COPES-VULCAN

SPX VALVES & CONTROLS™

GUIDANCE NOTES FOR THE INSTALLATION OF TOP-ENTRY TYPE COMBINED PRESSURE-REDUCING & DESUPERHEATING STATION AND DIRECT STEAM CONDITIONING VALVE (PRDS & DSCV)

(FORM GN-03)

SPX Valves & Controls • 9843 Martin Ave. • P.O. Box 577 • Lake City, Pennsylvania 16423 USA
Telephone: (814) 774-1500 • Fax: (814) 774-1681
Web Site: www.spxvalves.com • E-mail: info@spxvalves.com

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GUIDANCE NOTES FOR INSTALLATION OF TOP-ENTRY TYPE COMBINED PRESSURE-REDUCING & DESUPERHEATING STATION (PRDS) AND DIRECT STEAM CONDITIONING VALVE (DSCV)

1.0 INTRODUCTION

The Copes-Vulcan top-entry combined pressure-reducing and desuperheating station (called the PRDS or, at times, the DSCV) is designed to reduce simultaneously the pressure and temperature of a superheated vapor by throttling the vapor flow through a variable restriction as coolant is introduced into the flow. The PRDS is a "contact type" desuperheater in that desuperheating is achieved by the coolant making contact with the vapor being desuperheating. This results in an increased flow of desuperheated vapor at the PRDS outlet. The pressure-reducing function is achieved by the PRDS trim, which can take various forms depending on the degree of shut-off required from the PRDS and the acceptable noise level. (Please refer to Figure 6 for a cut-away view of a typical PRDS and to Figure 7 for a cut-away view of a typical pressure-seal style PRDS.)

To aid absorption of the coolant by the vapor, a diffuser plate in the PRDS outlet subjects the vapor and coolant mixture to a final pressure drop before leaving the PRDS.

The PRDS requires a separate coolant control valve, along with a pressure and temperature control loop to complete the system. The PRDS is thus part of a total system made up of various interdependent elements, each of which contributes to the overall efficiency obtained. Each component should be considered individually to ensure its compatibility with the system requirements.

These guidelines for installation of a PRDS into a piping system are based on experience and good piping practice and must be followed to achieve trouble-free commissioning and proper operation. The close-fitting components of the PRDS require the same care and attention that is needed during installation of control valves. The operation of the unit depends on a satisfactory supply of coolant and adequate performance of the PRDS actuator, which will have been sized to produce sufficient force to overcome the forces normally expected within the PRDS. Poor installation can result in additional forces being set up that may impair the performance of the unit.

2.0 PRIOR TO DELIVERY

Shortly after your order is entered, Copes-Vulcan will issue a certified copy of the PRDS Data Specification Sheet, detailing the operating conditions for which the equipment is being designed, along with drawings illustrating the critical installation dimensions of the equipment we propose to supply. This information should be reviewed carefully to confirm that our interpretation of the service requirements is correct. Any discrepancies should be pointed out immediately to Copes-Vulcan.

These guidance notes and the drawings illustrating the equipment should be forwarded to the person(s) responsible for locating the PRDS and designing the associated piping so that the recommendations contained herein may be followed and a satisfactory installation achieved.

3.0 EQUIPMENT RECEIPT

On receipt, the PRDS should be inspected to ensure that no damage has been sustained in transit. Particular attention should be paid to the actuator, its accessories, and the inter-connecting piping.

A packing list containing a complete description of the equipment is included with the shipment. Check the list against the items that have been supplied. Check that the serial number on the unit matches that on the Copes-Vulcan PRDS Data Specification Sheet. Report any problems to Copes-Vulcan.

4.0 PROVISIONS FOR PROPER STORAGE

If the PRDS is not being installed immediately upon receipt, the points below should be considered when placing the equipment into storage. Regular inspections of the stored equipment should be made, as detailed in Section 5.

A. Location During Storage

If possible, the PRDS should be stored indoors in a ventilated area in its original shipping container. If indoor storage is not possible, the equipment should not be stored in contact with the ground.

B. Use of Desiccants

When desiccant bags are used as part of the packing, a tag will be attached to an outside surface of the PRDS identifying the number of bags, their location, and the trade name of the desiccant. The desiccant bags are to be replaced every three months while the PRDS is stored.

C. Protection from Rust

Unpainted metal surfaces may be protected from rust by applying a rust preventive compound such as CRC 3-36 or equivalent.

PRDS end covers should be removed and a film of rust preventive compound should be sprayed on the PRDS internals and on the inside surface of the body. The ends should then be securely re-sealed. NOTE: Before performing this procedure, make sure that any substance used for this purpose will not be detrimental to the fluid to be passed through the installed unit.

Where needed, the above treatments should be applied annually.

When a rust preventive compound is not permissible or cannot be used, the equipment must be enclosed in a vapor-proof envelope, evacuated of all air, and sealed.

D. Treatment of Electric Contacts on Limitorque Motor Operators

Valves with Limitorque actuators that are to be stored for periods longer than one year require maintenance of the electric contacts located in the limit switch compartment as follows:

When storing for one to two years maximum, spray all electric contacts with CRC 2-26 or equivalent. This preservative does not have to be removed prior to use of the actuator.

For storage periods from two to five years, spray electric contacts with CRC Lectra Shield spray coating or equivalent. This coating must be removed with a suitable cleaner--such as any petroleum solvent--prior to making electrical connections.

5.0 INSPECTION WHILE IN STORAGE

While in storage, the PRDS must be inspected regularly, as detailed below.

