise, falling objects, and dangers to eyes and face.

1.11 Permits to work

All work must be carried out or be supervised by a suitably competent person. Installation and operating personnel should be trained in the correct use of the product according to the Installation and Maintenance Instructions.

Where a formal 'permit to work' system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person should know what work is going on and, where necessary, arrange to have an assistant whose primary responsibility is safety.

Post warning notices if necessary.

1.12 Handling

Manual handling of large and/or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

1.13 Residual hazards

In normal use the external surface of the product may be very hot. If used at the maximum permitted operating conditions the surface temperature of some products may reach temperatures of 580 °C (1076 °F).

Many products are not self-draining. Take due care when dismantling or removing the product from an installation (refer to 'Maintenance instructions').

1.14 Freezing

Provision must be made to protect products which are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

1.15 Disposal

Unless otherwise stated in the Installation and Maintenance Instructions, this product is recyclable and no ecological hazard is anticipated with its disposal providing due care is taken.

Please visit the Spirax Sarco product compliance web pages

<https://www.spiraxsarco.com/product-compliance>

for up to date information on any substances of concern that may be contained within this product. Where no additional information is provided on the Spirax Sarco product compliance web page, this product may be safely recycled and/or disposed providing due care is taken. Always check your local recycling and disposal regulations.

1.16 Returning products

Customers and stockists are reminded that under EC Health, Safety and Environment Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

2. General product information

2.1 General description

Spirax Sarco VAD variable area desuperheaters reduce the temperature of superheated steam by spraying atomised 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 Kv value and control rangeability required for the application:

- **VAD a** for 30 mm travel and Kv 0.1 to Kv 1.4
- **VAD b** for 70 mm travel and Kv 1.8 to Kv 4.0

VAD a with a PN9000 series actuator

30 mm travel Kv 0.1 to Kv 1.4

Description

The **VAD a** variable area desuperheater has been designed to perform between a K_v of 0.1 to K_v 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 atomised 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 a PN9000 Series actuator 30 mm travel.

The steam branch line connection is DN80 as standard, but could be customised at the required dimension. The steam line should be 100 mm as a minimum.

The water connection is DN25 as standard, but could be customised.

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 in Section 2.3, but please note that these can be customised to meet any specific application to meet your needs.

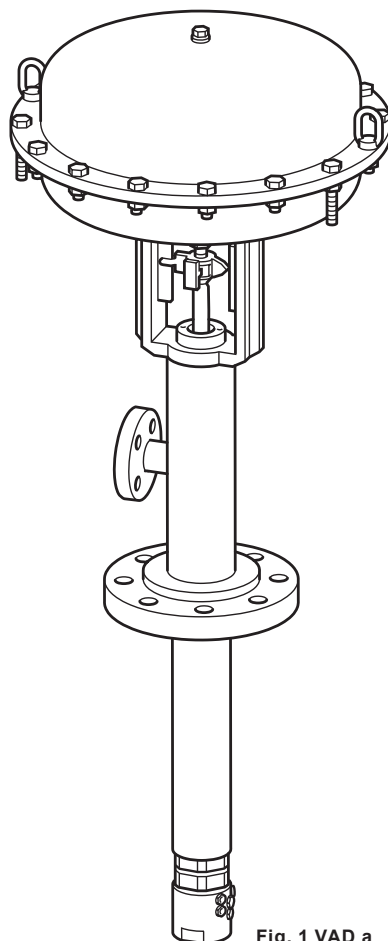


Fig. 1 VAD a

VAD b with a PN9400 series actuator

70 mm travel Kv 1.8 to Kv 4.0

Description

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

The steam branch line connection is DN80 as standard, but could be customised at the required dimension. The steam line should be 100 mm as a minimum

The water connection is DN25 as standard, but could be customised or increased for a K_V higher than 4.

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 in Section 2.3, but please note that these can be customised to meet any specific application to meet your needs.

