



Industry, power plants and process technology: PRDS Installation Guide



Excellence is our standard



Holter Regelarmaturen GmbH & Co. KG, established in 1967, offers a whole range of products for use in industry, power plants and process technology. Also known as HORA, the company designs and produces valves, pump recirculation valves, special valves for use in power plants, as well as electric and pneumatic actuators.

37 years of experience have made the independent family-owned company from Schloss Holte-Stukenbrock into European and world-wide partner for leading boiler and power plant manufacturers and also for measurement and control companies.

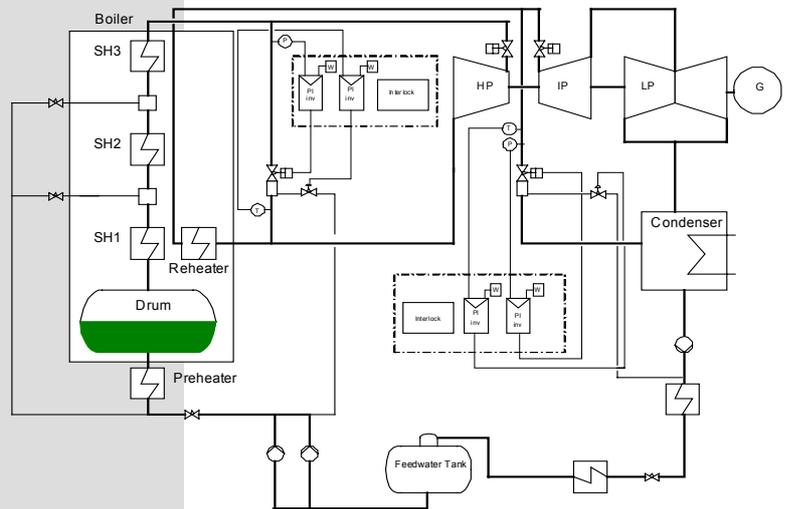
Today's position of the company on the market is a result of the successful combination of innovative ability, continuity and reliability





PRDS Installation Guide

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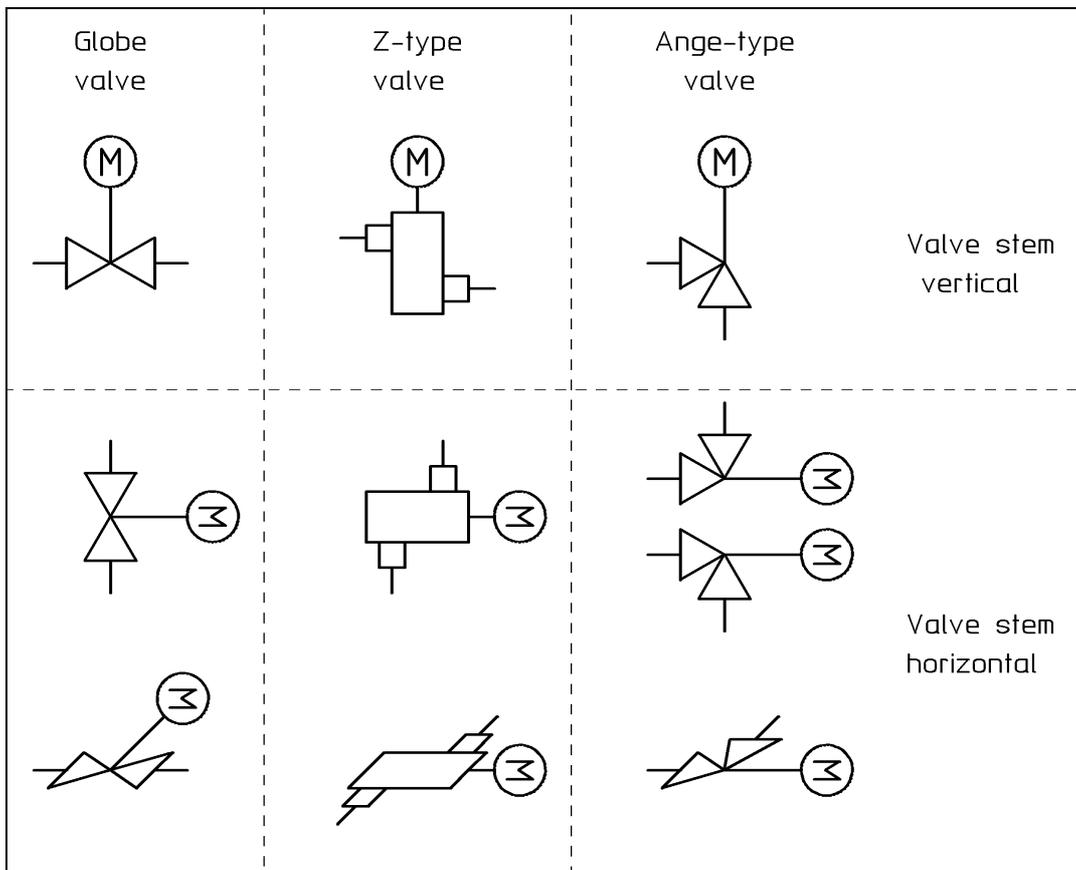


Mounting Orientation

HORA PRDS valves can be installed in any orientation. The recommended position is with a vertical stem and a top mounted actuator for easy maintenance. HORA advises against the upright down position with a vertical stem and the actuator mounted downwards. A horizontal stem is possible for a reliable function of the valve. This installation is subject to consultation with HORA because in case of large valves with heavy actuators flexible support or hanger to bear the weight of the actuators might be necessary.