A. Inspection Schedule

Visually examine the exterior surfaces of the equipment on a semi-annual basis; visually examine accessible interior surfaces of the equipment on an annual basis.

Disassembly of the equipment is not intended or required during inspection--a satisfactory inspection can be performed while limiting any disassembly to removal of accessory covers and shipping caps.

B. Prevention of Contamination

Water, dirt, oil, grease, or other foreign material should be removed from the equipment. The source or these contaminants should be found and action should be taken to prevent recurrences.

C. Inspection of Desiccants

Equipment stored with desiccants is to be inspected to confirm that the desiccant material is being replaced every three months and is properly located and secured in the equipment.

D. Inspection of Covers, Caps and Plugs

Inspect all equipment covers and temporary shipping caps and plugs to make sure these items are firmly attached and will prevent the entrance of foreign matter into the PRDS and accessories.

6.0 FOLLOWING STORAGE

If the PRDS has been in storage, the following steps (as applicable) should be performed before the equipment is installed.

A. Replacement of Packing, Seals, Gaskets, O-Rings and Diaphragm

Copes-Vulcan recommends replacing the packing if the equipment has been stored for a period longer than a year and a half. Seals, gaskets, o-rings and diaphragms should be replaced if the equipment has been stored for a period longer than three years.

B. Removal of Coating on Electric Contacts on Motor Operators

On motor operators, if the electric contacts have been treated with CRC Lectra Shield spray coating or equivalent, the coating must be removed with a suitable cleaner--such as any petroleum solvent--prior to making electrical connections.

C. Removal of Shipping Caps, Plugs, Covers and Desiccant Bags

When readying the PRDS for installation, check to make sure that all temporary shipping caps, plugs, covers and desiccant bags have been removed.

D. Copes-Vulcan Assistance After Long-Term Storage

If the storage period has exceeded three years, consideration should be given to hiring a Copes-Vulcan Service Engineer to inspect the equipment before installation.

7.0 LOCATION

A. Position of the PRDS

The PRDS is of angle-style construction and can be installed with the outlet either horizontal or vertical. For ease of maintenance, however, it is recommended that the unit be installed with the outlet vertically downward, as this will provide the most convenient access to the PRDS internals through the bonnet, which will be uppermost.

B. Position of the Actuator

Because access to the PRDS internals is through the bonnet, it will be necessary to remove the actuator when internal inspection or maintenance is performed. This fact should be kept in mind when locating the PRDS. This is of particular importance in installations where the actuator is being mounted in a horizontal plane or where the outlet from the PRDS is required to be vertically upwards, resulting in the actuator being positioned below the PRDS. In these situations, make sure that adequate provision is made for maintenance access.

If it is intended to mount the actuator in any position other than vertical, advise Copes-Vulcan so that the accessories can be oriented correctly.

Additional supports may be needed for large, horizontally mounted actuators. These supports must not impose any strain on the PRDS-to-actuator connection.

C. Allowing for Access

In selecting the location for the PRDS, consideration should be given to the need for adjustment and maintenance. The positioner and other accessories on the actuator may require adjustment or setting and the actuator will require routine maintenance. As stated above, access to the PRDS internals is through the bonnet, which necessitates removal of the actuator. Adequate access to the equipment, along with provision for suitable lifting equipment, must be provided for.

8.0 UPSTREAM AND DOWNSTREAM PIPING

A. Upstream Piping

Attention should be paid to the effect of flow disturbances created by the incoming piping configuration on the performance and capacity of the PRDS. Ideally, the upstream pipe should be straight and of uniform diameter with no expanders, tees, elbows or valves for a distance of five pipe diameters or 3 feet (914 mm), whichever is greater.
(See Figure 1.)

B. Downstream Piping

Downstream of the PRDS, a long radius pipe bend can be close-coupled to the outlet; however, a short length of straight piping is recommended, which can then be followed by a long radius bend. (See Figure 2.) The long radius bend will minimize the risk of liquid particle impingement on the wall of the bend in the event any moisture is present in the vapor flow. This moisture could be unabsorbed coolant particles or condensate thrown out of suspension by centrifugal action as the mixture passes through the bend.

C. T-Pieces in Piping

When considering the pipe installation, discretion should be exercised in locating tees on the upstream or downstream side of the PRDS as these can generate shockwaves which can filter back to the PRDS and adversely affect its performance.

D. Installation of Isolating Valves

If installing an isolation valve immediately upstream of the PRDS, it is essential that the valve be of the same bore as the inlet to the PRDS to avoid generation of a nozzle discharge effect into the PRDS inlet, which can adversely affect the stability and performance of the unit.

E. Pipe Size

It is not considered good practice to install a PRDS into piping that is more than two sizes larger than the size of the PRDS, but if doing so is necessary to achieve reasonable velocities in the piping, consider a two-stage reduction or expansion with a short recovery distance between the stages. Be aware in designing the piping system that the outlet of the PRDS is always twice the size of the inlet.

Any transition from the PRDS outlet size to the downstream pipe size should be gradual so not to become a noise generator. A 15^{o} inclusive taper is recommended.

In considering the outlet pipe size, be aware that an increase in volume will occur as a result of both the pressure reduction process and the addition of coolant. Size the piping to achieve acceptable velocities in the pipe. These will normally be in the range of 150 to 250 feet per second (46 to 76 meters per second).