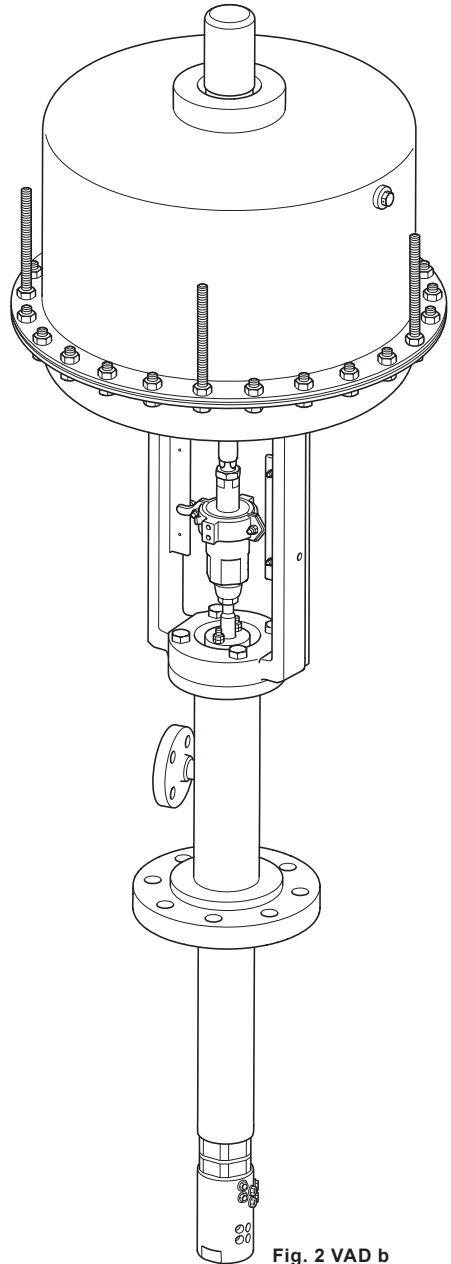


Fig. 2 VAD b

2.2 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 are governed by the flange connection of choice:

	Flanges	PMA bar g @ °C	TMA °C @ bar g
VAD4	ASME 150	19.6 @ 38 °C	425 °C @ 5.5
	ASME 300	51.5 @ 38 °C	425 °C @ 28.8
	ASME 600	102.1 @ 38 °C	425 °C @ 57.5
	ASME 900	153.2 @ 38 °C	425 °C @ 86.3
	ASME 1500	255.3 @ 38 °C	425 °C @ 143.8
	ASME 2500	425.5 @ 38 °C	425 °C @ 239.7
	PN40	40.0 @ 50 °C	400 °C @ 23.8
	PN63	63.0 @ 50 °C	400 °C @ 37.5
	PN100	100.0 @ 50 °C	400 °C @ 59.5
	PN160	160.0 @ 50 °C	400 °C @ 95.2
	PN250	250.0 @ 50 °C	400 °C @ 148.8
	PN320	320.0 @ 50 °C	400 °C @ 190.4
	PN400	400.0 @ 50 °C	400 °C @ 238.0

	Flanges	PMA bar g @ °C	TMA °C @ bar g
VAD6 (316)	ASME 150	19.0 @ 38 °C	538 °C @ 1.4
	ASME 300	49.6 @ 38 °C	538 °C @ 25.2
	ASME 600	99.3 @ 38 °C	538 °C @ 50.0
	ASME 900	148.9 @ 38 °C	538 °C @ 75.2
	ASME 1500	248.2 @ 38 °C	538 °C @ 125.5
	ASME 2500	413.7 @ 38 °C	538 °C @ 208.9
	PN40	40.0 @ 100 °C	580 °C @ 25.0
	PN63	63.0 @ 100 °C	580 °C @ 39.5
	PN100	100.0 @ 100 °C	580 °C @ 62.7
	PN160	160.0 @ 100 °C	580 °C @ 100.3
	PN250	250.0 @ 100 °C	580 °C @ 156.7
	PN320	320.0 @ 100 °C	580 °C @ 200.6
	PN400	400.0 @ 100 °C	580 °C @ 250.8
	VAD8 (A182 F11 Cl.2)	ASME 150	19.8 @ 38 °C
ASME 300		51.7 @ 38 °C	538 °C @ 14.9
ASME 600		103.4 @ 50 °C	538 °C @ 29.8
ASME 900		155.1 @ 50 °C	538 °C @ 44.7
ASME 1500		258.6 @ 50 °C	538 °C @ 74.5
ASME 2500		430.9 @ 50 °C	538 °C @ 124.1
PN40		40.0 @ 300 °C	490 °C @ 27.2
PN63		63.0 @ 300 °C	490 °C @ 42.8
PN100		100.0 @ 300 °C	490 °C @ 68.0
PN160		160.0 @ 300 °C	490 °C @ 108.8
PN250		250.0 @ 300 °C	490 °C @ 170.0
PN320		320.0 @ 300 °C	490 °C @ 217.6
PN400		400.0 @ 300 °C	490 °C @ 272.0

VAD Variable Area Desuperheaters

2.3 Dimensions / weights (approximate) in mm and kg

Dimensionally there are **two versions** available the 'Standard' and the 'L' version for use on larger pipelines of 300 mm.