Control valves shall never be designed as fixed points.

Fixed points shall be arranged along the pipe. For service work a platform and a crane are required.



For a good performance of the valves it is also required to pay much attention on the upstream and downstream piping and also on the spray water control line. Piping arrangements and shortage of space means that compromises must be made. In the following we describe those factors to achieve a advanced system design for the HORA PRDS valves.

Piping upstream

It is required to have a straight piping upstream. In this pipe section there should not be any components; t-shaped junctions must be avoided. If stop valves upstream are not designed properly the characteristic of the control valve is extremely influenced due to a high velocity in the vena contracta and a ununiform distribution. A uniform flow pattern achieves a minimum of vibration and noise. In addition HORA supplies for special solutions a cage in the inlet of the valve body to align the flow and to avoid rotational forces on the plug.

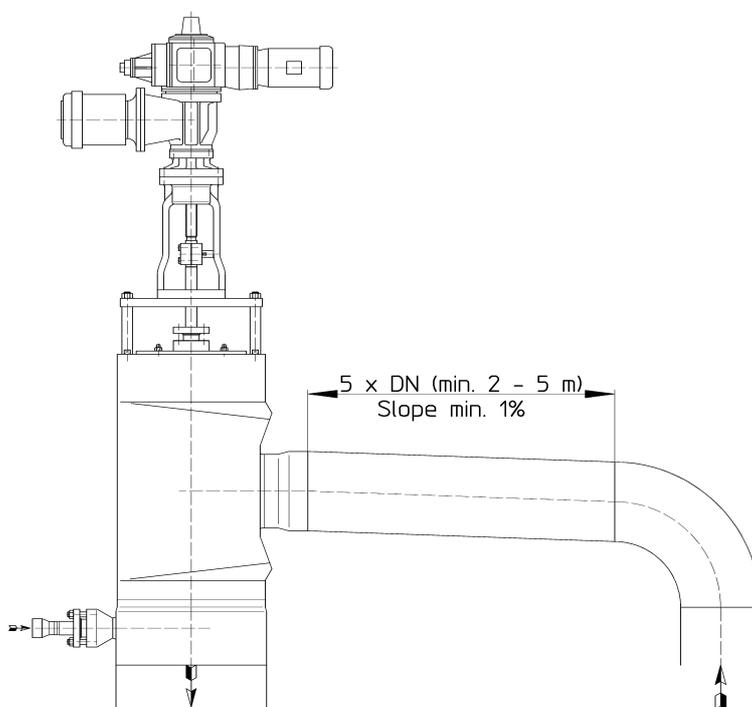
HORA's guide value for the straight length of upstream piping is ~5 times the nominal diameter with a minimum of 2-5m.

If multiple components are located upstream the PRDS valve the distance must be increased and confirmed by the HORA.

It is essential to keep water out of the system (see drains). It causes noise, mechanical damage and can make the temperature measurement impossible.

HORA's guide value for a slope against the flow is min. 1%.

A drain should be provided at the lowest point.



Piping downstream

After injection the water needs a distance to evaporate. It has to be avoided that the droplets hit the pipe wall causing erosion and in extreme situations formation of water paddles. Bends will separate the water from the steam because of the different density.

It is required to have a minimum straight length of the piping downstream the PRDS valve. With the HORA injection solutions the spray water is atomised to an optimum but still needs time to a fully evaporation.

Influencing variable	Dependence and Function
Diameter of water droplets	Small ultimate atomised droplets have the maximal surface which enables the best heat transfer and evaporation
Cooling water temperature	With a higher temperature the heat up time to evaporation temperature decreases – low surface tension.
Steam velocity	The steam entrains the water droplets and burst open the saturated steam envelope.
Superheated temperature of cooled steam	With a higher thermal head between water and steam the evaporation and mixing distance decreases. The minimum delta T to saturated steam temperature is fixed at 10°C.

HORA's guide value for the distance to the first pipe bend is ~10 times the nominal diameter with a minimum of 2-5m. This minimum distance is also the point to change the pipe specification.

For **HP-Bypass valves** going to the cold reheat or similar applications he distance could be reduced in accordance to:

- the degree of superheat (>100°C)
- the spray water temperature (>150°C).