-

F. Pipe Material

The piping material for the downstream piping should be selected taking into account the usage of the equipment, the rate of opening, and the final steam temperature. If the final steam temperature is below 800°F (427°C), it is reasonable to consider downgrading the pipe material, but there must be assurance that the cooling water will always be available and that the cooling water control valve has sufficient capacity to cool all of the steam that the PRDS could pass should it go to its full open position.

G. Pipe Supports

Pipe supports should be located in the vicinity of the PRDS to support the weight of the PRDS and to absorb any pipe loads. It is recommended that a fixed support be applied close to the inlet connection and that a sliding support be provided close to the outlet. No supports should be attached to the PRDS itself or to the actuator without prior consultation with Copes-Vulcan.

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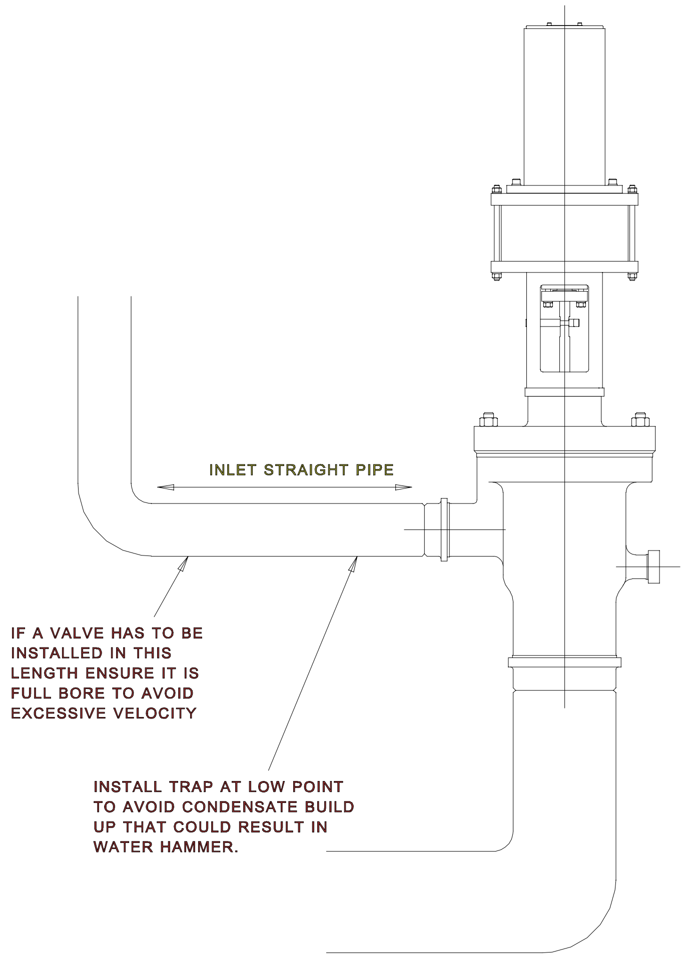

FIGURE 1 - UPSTREAM STRAIGHT PIPE RECOMMENDATION

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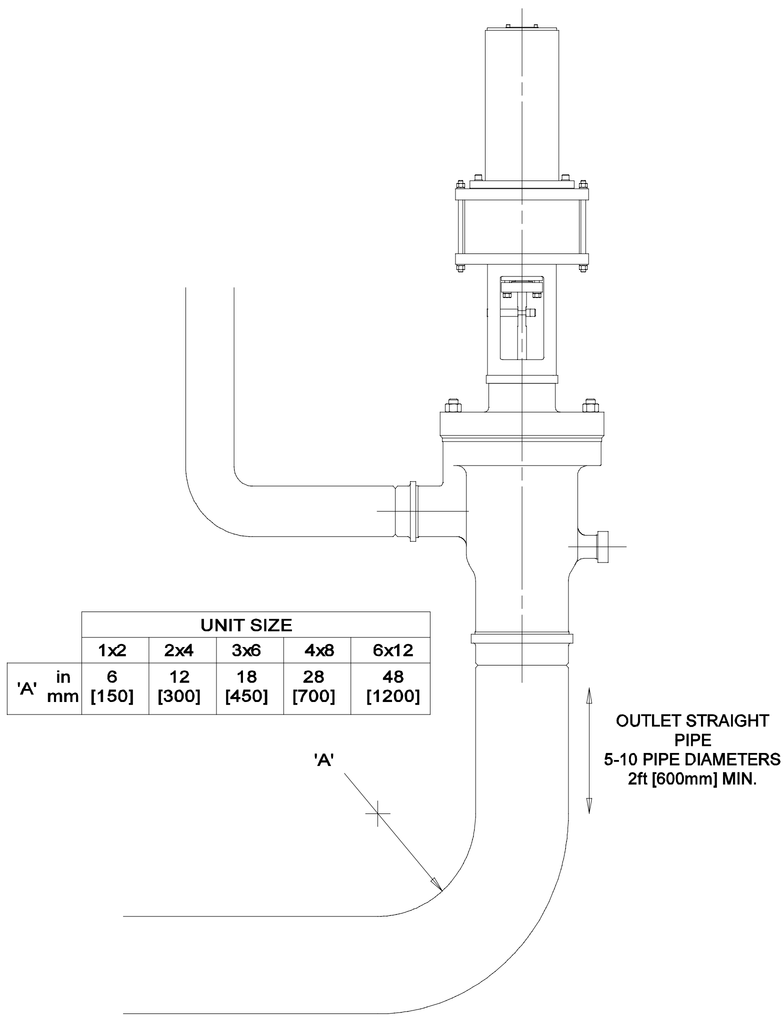

		UNIT SIZE				
		1x2	2x4	3x6	4x8	6x12
'A'	in	6	12	18	28	48
	mm	[150]	[300]	[450]	[700]	[1200]

MINIMUM PIPE BEND RADIUS ('A') = 1.5 x PIPE DIAMETER

FIGURE 2 - DOWNSTREAM STRAIGHT PIPE RECOMMENDATION

8.0 UPSTREAM AND DOWNSTREAM PIPING (Cont'd)

H. Safety Valve

As with all pressure-reducing valves, the downstream system should be protected by a safety valve. Particular care is required in sizing the safety valve. As discussed below, there are two major factors to consider; one of which depends on the integrity of the coolant supply, the other on the capacity of the coolant control valve.