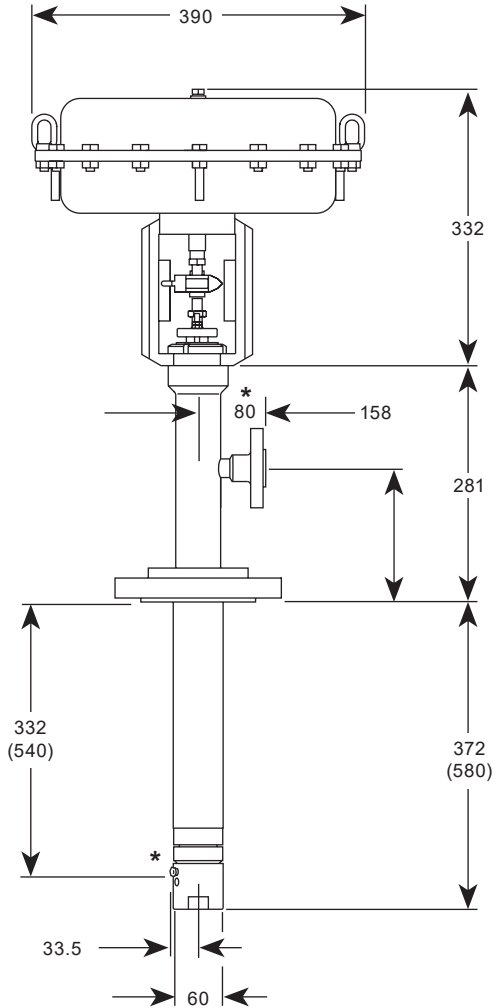
Please note that the dimensions in brackets () are for the 'L' version.

Weights

VAD a	35 kg
VAD b	70 kg

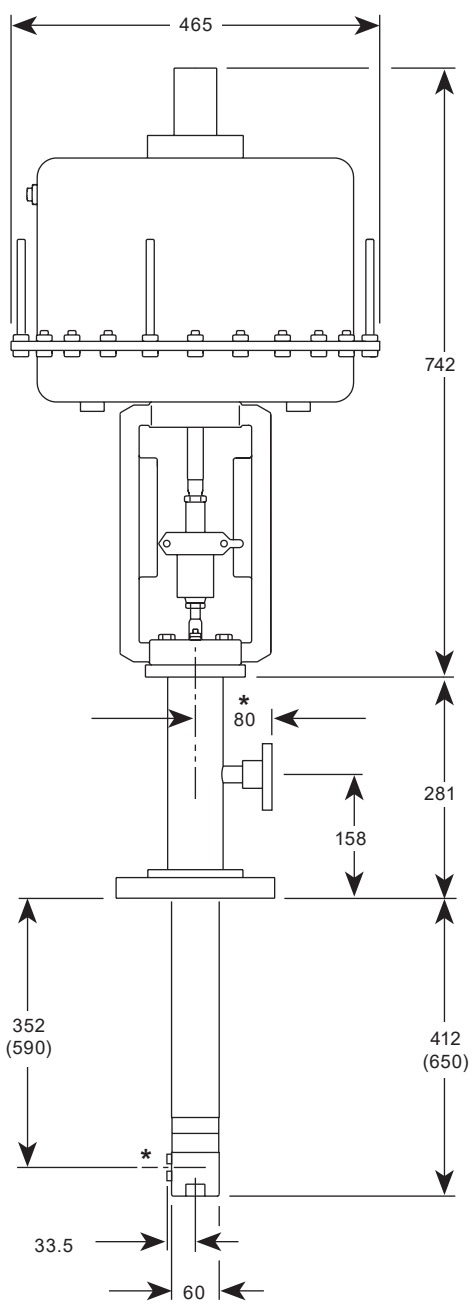
VAD a

Fig. 3



VAD b

Fig. 4



*** Please note:**
This dimension becomes 100 mm when the flange is greater than 25 mm or the pressure is greater than A600 / PN100

3. Installation

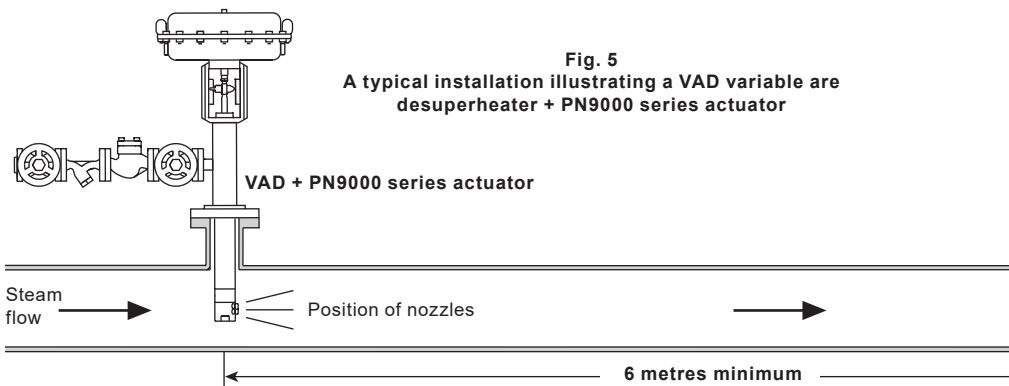
Note: Please read Section 1, 'Safety information' before proceeding with installation.