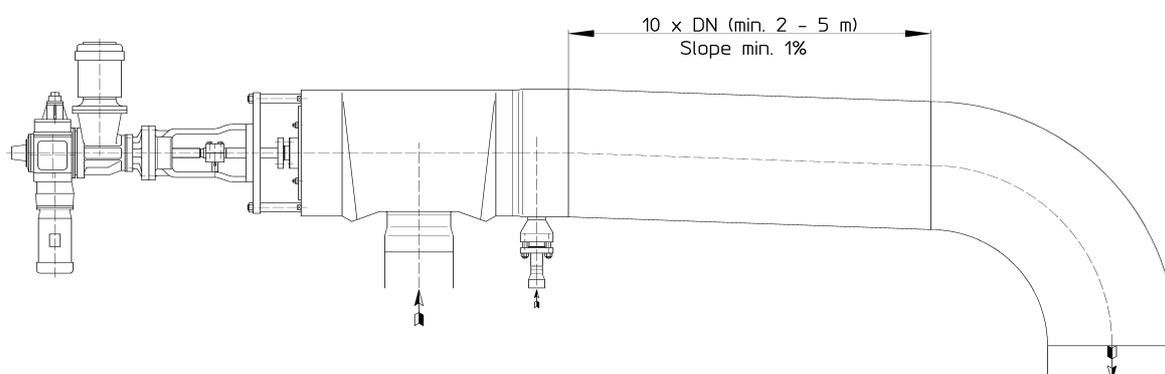
The straight length might be increased for **HRH Bypass valves** going to the condenser or similar applications to minimise the risk of non evaporated water in accordance to:

- the degree of superheat (<20°C)
- water temperature (<100°C)
- water ratio (>25%)

Everything said for the avoidance of water in the upstream piping also applies downstream (see drains).

HORA's guide value for a slope with the flow is min. 1%.

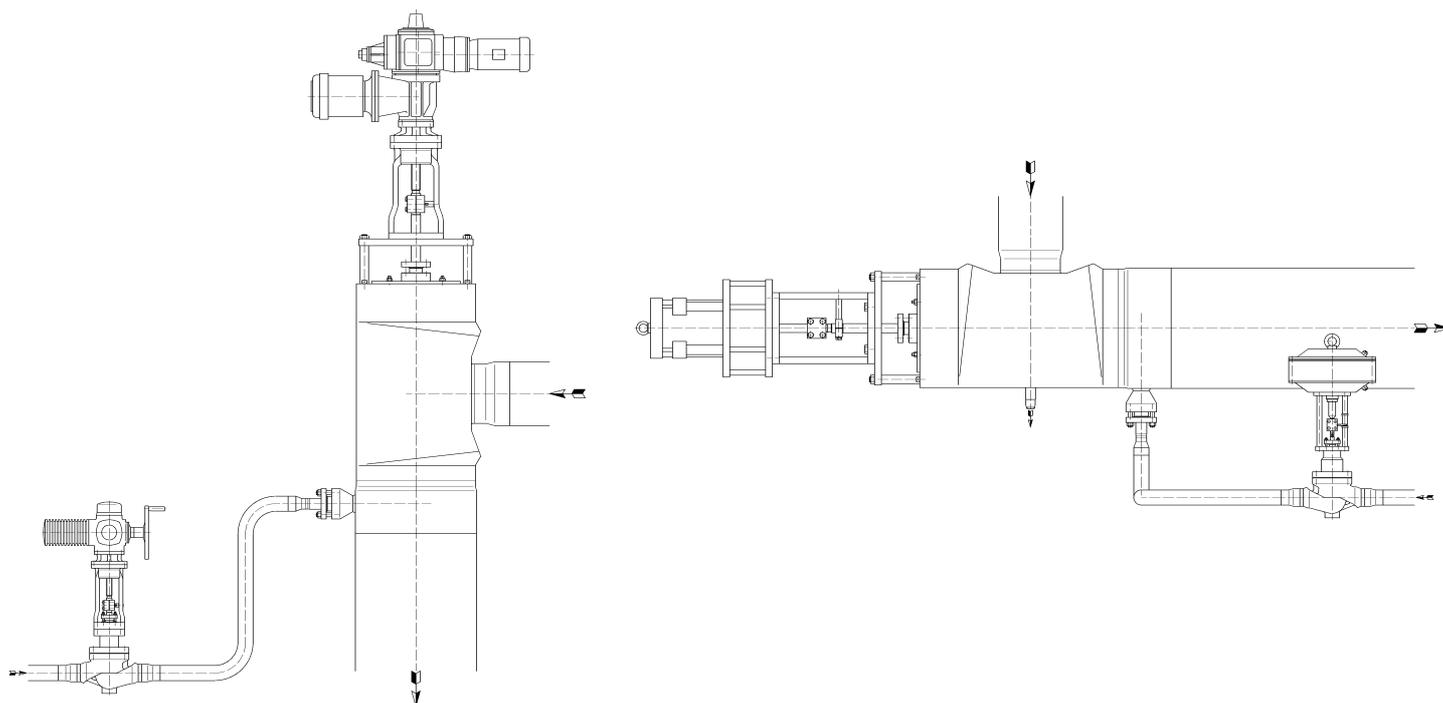
A drain should be provided a the lowest point.