The safety valve should have sufficient capacity to handle the full flow through the PRDS should the unit go full open. In such a situation--providing the coolant supply is intact and the coolant supply valve has sufficient capacity--the safety valve must be sized to handle the total flow through both the coolant supply valve and the PRDS at the downstream conditions.

If, however, there is a possibility of the coolant supply failing or if the coolant control valve does not have sufficient capacity to supply coolant to desuperheat the increased flow through the PRDS, then the downstream conditions may not be reached and the safety valve would have to handle a larger volume of vapor.

I. Location of Drains and Traps

Traps should be provided in the system as dictated by good piping practice. Since it is particularly important to ensure that the upstream system does not contain any liquid that could be carried into the PRDS, a drain or trap is recommended at the lowest point in the piping immediately upstream of the PRDS.

On the downstream side, it is good practice to install a trap between the PRDS and the temperature sensor to remove any unabsorbed liquid or condensate that could influence the sensor readings.

9.0 COOLANT SUPPLY PIPING

A. Locating the Coolant Supply Valve

Consideration should be given both to the need to provide a supply of coolant to the PRDS and to the location of the coolant control valve. It is recommended that the coolant control valve be positioned below the coolant entry point on the PRDS. This will ensure that the coolant leg is always charged with coolant, which will improve the response speed of the system. (See Figure 3.)

B. Installation of Non-Return Valve

To prevent any steam flow back through the coolant line, it is recommended that a full- bore non-return valve be installed between the coolant control valve and the PRDS.
(See Figure 3.)

C. Strainer

If there is any doubt about the purity of the coolant supply, a strainer should be installed in the coolant line. (Please refer to Section 10 for additional information.)

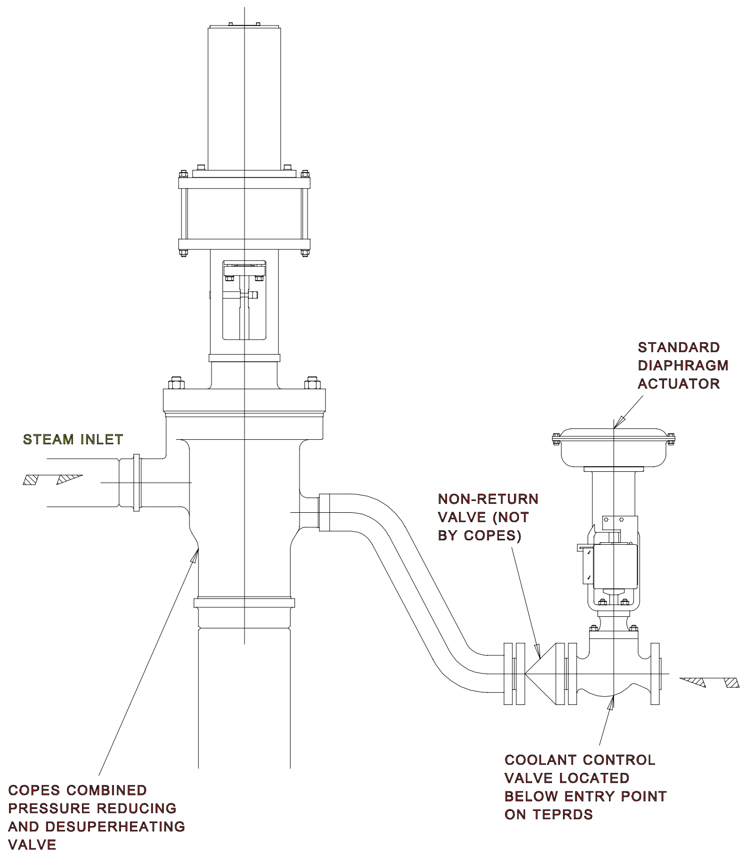

FIGURE 3 - COOLANT SPRAY WATER VALVE AND PIPING LAYOUT

10.0 INSTALLATION/SET-UP

Care taken in the installation of a combined pressure-reducing and desuperheating station is essential for good desuperheater performance and trouble-free service. The most common causes of problems with this type of equipment are a result of incorrect installation, transference of pipe stresses to the PRDS body, or the ingress of foreign matter into the trim, which causes sticking and damage to the PRDS internals.

A. Direction of Flow through the Body

Make sure that the PRDS is installed so the direction of flow through the PRDS body is in the correct direction. An "INLET" tag is fastened to the inlet connection indicating the direction of flow. (The PRDS inlet connection is always smaller than the PRDS outlet.)

B. Connecting Piping

The PRDS and piping should be properly aligned and the connecting piping should be adequately supported so that no pipe strain is imposed upon the PRDS body.