Warning: Read all of Section 3 before installing the unit !

3.1 General

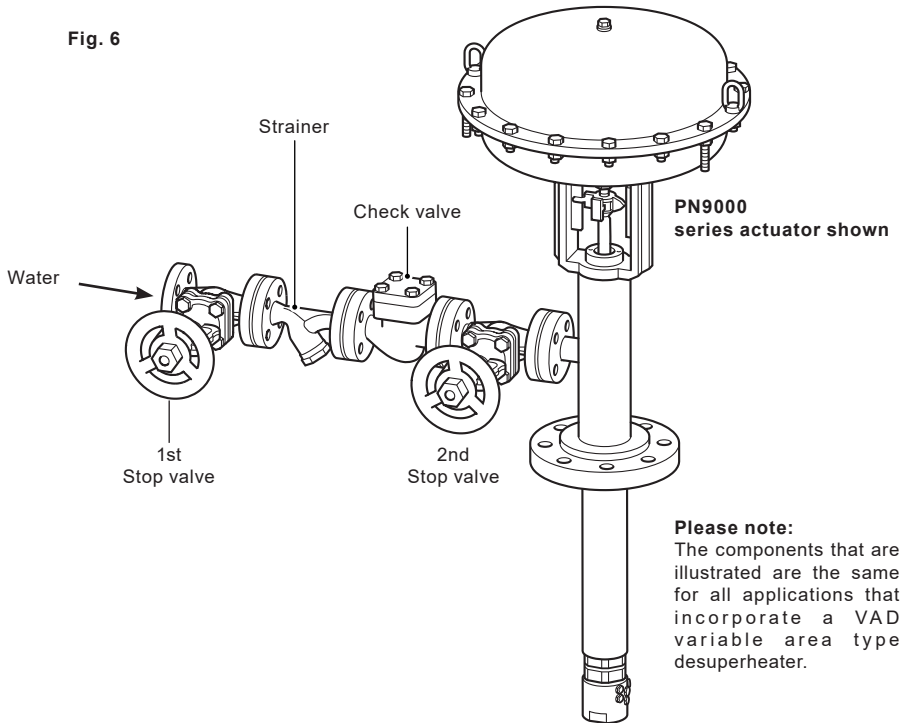
It is important that installation should only be carried out by qualified, experienced personnel, who are familiar with fitting desuperheaters, and who have read and understood the instructions in this IM. Referring to the Installation and Maintenance Instruction, name-plate and Technical Information Sheet, check that the product is suitable for the intended installation.

- Check materials, pressure and temperature and their maximum values. If the maximum operating limit of the product is lower than that of the system in which it is being fitted, ensure that a safety device is included in the system to prevent overpressurisation.
- Remove protective covers from all connections and protective film from all name-plates, where appropriate, before installation on steam and water lines.
- Determine the correct installation situation and the direction of fluid flow:
 - i) Desuperheaters may be installed either horizontally or vertically with the steam flowing upwards.
 - ii) Spirax Sarco strongly advises against installations in which the steam flow is vertically downwards.
- The temperature sensor should be located a minimum distance calculated on the sizing sheet after the VAD, however for optimum temperature control it is recommended that it be installed at the point of use.
- Allow a minimum of 6 metres of pipeline before an elbow. A thermal sleeve is recommended to protect the elbow from corrosion and erosion.
- The smallest steam pipeline that can be considered for an application using the VAD type desuperheater is 150 mm - We also recommend that a thermal sleeve be used on the steam pipeline after the desuperheater - See Section 3.2.1.
- The differential pressure between steam and water must be more than 3 bar for the water.
- 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.
- **Never use the water connection to carry the product.**



VAD Variable Area Desuperheaters

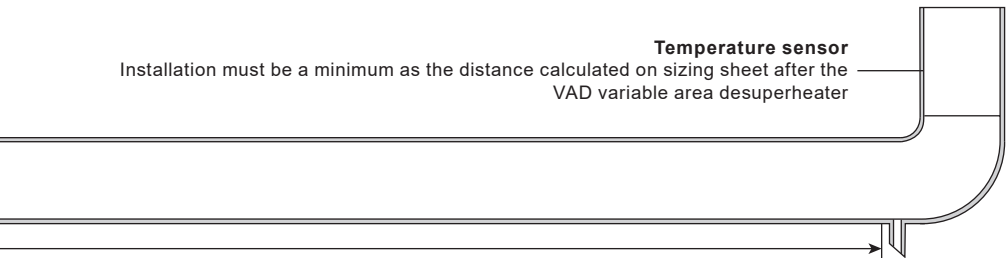
Fig. 6



A typical desuperheater installation is shown above:

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 preferred selection would be an LCV lift check valve as it will give optimum performance in this type of application application.
2nd stop valve	Required to isolate the system for maintenance.

