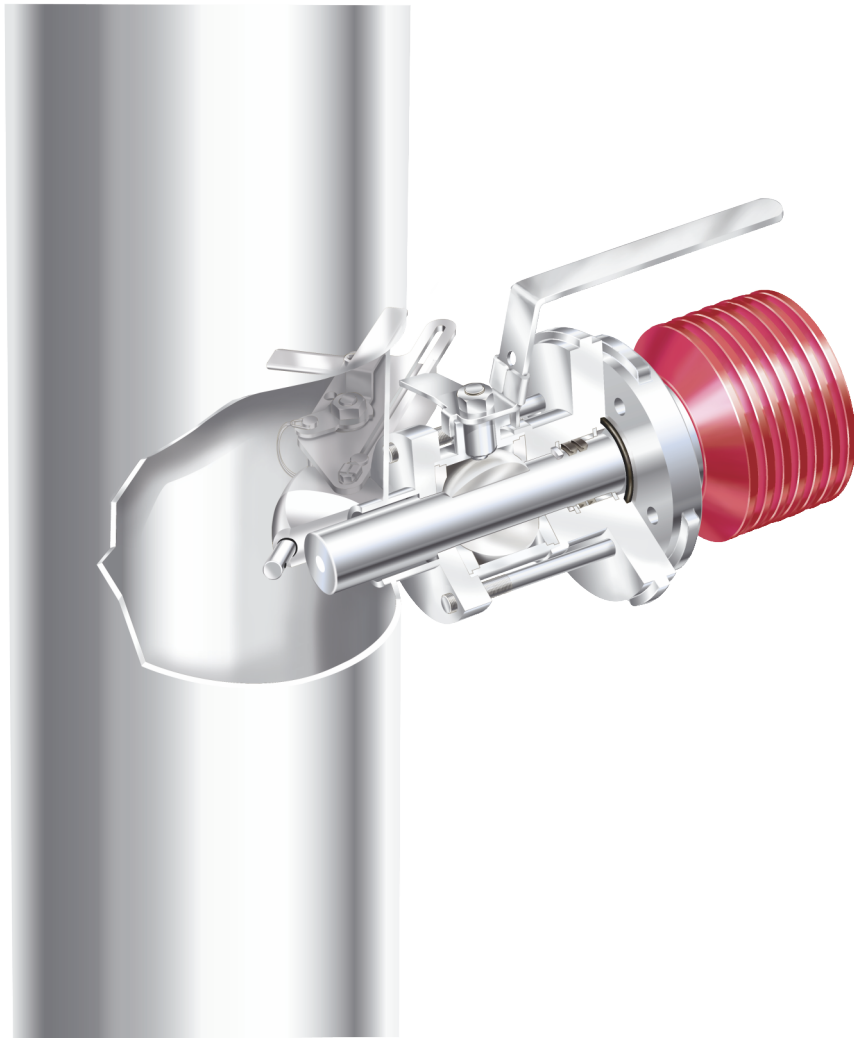


Best Practices

Safe-Drive™ Process Refractometer
Generation 2.1
PR-23-SD



VAISALA

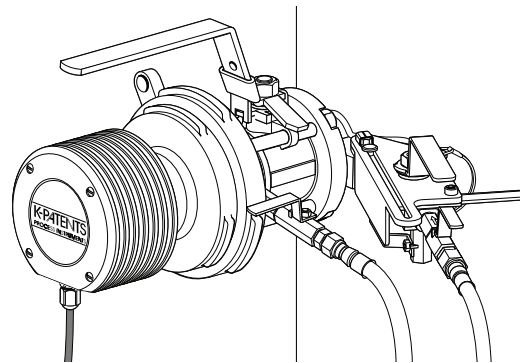
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Safe-Drive™ Process Refractometer PR-23-SD Generation 2.1 Best Practices

1 About this document

This document is intended for individuals installing, commissioning, operating, and/or servicing the Safe-Drive™ Process Refractometer PR-23-SD, generation 2.1 model. The purpose of this document is to provide a quick guide for the abovementioned tasks in the form of Vaisala recommended best practices.