Avoid locating the PRDS at a point where large end loads may occur.

If the unit is flanged, make sure that the mating flanges are aligned and are square to each other.

If the PRDS is to be welded into the line, again make sure that there is no offset between the pipe and PRDS end before welding.

C. Cleaning the Piping before Installation

Before final connection of the PRDS to the pipe, the piping must be thoroughly cleaned and checked to make sure it is free of foreign matter.

D. Weld-End PRDS

PRDS that are welded into the line with their trim installed should be positioned at mid-stroke during welding/post-weld heat-treatment operations.

Two important areas to be considered in the installation process are welding procedures and system flushing. If the PRDS is to be welded into the line, care must be taken to ensure that excessive temperatures are not imparted to the PRDS internals. Welding typically involves pre-heating, welding and post-weld heat-treatment (stress relieving).

Pre-Heating Precautions

Typical pre-heating temperatures are in the region of 300 to 500^{o}F (150 to 260^{o}C), which is not detrimental to the PRDS components, so no special precautions are required.

Inter-Pass Temperature Concerns

During the actual welding process, a good deal of heat can be generated. It is desirable to control the heating of the PRDS body in the area of the trim to a level below 750^{o}F (400^{o}C).

Post-Weld Heat-Treatment Precautions

Post-weld heat-treatment is a cause for concern as temperatures typically can reach 1400^{o}F (760^{o}C) and those temperatures may be held for several hours. Although the heat is applied locally to the PRDS ends, it also is conducted back into the PRDS body. Care must be exercised to maintain the body temperature in the area of the PRDS internals below 750^{o}F (400^{o}C). If this is not possible, consider removing the internals during welding and post-weld heat-treatment.

Under no circumstances should the complete PRDS body be wrapped during heat-treatment with the internals installed.

Copes-Vulcan recommends that the PRDS body temperature be monitored at all times during the welding and post-weld heat-treat cycles.

E. Precautions for Flushing and Chemical Cleaning

If flushing or chemical cleaning is to be performed, consideration should be given to the procedure to be followed. If not performed carefully, these procedures may cause problems with the installed equipment.

Flushing is used to remove solid particles from the system. These particles may get trapped in the PRDS trim and cause scoring of the components, damage to the seats, and possible sticking of the PRDS. If flushing is to be carried out with the PRDS in line, it is recommended that the trim be removed and be replaced with a special set of flushing trim or a stuffing box plug. Copes-Vulcan can supply special flushing trims for the PRDS, but will need to know how the flushing is going to be carried out.

Bear in mind that the PRDS contains a diffuser plate in the outlet. This could act as a strainer and will need to be cleaned before the PRDS is put into service after flushing.

Chemical cleaning can result in similar problems, especially if the cleaning solutions are not neutralized after cleaning is complete and are allowed to remain in the PRDS body. Some acids will etch seating or gasket surfaces or may attack other parts of the trim. Copes-Vulcan strongly recommends replacing the trim with a special flushing trim prior to chemical cleaning.

F. Replacement of Packing and Gaskets

If the decision is made to disassemble the PRDS for welding, heat-treatment or cleaning, make sure that an extra set of packing and gaskets are available, as these parts should not be re-used.

G. Air Connections to Pneumatic Actuators

When making air connections to pneumatic actuators, use only brass or stainless steel fittings. Make sure the tubing has been correctly deburred and blown clean before final connections are made.

H. Thermal Insulation

To minimize thermal stress, the PRDS should be fully insulated before being put into service. **NOTE:** On pressure-seal style PRDS, do not insulate above the access holes in the PRDS body or around the mounting plate.

If the use of thermal insulation has been included in a noise calculation, the thickness of lagging will be specified on the PRDS Specification Data Sheet. In this situation, or if acoustic lagging is being used for noise reduction, the manufacturer of the insulation material should be consulted regarding the distance over which the insulation should be applied.

11.0 LOCATION OF PRESSURE SENSOR

The location of the pressure-tapping point for the control system will depend upon the operation required from the system. For upstream pressure protection systems, the tapping point will be installed somewhere in the upstream system. For downstream pressure control, the tapping point will be installed somewhere in the downstream system. In either case, the tapping point should be installed where the pressure is required to be controlled as in this way the system will take care of any line losses between the tapping point and the PRDS. The tapping point should be a distance of at least 5 feet (1525 mm) from the PRDS. (See Figure 4.)

The impulse line to the pressure controller should be capable of being isolated at the steam main end and should contain a ‘U’ section to prevent the superheated vapor from entering the sensor housing.