Temperature sensor
 Installation must be a minimum as the distance calculated on sizing sheet after the VAD variable area desuperheater



VAD Variable Area Desuperheaters



3.2 Installation considerations

3.2.1 Thermal sleeve

We strongly recommend that a thermal sleeve is installed in the steam line.

The purpose of the thermal sleeve is three-fold:

- The thermal sleeve allows circulation of superheated steam through the annular area between the outside of the sleeve and the inside diameter of the shell. This arrangement heats the thermal sleeve and provides a hot surface on which serves to assist the evaporation of the water droplets. It aids operation of the VAD at the bottom of its operating range when the spray pattern of the nozzle is not at its most efficient.
- It protects the pipe from erosion due to the impingement of the sprayed water droplets and
- It prevents local thermal shock (and possible subsequent stress corrosion) in the pipe wall where the cold water would otherwise impinge on the hot pipe.

The thermal sleeve shall be located such that the spray of water droplets is directed towards it. The spray angle of the spray nozzles used in the VAD design is 70° inclusive angle.

We recommend the use of Schedule 10 stainless steel for the thermal sleeve or standard wall thickness.

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.

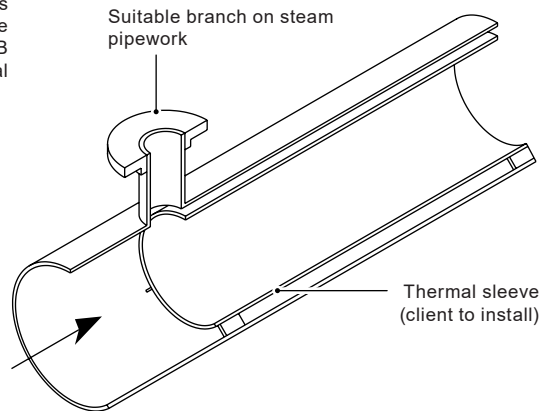


Fig. 7

Steam in

3.2.2 Steam piping upstream of the desuperheater

- Where noise from the PRV pressure reducing valve is expected to be a problem, consider making this pipe thicker than that required to just contain the pressure. This will help reduce noise levels emitted to atmosphere. Under extreme conditions this pipe may have to be acoustically insulated. This, however is very rare indeed.
- The distance between the PRV and inlet to the VAD should be as short as possible but long enough to have eliminated valve turbulence at the inlet to the desuperheater. The rule of thumb is that this distance should be 1.5 metres minimum. If the PRV and VAD are too close or if the PRV is too close to a pipe bend or other fitting, then turbulence may cause noise and vibration. Spirax Sarco recommend the use of a flow stabiliser before the VAD.

3.2.3 Discharge steam piping

- a) The temperature sensor should be located a minimum distance of 12 metres after the VAD, however for optimum temperature control it is recommended that it be installed at the point of use.
- b) If bends or restrictions are placed in this pipework within the specified distance, before the droplets have had chance to evaporate, inertia causes the droplets to separate out from the main steam flow and run along the bottom or side wall of the pipe.
Contact between the steam and cooling water is lost and desuperheating is halted.
- c) Use thermal insulation over this pipe section to help prevent false temperature readings (condensation can still occur on the walls of a 50 °C superheated steam line). Measurement error can be quite large, especially at low flow rates when heat lost through condensation is a high percentage of total heat energy in the line.

3.2.4 Temperature sensor

- a) Speed of controlled response is important. For this reason, thermocouples or resistance thermometers are usually employed.
- b) The size of an associated thermowell is important. Ones with large mass slow down rate of heat transfer and can cause serious measurement time lags. At low flowrates the problem is worse. Sometimes it's sufficient to simply improve contact between the sensor and well. But in other cases a special well may be needed, such as an extended-surface type. Recommendations should be sought from the instrument supplier.

3.2.5 Pressure sensor

This should be located at a minimum distance of 1.5 metres away from the VAD discharge flange. Ideally however, this should be located at the point of use so that the pressure control valve can compensate for any line loss between the desuperheater and the point of use.

3.2.6 Safety valve

In applications involving simultaneous pressure reduction and depending upon the pressure rating of the equipment, a safety relief valve to protect both the VAD and downstream equipment from the effects of excess pressure shall be considered. This could protect the VAD and downstream equipment if the PRV failed fully-open for example.

3.2.7 Installation orientation

The VAD may be installed with the steam flowing either horizontally or vertically upwards.

We strongly advise against an installation in which the steam flow is vertically downwards.