This document is intended for PR-23-SD applications that have a steam wash system (typical application for black liquor) and applications that have high pressure water wash system (typical application for green liquor).

NOTE: These instructions are for quick reference only. For more thorough guidance, please refer to user manual and documentation.

2 Before installation

2.1 Installation location checklists

2.1.1 Checklist for steam wash (black liquor)

Before the SD sensor system is installed, it is important to inspect the installation location carefully for the following conditions:

- Install the SD sensor system onto either vertical or horizontal pipeline. The recommended flow rate is 0.4 m/s – 2 m/s (1.5 ft/s – 6 ft/s).
- Mount the system at waist level. This is the natural and safe height for the system and enables you to use the tools more ergonomically.
- Leave a 1 m (approximately 3 ft) space around the installation for operating around the SD sensor system. For the same reason, the steam connections should be installed on the sides or back of the sensor system.
- Recommended maximum ambient temperature of installation location is 45°C (120°F).

- Avoid locations that are blocked by other piping and/or equipment, or require additional tools, such as a ladder, to access the sensor. The installation location must be level, firm, and free of clutter to provide safe and easy access to the system.
- Use suitable type of steam for cleaning the prism. Dry saturated steam and 10-12 bar (150-180 psi) from steam source are recommended.
- Access to steam. The distance between the steam supply and the SD sensor system should be minimized.
- Access to drain for steam trap condensate outlet.
- Emergency shower and eye wash should be easily accessible. Water can also be used for cleaning SDI2 valve lip seals and sensor after sensor removal.
- Shut-off valve needs pressurized instrumentation air (5-10 bars / 70-150 psi).
- Ensure connection to the power supply (110-230V AC).

If these conditions do not apply, please reconsider the intended location for your installation or contact Vaisala.

2.1.2 Checklist for high pressure water wash (green liquor)

Before the SD sensor system is installed, it is important to inspect the installation location carefully for the following conditions:

- Install the SD sensor system onto either vertical or horizontal pipeline. The recommended flow rate is 0.4 m/s – 2 m/s (1.5 ft/s – 6 ft/s).
- Mount the system at waist level. This is the natural and safe height for the system and enables you to use the tools more ergonomically.
- Leave a 1 m (approximately 3 ft) space around the installation for operating around the SD sensor system. For the same reason, the steam connections should be installed on the sides or back of the sensor system.
- Recommended maximum ambient temperature of installation location is 45°C (120°F).
- Avoid locations that are blocked by other piping and/or equipment, or require additional tools, such as a ladder, to access the sensor. The installation location must be level, firm, and free of clutter to provide safe and easy access to the system.
- Water for washing must be hotter than process temperature and the feed pressure needs to be 20-30 bar (290-435 psi) over process pressure. The source of water can be
 - boiler feed water 100-120 bar (1450-1740 psi), use pressure reducer valve.
 - blowdown water 80-100 bar (1160-1450 psi), use pressure reducer valve.
 - intermediate feed water 40-60 bar (580-870 psi).
 - if there's no ready source of hot pressurized water, a pump can be used. Check pump temperature rating.
- The distance between the water supply and the SD sensor system should be considered for the length of piping. Insulation of piping is important, water temperature must be higher than process temperature
- Access to drain for precondition outlet
- Emergency shower and eye wash should be easily accessible. Water can also be used for cleaning SDI2 valve lip seals and sensor after sensor removal.
- Actuator valve needs pressurized instrumentation air (5-10 bars (70-150 psi))
- Ensure connection to the power supply (110-230V AC).

If these conditions do not apply, please reconsider the intended location for your installation or contact Vaisala.



Warning! Hard-scale removal in green liquor handling systems: Make sure that the sensor and wash nozzle materials are suitable for the hard-scale removal chemicals.