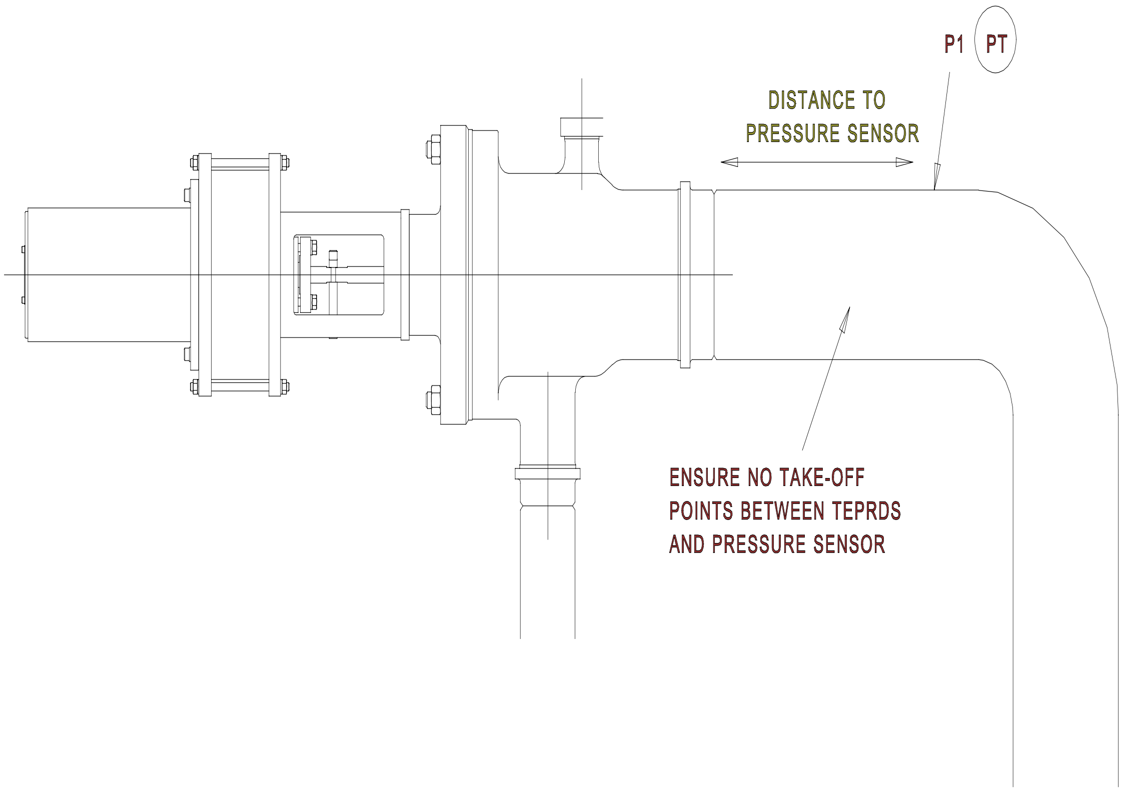

FIGURE 4 - PRESSURE SENSOR LOCATION

12.0 LOCATION OF TEMPERATURE SENSOR

The location of the temperature-sensing element will always be downstream of the PRDS and is critical to successful operation of the system. Copes-Vulcan determines the distance taking into account the residual superheat in the vapor, the differential between the temperature of the outgoing vapor and that of the coolant, and the velocity in the vapor main. The recommended minimum distance for a particular application is indicated on the PRDS Data Specification Sheet. If it is necessary to deviate from this recommendation in order to clear an obstruction or a bend, the distance should be lengthened. (See Figure 5.)

Copes-Vulcan recommends that a check thermometer pocket be located adjacent to the temperature-sensing point so check readings can be taken.

It is important that there are no vapor take-off points between the PRDS and the temperature sensor, otherwise a false reading will be obtained and the system will not function correctly.

In some applications, it may not be possible to locate the temperature sensor at the recommended distance. In these situations, an alternate form of control is used, such as an algorithm built into the main control system (DCS) that evaluates the incoming vapor enthalpy, the outgoing vapor enthalpy, and the enthalpy in the coolant to arrive at the amount of coolant required.

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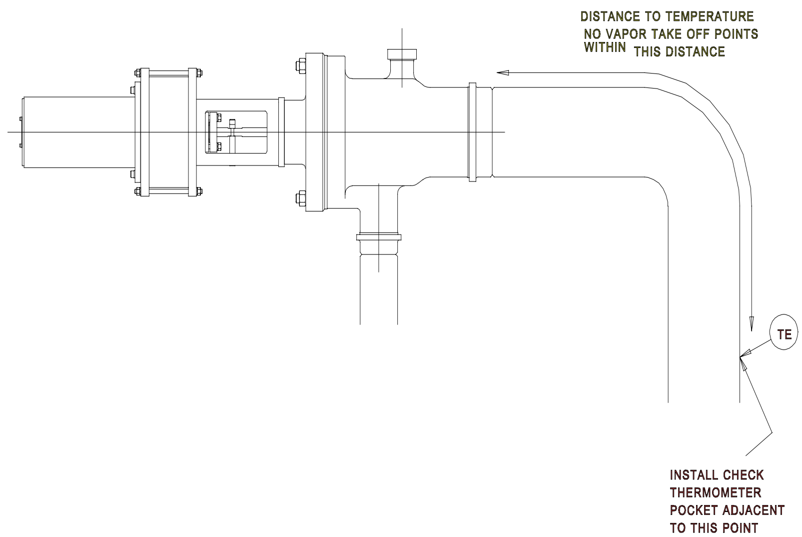

FIGURE 5 - TEMPERATURE SENSOR LOCATION

13.0 COOLANT SUPPLY

For any desuperheating application where the coolant is mixed with the vapor, it is important that a high grade of coolant be used. Any impurities in the coolant will be left behind when the coolant evaporates and can result in the build-up of solids in the vapor main. Worse still is the risk of chemical attack when diluted chemicals become concentrated as the coolant evaporates.

The ideal coolant is condensate or liquids with no more than 11 parts per million of dissolved solids.

It is important that the coolant is deaerated, otherwise there is a risk of the oxygen in the coolant being released during the evaporation stage. This can give rise to oxygen corrosion, particularly in carbon steel piping.