Spray water pipe

A proper installation between the PRDS valve and the spray water control valve is important for the function of the system. It is required to prevent the spray water piping from emptying to ensure a continuous, immediate supply of water.

- The piping coming from the spray water control valve going to the PRDS valve or Bypass station shall be arranged below the level of the water stud.
- The distance between the spray water control valve and the water stud should be minimised and not exceed a length of 5m.
- If the PRDS valve has more than one water connection the water should be supplied through a symmetrical rising pipe. This ensures a continuous and constant supply of the spraywater to the nozzles of the PRDS valve.



Drains

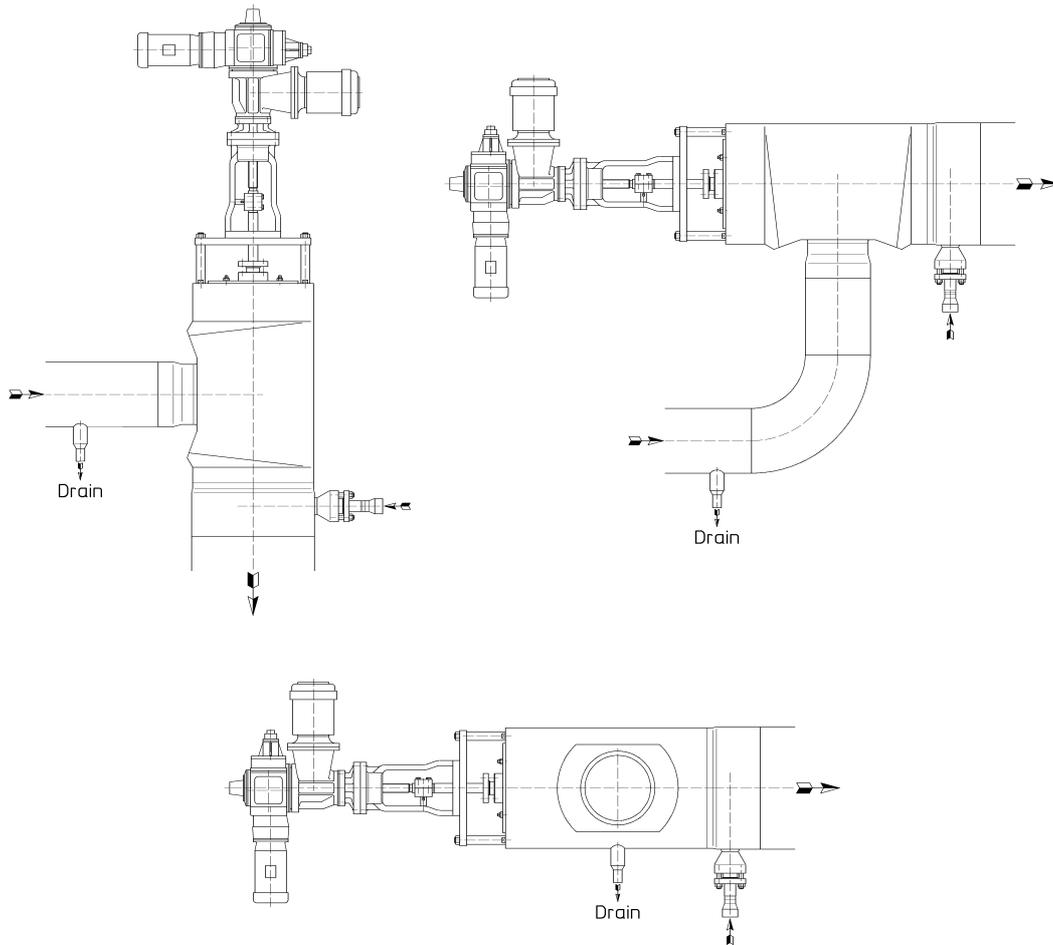
Condensate or non evaporated spray water in the valve or steam piping is very dangerous.

- Erosion on piping and valve
- Vibrations and water hammer
- Droplets can hit the temperature sensor causing control problems