2.2 Component checklist (steam wash only)

Before starting installation, make sure you have all the tools and components listed below.

NOTE: Components 4 and 5 are connected by union nipple or piping not included in the delivery.

System components included in delivery:

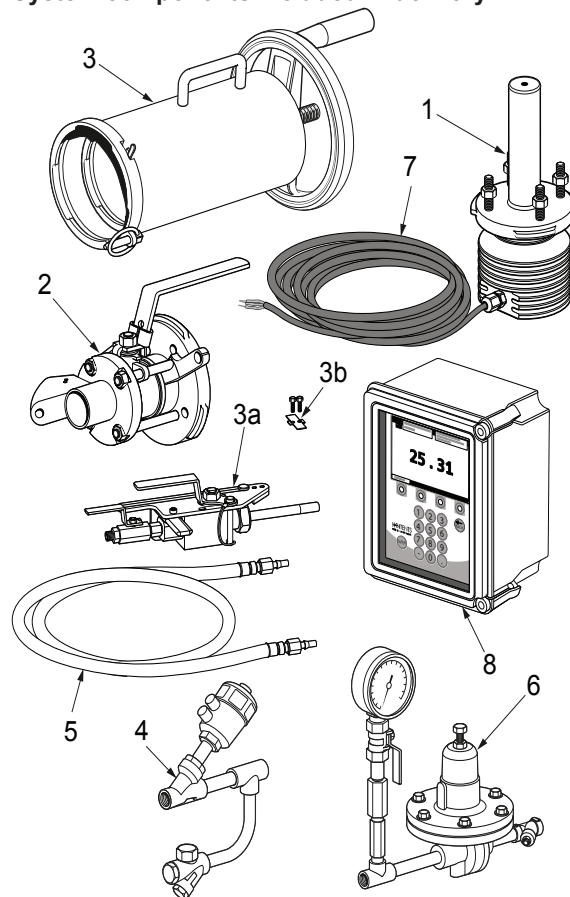


Figure 1 System components included in delivery

<input type="checkbox"/>	1	PR-23-SD sensor
<input type="checkbox"/>	2	SDI2 valve
<input type="checkbox"/>	3	Retractor tool SDR
<input type="checkbox"/>	3a	Prism wash nozzle assembly
<input type="checkbox"/>	3b	Wash nozzle installation bolts and locking plate
<input type="checkbox"/>	4	Compressed air operated solenoid shut-off valve with steam trap
<input type="checkbox"/>	5	Steam connection hose PR-3515
<input type="checkbox"/>	6	Pressure reducer valve and pressure gauge
<input type="checkbox"/>	7	Sensor connection cable
<input type="checkbox"/>	8	DTR transmitter

NOTE: If any of tools or components are missing, contact your supplier before starting installation