The PRDS has close fitting components that can be affected by the ingress of foreign matter. The coolant, therefore, should contain no foreign particles. If there is any doubt about the quality of the coolant, it is recommended that a 30 x 30 mesh strainer be installed upstream of the coolant inlet. A 30 x 30 mesh contains 900 holes per square inch (6.5 cm), which will not allow particles larger than 0.025 inch (0.64 mm) to pass.

14.0 THERMAL LINERS

The PRDS does not require a thermal liner for protection of the downstream piping as the desuperheating process is virtually complete within the PRDS, making the risk of coolant impingement on the downstream pipe wall minimal.

15.0 NOISE AND VIBRATION

Particular care is taken by Copes-Vulcan in selecting equipment to meet a specific noise level requirement. Many other factors, however, can influence the noise generated by a particular PRDS. Therefore, the following recommendations are given.

- Avoid multiple bends and elbows in the vicinity of the PRDS.
- Use a minimum of 4 feet (1200 mm) of straight pipe upstream of the PRDS.
- Size the outlet piping for a maximum velocity of 250 feet per second (4573 meters per minute).
- Select an outlet pipe size of adequate thickness.
- Design pipe reducers and expanders so not to become noise generators.
- Apply adequate insulation--either thermal or acoustic--to the downstream piping, as recommended. In installing insulation, cover the entire PRDS, including the top surface of the bonnet. Arrange the insulation so it can easily be removed for maintenance. When insulation is used for noise reduction purposes, particular care should be taken that there are no gaps or bridges to uninsulated attachments.
- When multiple PRDS are attached to branches on a common header, vary the distance to the units to avoid pressure fluctuations caused by resonance.

16.0 WARM-UP AND START-UP CONSIDERATIONS

It is good practice to warm up steam conditioning equipment, particularly when the system is required to operate in a stand-by mode where the unit will remain closed for long periods of time.

There are many ways to warm up the equipment; most tied into the start-up requirements of the system as a whole. On some applications, it is possible to back-feed the PRDS and piping from the downstream system. This has the added advantage of preventing a build-up of condensate in the downstream piping. Bypass loops can be arranged around the PRDS either by installing a run of piping around the unit with an isolating valve installed in the run or by specifying (on certain sizes) that tapping points be provided on the PRDS. The bypass piping size required is normally 1-inch (25-mm) or 1-1/2-inch (40-mm), depending upon how much steam is required to warm up the system.

One feature of the PRDS design is the capability of arranging a bypass flow through the balancing arrangement on the plug. For some applications, Copes-Vulcan can arrange for a designed leakage through the balancing system in the valve plug so that the leakage flow bypasses the seating areas in the plug, thus avoiding damage to these areas. As this arrangement is not always possible, any requirements for this feature should be discussed with Copes-Vulcan as soon as possible.

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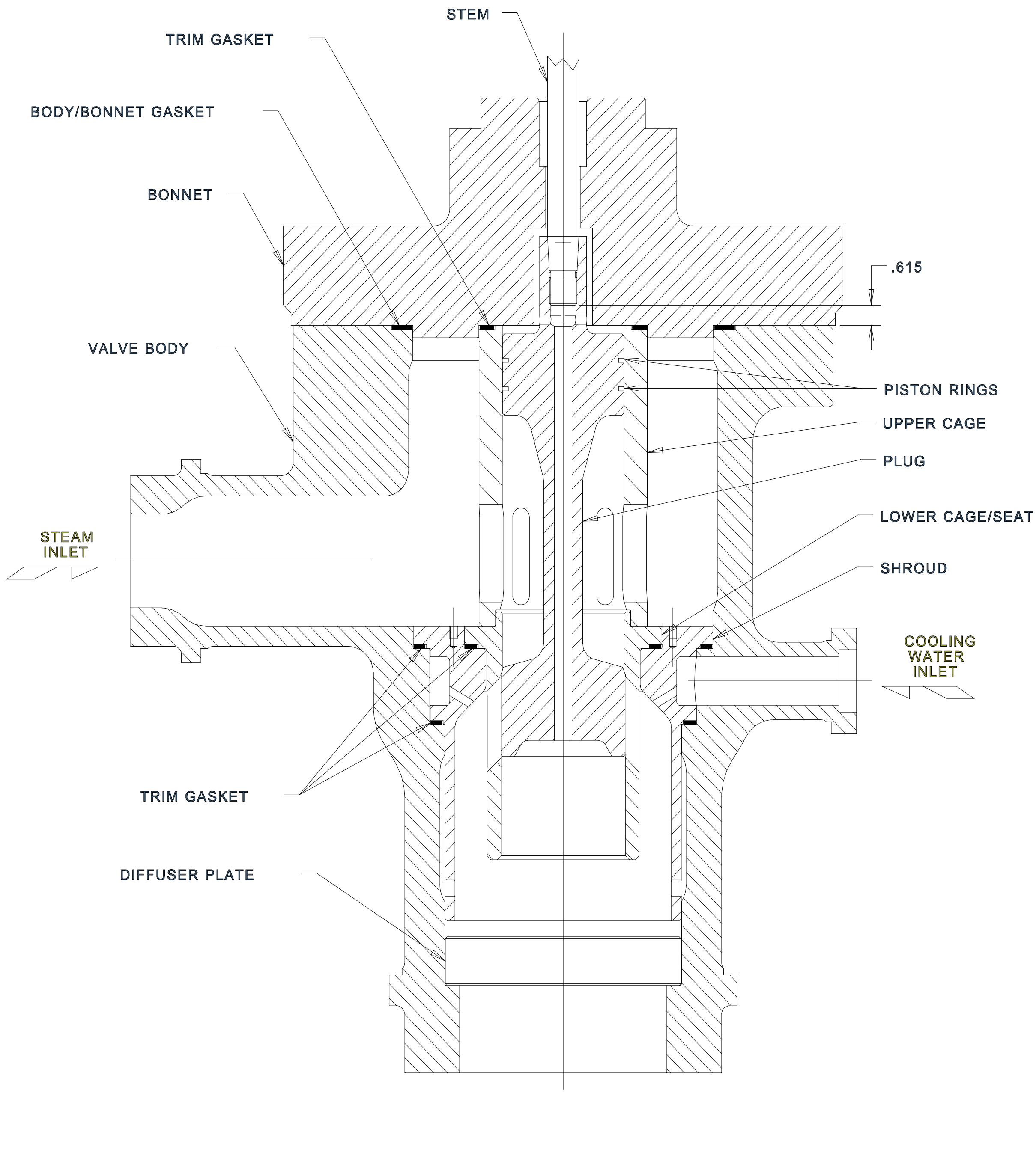
FIGURE 6 - TYPICAL PRDS CUT-AWAY VIEW