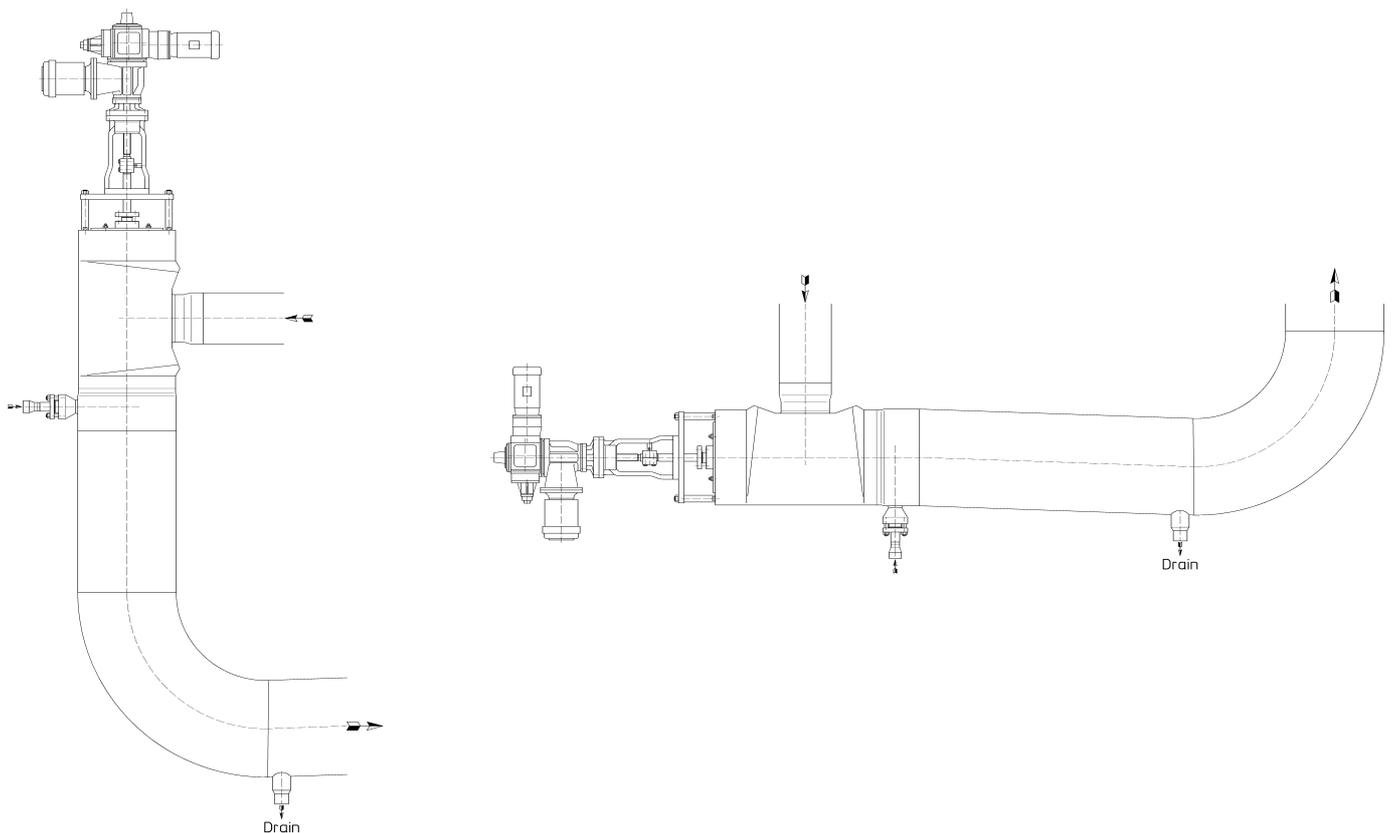
Upstream drains are essential to protect the PRDS valve. The drain connections shall be at the lowest point and nearest to the PRDS valve. It is recommended to avoid an installation with the valve at the low point, the drain could be undersized or blocked. Nevertheless depending on the piping slope the valves can be equipped with drain studs. The stud should not be too small.

The drain size is a function of the valve design, mounting orientation and the volume of the non-self-draining area in the valve body. It is advised to ask HORA for a agreement.

HORA's guide value for a standard drain connection upstream (condensate) is a G ½" pipe thread.



It is also important to protect the **downstream** system. The connection has to be at lowest point after the valve. It has to be avoided that the valve is at the low point because water can accumulate and cause serious damage. A minimum slope of 1% is recommended (see Piping).



The required straight piping length (see piping downstream) has to be considered but also a malfunction of the temperature sensor (see temperature sensor) has to be avoided.

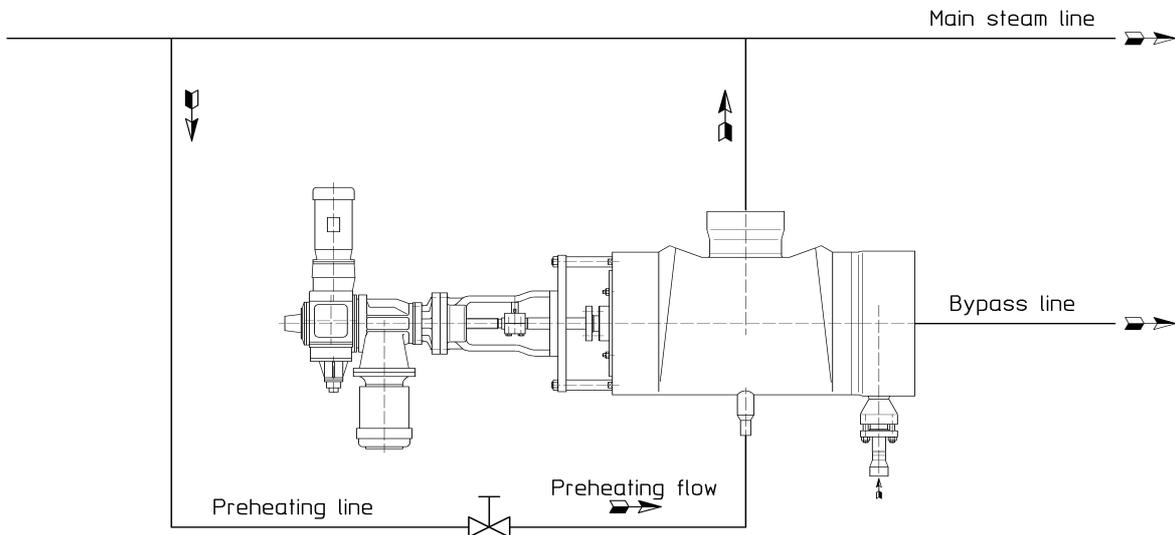
HORA's guide value for a standard drain connection downstream is to size it for ~10% of the maximum spray water amount. This will consider not only condensate formation but also leaking spray valves. The location of the drain shall be 2/3 of the distance to the temperature sensor.