The branch to which the VAD is fitted is usually on the top of the steam line. It may also be located on the side. We would recommend against having the branch at the bottom of the steam line as this would provide an area where hot condensate could collect. This condensate could present a hazard when removing the VAD from the pipeline during maintenance.

3.3 Other installation considerations

- a) **Isolation valves:** To provide a shut-off facility and to allow maintenance to be carried out, isolation valves are recommended upstream of the water inlet connection.
- b) **Strainers:** Consider installing strainers equipped with a 100 mesh screen in the pipelines in order to prevent the small bores within the desuperheater from becoming blocked.
- c) **Separator station:** In applications where there must be no moisture in the resulting steam (such as steam supply to a turbine or motive steam supply to a thermocompressor for example) it is recommended that a separator is installed downstream of the desuperheater system. This will protect downstream pipework and equipment from the effects of moisture in the event of a control system failure or from abnormal operating conditions, such as at start-up for example.
It is also considered prudent to install a separator station when desuperheating close to saturation temperature or for applications involving large steam turndowns. The separator must be located after the temperature sensor thereby giving the water droplets as much time as possible to evaporate. The associated steam trap should be selected to prevent air binding and the discharge pipe from the steam trap should have ample capacity to deal with the drainage and be installed as near to the vertical as possible. There must be sufficient space in the drainpipe for the water to flow down and the air to pass up the pipe.
- d) **Check valve:** Consider the installation of an LCV in the cooling water line located immediately before the cooling water inlet connection to prevent back flow of steam into the cooling water inlet line in the event of either cooling water failure or excess pressure in the desuperheater caused by failure of the steam pressure reducing valve for example.
- e) **Pressure tappings:** Include plugged pressure tappings within the connecting pipework which will allow gauges to be fitted to assist troubleshooting in the event of operational problems.
- f) All connecting pipework must be sized in accordance with good working practice.
- g) All auxillary components that are used in the application must be carefully selected as there must not be any reduction in the cross sectional area of the connecting pipelines. This is of particular importance in smaller bore pipework.
- h) Ensure that low points of all interconnecting pipework have suitable connections for drains.
- i) Ensure the system can be safely vented back to atmospheric pressure following a shutdown.
- j) Consider the installation of air vents to remove air on start-up.

3.4 Unit installation

3.4.1 Pre-installation check

- a) The gasket materials used for the installation must be compatible with the fluids passing through the desuperheater and must be suitable for the design conditions of the installation.
- b) Ensure that the connecting pipelines are clean and that all weld spatter and foreign bodies have been removed.
- c) Ensure the desuperheater is free of foreign bodies such as packing materials etc.

3.4.2 Installation

Only two connections to the connecting pipework are required:

- a) The steam inlet connection is to be connected to the superheated steam line.
- b) The cooling water inlet connection is to be connected to the cooling water inlet line.

4. Operation

4.1 Unit operation

VAD type variable area desuperheaters may be installed either horizontally or vertically with the steam flowing upwards.

Spirax Sarco strongly advises against installations in which the steam flow is vertically downwards.

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 **temperature sensor** should be located a minimum distance of 12 metres after the VAD, however for optimum temperature control it is recommended that it be installed at the point of use.

A **minimum length of 5 metres** 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 DN100. 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 5m/s velocity in each flowrate, in case of lower value please contact Spirax Sarco.

Water must be supplied with more than 3 bar differential pressure to the steam.

The spray of droplets is directed towards a third-party thermal sleeve, which must be fitted into the steam pipe. The thermal sleeve allows circulation of superheated steam through the annular area between the outside of the sleeve and the inside diameter of the shell. This arrangement heats the thermal sleeve and provides a hot surface on which serves to assist the evaporation of the water droplets.

The thermal sleeve also serves to protect the pipeline in two ways. Firstly it protects the pipe from erosion due to the impingement of the sprayed water droplets and secondly it prevents local thermal shock (and possible subsequent stress corrosion) in the pipe wall where the cold water would otherwise impinge on the hot pipe. The incorporation of a thermal sleeve also aids operation at the bottom of its operating range when the spray pattern of the nozzle is not at its most efficient.

As there is very little restriction to the steam flow, there is no steam pressure drop across an VAD.

The fail safe position of the standard VAD unit is in the shut off position, spring-retract 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.

4.2 Pre-operational check

- a) Check control system has been tested and is operational.
- b) Check relief valve (if fitted) has been tested and is fit for operation.
- c) Ensure all isolation valves (both steam and cooling water) are closed.
- d) Ensure that all line restrictions have been removed.
- e) Ensure that cooling water is available upstream of the cooling water isolation valve.
- f) Take all precautions necessary to handle the possibility of leakage, both in terms of protection of personnel and nearby equipment.