GUIDANCE NOTES FOR INSTALLATION OF TOP-ENTRY TYPE COMBINED PRESSURE-REDUCING & DESUPERHEATING STATION (PRDS) AND DIRECT STEAM CONDITIONING VALVE (DSCV)

FIGURE 7 – TYPICAL PRESSURE-SEAL DSCV CUT-AWAY VIEW

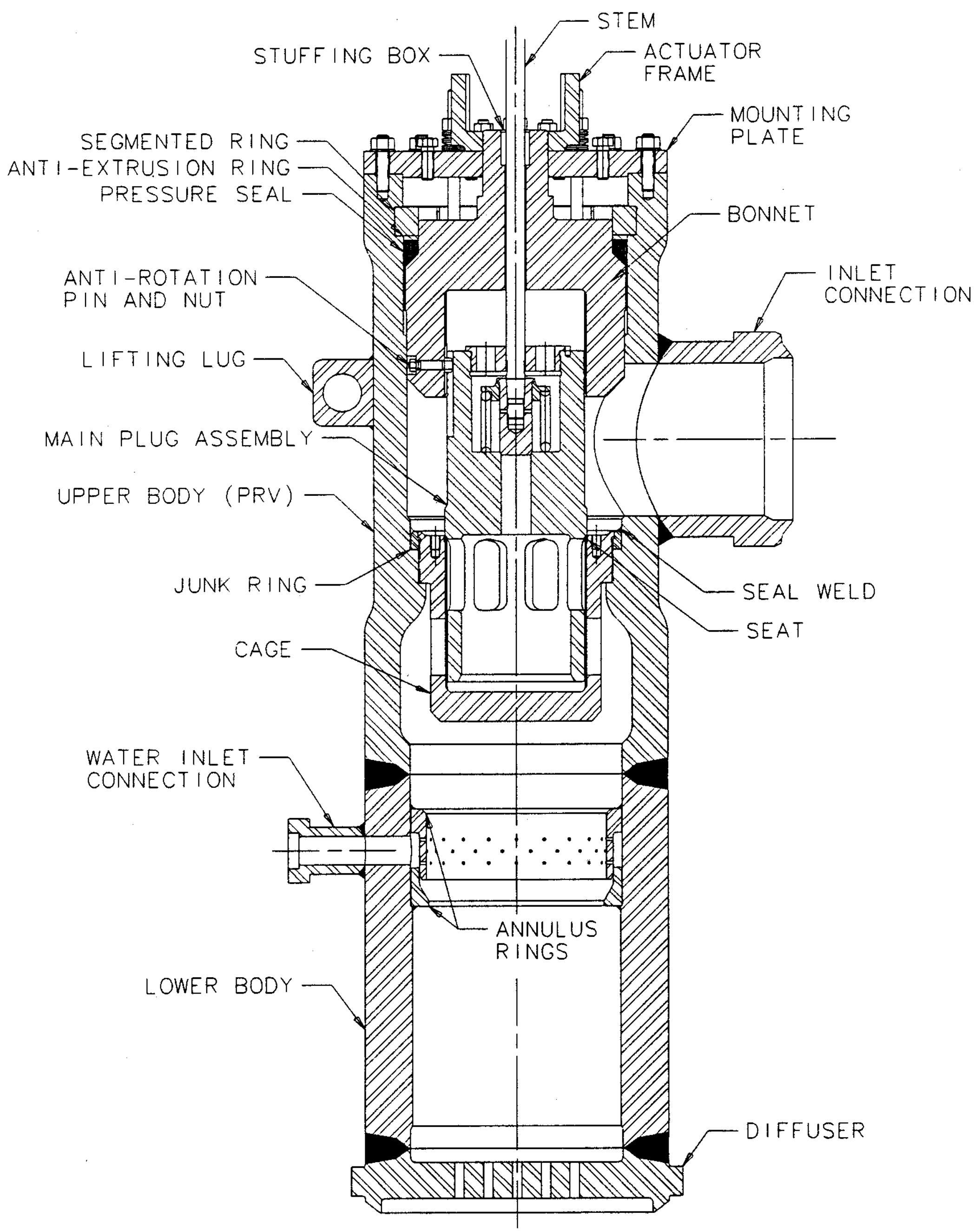


FIGURE 8 – TYPICAL BOLTED DSCV CUT-AWAY VIEW