For the HRH Bypass valves the non evaporated water has to drain off freely into the condenser. In plants with air-cooled condenser a drain is used.

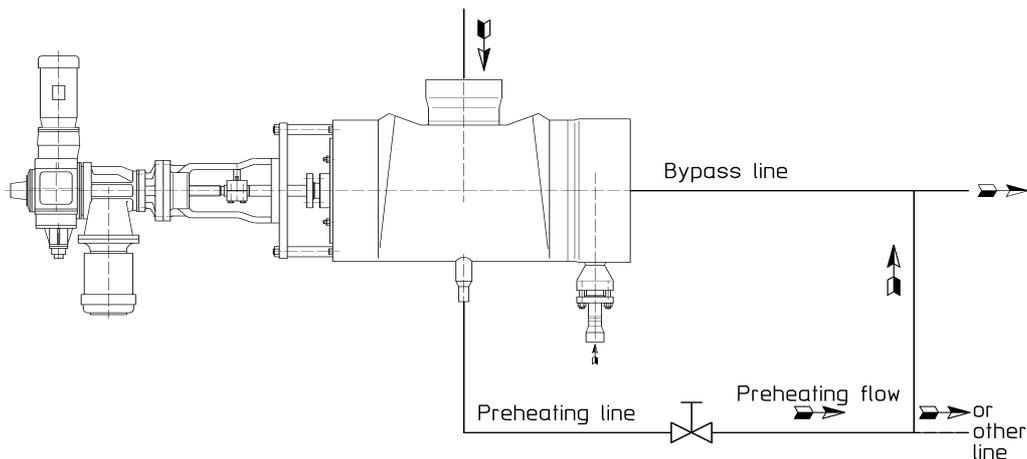
Pre-Heating

Pre-Heating lines prevent the formation of condensate and reduce the risk of thermal stress. Especially in cases where the PRDS valve is closed in normal conditions (e.g. Bypass Valves) preheating has to be arranged. At continuous operation condensation is little whether at frequent opening and closing (e.g. start-up and shutdown) the production is a big problem.

The amount of preheating has to be determined by the customer but must maintain the valve **upstream** conditions above saturation. Pre-Heating of the upstream piping is not required when the PRDS valve is located above the main steam line.



The above solution is using the natural pressure drop in the steam line. Warming **downstream** of the PRDS valve can be provided within the valve plug by hole of ~10mm for a continuous "leakage". In this case HORA will supply a screw plug to seal off the hole during shipping and pressure testing. During commissioning (see Pickling, Flushing, Blow Out Device) the screw can be replaced with a screw incl. a bleed hole of ~ Ø 1mm. Another common solution of pre-heating is using a bypass valve.

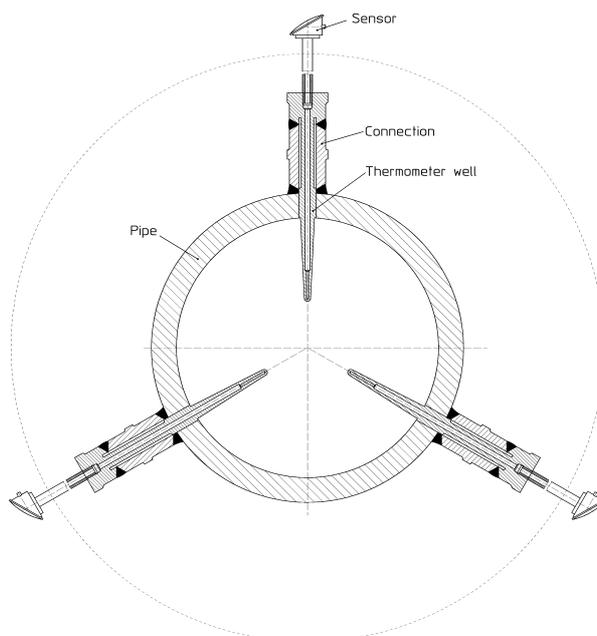


Temperature sensor

It is desirable to have the temperature sensor as close after the PRDS valve as possible in order to reduce the signal lag time. **The distance depends on the degree of superheat. The higher temperature the shorter the distance.**

The temperature sensors are fitted downstream in the straight piping at least 10xDN after the valve (min. 5m) and in case of horizontal piping ~30° rotated of the vertical piping.