4.3 Start-up procedure

The following start-up procedure should be considered as our initial recommendation on how to start-up the VAD desuperheater. It must be reviewed by the end user, preferably within a HAZOP, to determine whether it is consistent with the operating philosophy of the rest of the plant. The sequence of steps can be revised if necessary. However, the approach of ensuring the cooling water is made available to the VAD before admitting steam must be followed.

1. Activate the control system. The VAD actuator should be retracted to shut off the VAD nozzles.
2. Open the cooling water isolation valve.
3. Open the steam isolation valve downstream the VAD. This may cause the VAD to pressurise, depending on the condition of the downstream system.
4. Very slowly open the upstream steam isolation valve to admit superheated steam to the VAD. Steam will begin to flow through the VAD. The PRV (if fitted) will begin to modulate to control the downstream pressure and the VAD actuator should begin to extend to allow water flow through the VAD nozzles.
5. At this point the VAD is fully operational. Operational checks should be made to ensure:
 - The VAD actuator is modulating correctly and is neither fully-open or fully-closed (This would indicate incorrect sizing).
 - The PRV pressure reducing valve (if fitted) is modulating correctly.
 - The pressures of all streams around the VAD are correct.
 - The desired desuperheated temperature is being met.
 - All other ancillary items related to the VAD operation are functioning satisfactorily.

4.4 Shutdown procedure

This procedure must be reviewed and checked for consistency of operation with the rest of the plant. The sequence of steps may be revised if necessary, but the general principle of isolating the cooling water as the last step must be followed.

1. Slowly close the upstream steam isolation valve.
2. Close the isolation valve downstream of the VAD desuperheater.
3. Close the cooling water isolation valve.
4. De-activate the control system.

The VAD variable area desuperheater is now shut down.

5. Commissioning

After installation or maintenance ensure that the system is fully functional. Carry out tests on any alarms or protective devices.

6. Maintenance and Spare parts

Note: Please read Section 1, 'Safety information' before proceeding with any maintenance.

Maintenance should only be carried out by qualified, experienced personnel, who are familiar with desuperheaters and who have read and understood all the instructions in this document.

Caution

Do not proceed with any maintenance unless the VAD has:

- Been relieved of all pressure and/or vacuum.
- Been allowed to reach ambient temperature.
- Been drained and purged of all fluid.
- Had all connecting lines fully isolated.

6.1 Preventative maintenance

Spirax Sarco suggests that the user creates maintenance schedules, safety manuals and inspection schedules for each specific desuperheater installation.

On all installations, the following items should be inspected by the user:

- a) Desuperheater for blockages, particularly the steam nozzle, internal diffuser and cooling water holes. Check cooling water holes for scale build-up which could indicate poor cooling water quality.
- b) Desuperheater for internal wear, particularly the steam nozzle, internal diffuser, main diffuser and cooling water holes.
- c) Discharge piping and fittings to be checked for signs of erosion, corrosion, debris build-up and blockages.
- d) Sufficient tightness of flange connecting bolts.
- e) Strainers for debris build-up.
- f) All other associated ancillary equipment and valves, in particular:
 - The correct operation of all control equipment.
 - The correct operation of instrumentation.

6.2 Maintenance of spray nozzle desuperheaters

The VAD comprises a cooling water branch, a cooling water inlet flange, a mounting flange, a nozzle holder and a spray nozzle. The spray nozzle is screwed into a nozzle holder.

Please note:

The parts identified in the adjacent illustration are exactly the same for both the VAD a and the VAD b.

6.3 Spare parts

There is only one spare part available for this product as identified in the following table and the adjacent illustration.

Available spares

Gland packing kit	10
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How to order spares

Always order spares by using the description given in the column headed 'Available spares' and state the size and type of desuperheater.

Example: 1 off Gland packing kit for a Spirax Sarco VAD variable area desuperheater.

Please note: For product specific spare parts for the Actuator, Positioner or any other ancillary see the relevant product documentation.

6.4 How to change the gland packing kit:

- Unfasten the gland packing bolts (11) by unscrewing the lock-nuts (12), and proceed to remove them along with the gland flange (13).
- Remove the gland packing (10) and replace it using the new gland packing kit.
- Replace the gland flange (13) and refit by using the gland packing bolts and lock-nuts (11 + 12) and tighten them up to the point where there is no leakage.
- When you have reassembled the unit recommission it back into operation and check for leaks.

If there is a leak tighten the lock-nuts (12) by small degrees until the leakage stops.