In range applications an arrangement of 3 sensors with a high value selection is recommended



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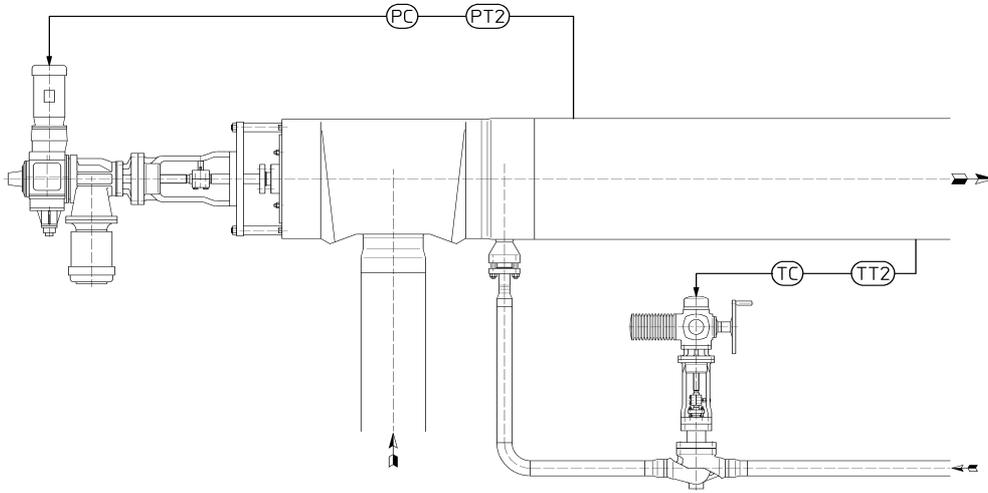
A feedforward control (see control) is recommended for this application.

Control

The type of control system is dictated by the application and has to be selected together with the end user and the Instrumentation supplier. PRDS valves combine the pressure control and temperature control. The pressure and temperature controllers give the input to the control valves. The pressure control system is a closed loop with feedback and quite uncomplicated.

The spray water control can be realised basically by a temperature control or a feedforward control with a heat balance calculation. For both systems a interlock between spray water and PRDS valve shall be used to open the steam valve before the water valve and close the water valve before the steam valve.

The direct method of the temperature control requires a distance between the water injection point and the sensor. A downstream temperature controller is monitoring the temperature leaving the PRDS valve and is adjusting the spray water control valve to maintain the setpoint temperature. For the temperature measurement the steam has to be absolutely dry, all water is evaporated. The setpoint temperature of the steam has to be minimum 8°C over saturation.

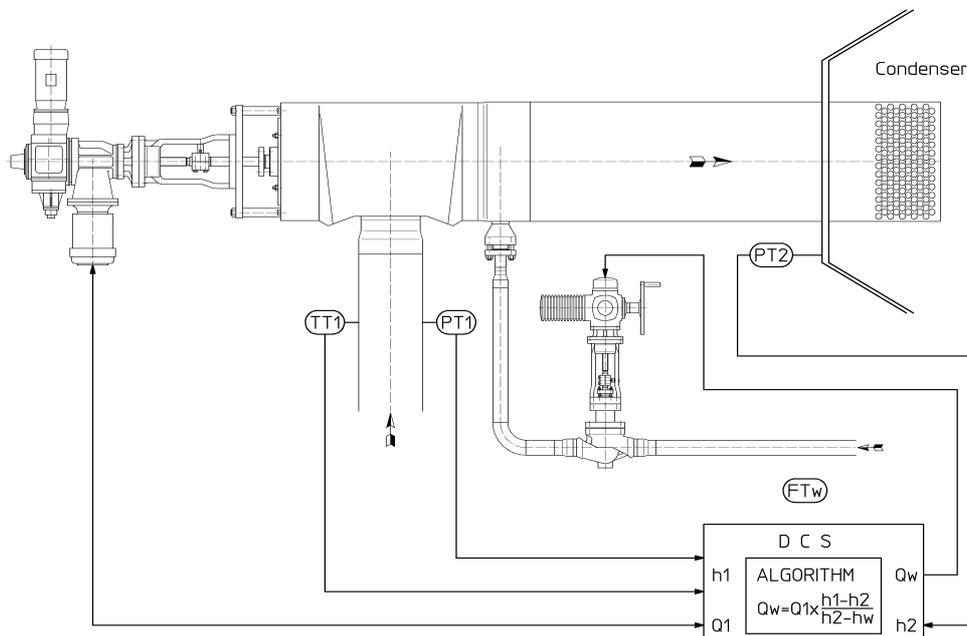


A closed loop temperature control is only used when the downstream setpoint temperature can be measured and used for feedback.

The feedforward control can be easily integrated in the DCS system. It reacts faster, before an event and avoids to inject a incorrect amount of spray water. With this system a lower downstream steam enthalpy can be achieved. It is used for LP Bypass valves in combination with dump tubes or where the distance from the valve to the condenser inlet is short. The method takes as inputs the steam inlet temperature, pressure and flow rate, the downstream or condenser pressure and the spray water enthalpy (cooling water temperature). The algorithm has integrated steam tables and calculates the required spray water quantity.

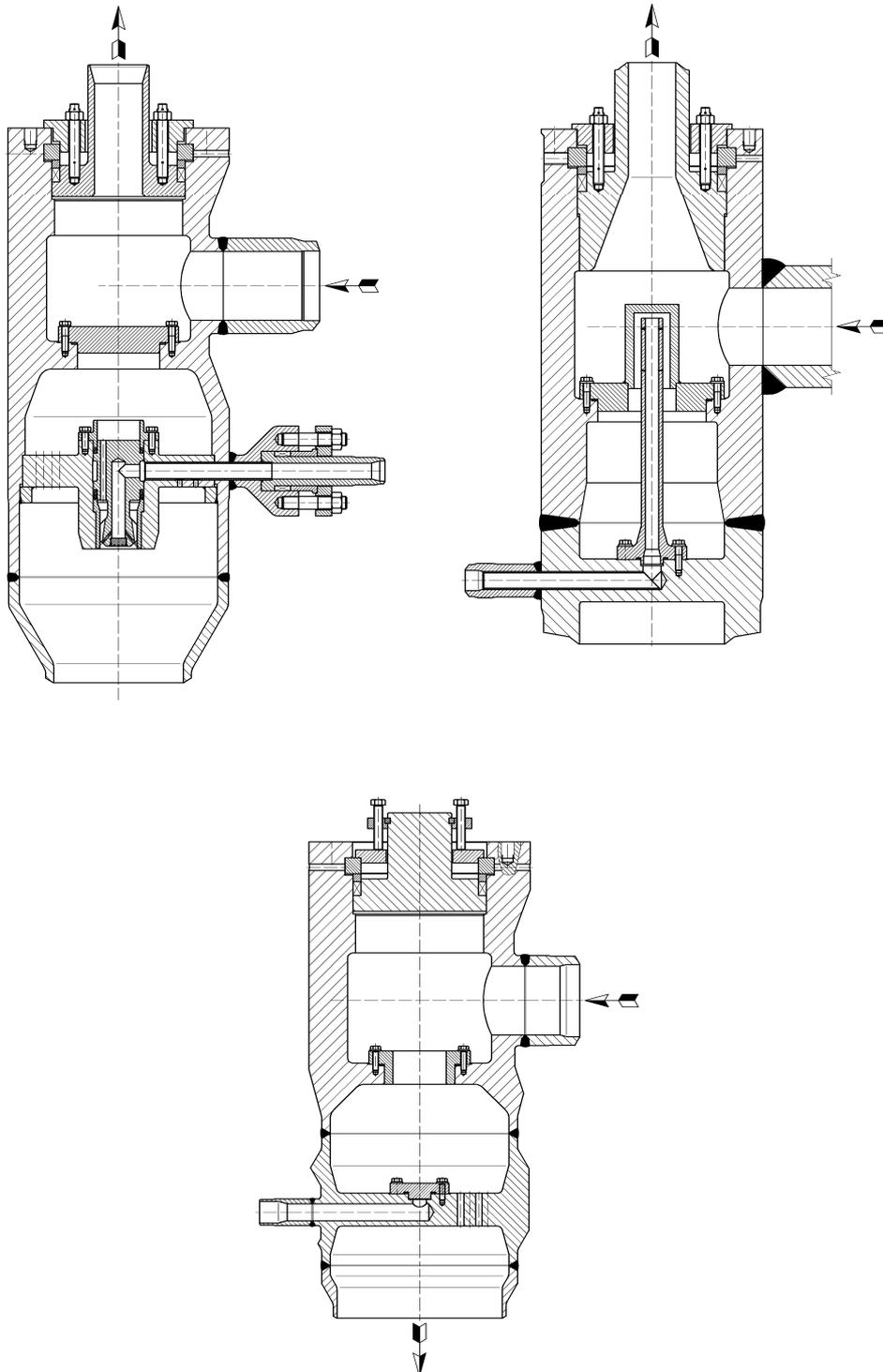
$$Q_{water} = Q_{steam} \times (h_{steam\ inlet} - h_{steam\ outlet}) / (h_{steam\ outlet} - h_{water})$$

An analogue output signal is directed to the spray water control valve which monitors the required flow against the actual flow. This is measured from a water flow meter. For HRH bypass systems the downstream enthalpy is a compromise between maximum allowable temperature and saturation condition in the condenser.



Flushing, Blow Out Device

New piping systems can contain foreign matters like particles from welding or rust. These have to be detached by a suitable acid solution or steam blow. To avoid damages on the valve internals protective inserts are used.



Summary