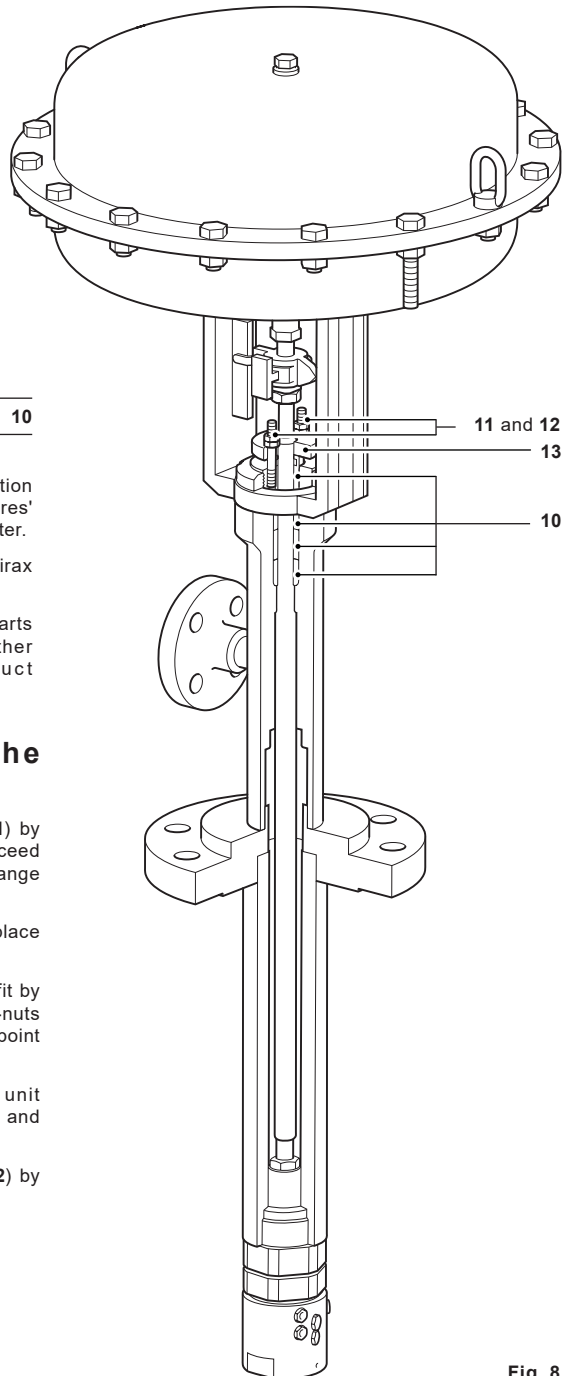


Fig. 8

7. Troubleshooting

Note: Please read Section 1, 'Safety information' before troubleshooting.

7.1 Introduction

Once successfully commissioned, desuperheaters provide trouble free service. However, as with any equipment in erosive or corrosive service, break down beyond control may occur.

A knowledge of the correct procedures for locating and correcting faults can lead to considerable time saving.

Poor performance of a desuperheater can be caused by either external or internal factors. Secondly, all performance can also be classified as either being gradual or sudden.

In general, a gradual loss of performance will normally suggest internal corrosion or erosion, whereas a sudden loss in performance will normally suggest an external factor is to blame.

Before setting out to examine why the desuperheater is not performing correctly, we strongly recommend that all instruments and any Control Systems are first checked that they are not giving false readings.

7.2 External causes of poor performance

At this stage, if an actual control system is fitted, ensure that all pressure and temperature indicating controllers are functioning and set correctly. Also check supply and signal pneumatic or electrical lines to the respective actuated control valve. Then check the operation of both the pressure and temperature control valves.

i) Steam outlet pressure not in accordance with the specification.

- a) Check the operation of the actuated or manually operated pressure control valve, prior to the Desuperheater.
- b) Check the steam pressure upstream and downstream of the pressure control valve. The superheated steam at the inlet to the desuperheater must be in accordance with the design specification or the design of the unit must be modified.
- c) A varying steam pressure will cause a fluctuating outlet steam pressure unless an actuated pressure control system is fitted.

ii) Steam outlet temperature not in accordance with the specification.

- a) Check temperature and pressure of cooling water prior to unit is in accordance with the design specification. If the pressure and temperature cannot be changed in accordance with the design specification, the desuperheater must be modified.
- b) Check all ancillary equipment associated with the cooling water supply line, including possible booster pumps, strainers, non-return valves and manually operated or automated shut-off valves and associated control system.

iii) Consumption of water in excess.

Check that the VAD is installed in a flow stabilised section - If not, review the installation. **Please note** that a PRV pressure reducing valve or an elbow on the pipeline are possible causes of unstabilised flow.

7.3 Internal causes of poor performance

Due to the simple construction of the VAD, the only internal problems are associated with the cooling water spray nozzle.

The problems encountered are:

1. Blocked or partially blocked spray nozzle due to the presence of a foreign body.
2. Blocked or partially blocked spray nozzle due to scaling, which in turn is due to poor cooling water quality.
3. Excessive wear within the spray nozzle - This is very rare.