2.3 Installation equipment

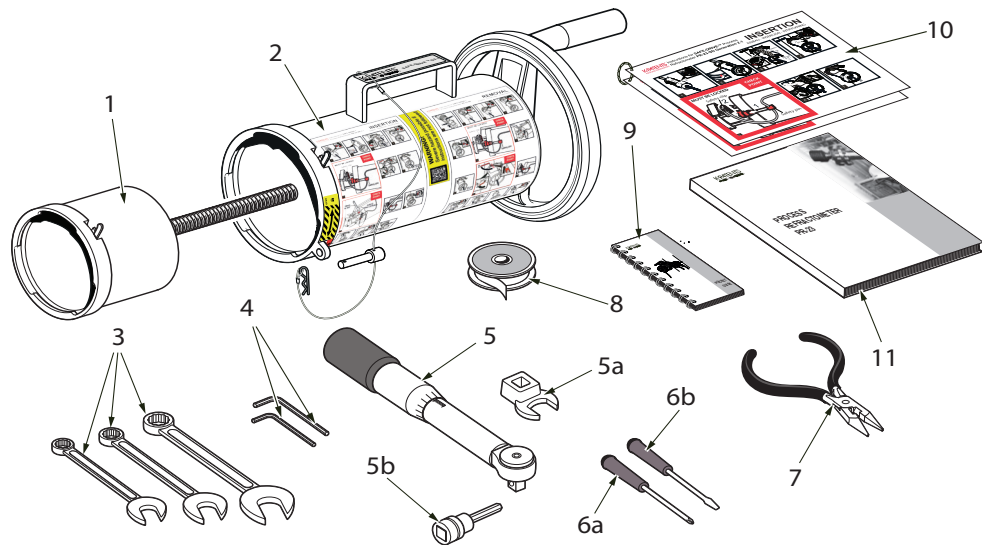


Figure 2 Installation equipment

<input type="checkbox"/>	1	Retractor inner casing	Supplied by Vaisala
<input type="checkbox"/>	2	Retractor outer casing	Supplied by Vaisala
<input type="checkbox"/>	3	Combination wrenches, 32 mm, 14 mm, 8 mm	
<input type="checkbox"/>	4	Allen keys 8 mm, 5 mm	
<input type="checkbox"/>	5	Torque wrench	
<input type="checkbox"/>	5a	open end fitting 19 mm	
<input type="checkbox"/>	5b	hex bit socket 8 mm	
<input type="checkbox"/>	6	Screwdriver	
<input type="checkbox"/>	6a	Phillips head	
<input type="checkbox"/>	6b	Flathead	
<input type="checkbox"/>	7	Pliers	
<input type="checkbox"/>	8	Thread seal tape	
<input type="checkbox"/>	9	Pocket guide for insertion and retraction of sensor and wash nozzle	Supplied by Vaisala
<input type="checkbox"/>	10	Laminated instructions for insertion and removal of SAFE-DRIVE sensor	Supplied by Vaisala
<input type="checkbox"/>	11	SAFE-DRIVE Process refractometer PR-23-SD Generation 2.1 Best Practices (this document)	Supplied by Vaisala

NOTE: The material of the SDI2 valve body that is welded onto a process pipe is Duplex steel SAF2205 (EN 1.4462, ASTM S32205/S31803). Choose the welding method and filler accordingly.

Vaisala recommends complying with the applicable EN / ASTM standards.

3 Safety requirements

These safety requirements must be followed at all times when installing, operating, or servicing PR-23-SD sensor. These are the minimum safety requirements – your company may require additional PPE (personal protective equipment).

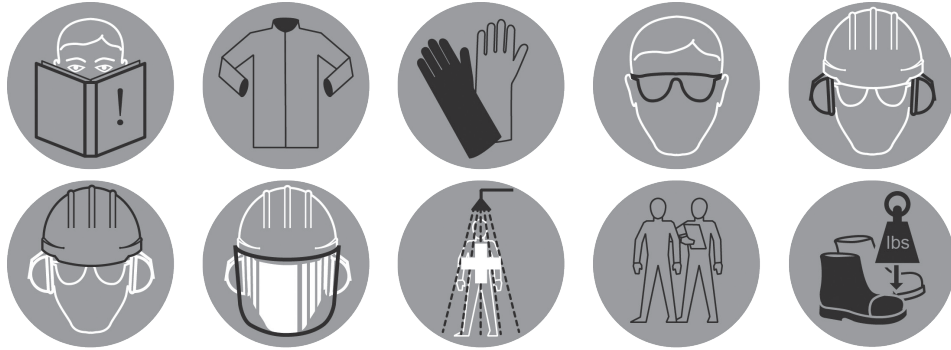


Figure 3 Safety symbols

WARNING: Watch out for hot steam and process pipes. Wear protective clothing as instructed below to work safely.

- Only authorized personnel can perform the tasks instructed in this document.
- Long-sleeved safety clothing.
- Protective gloves.
- Safety glasses and/or goggles.
- Ear protectors
- Hard hat or helmet.
- Face visor
- Locate the nearest emergency shower and eye wash before starting the work.
- Never operate the system alone: It is recommended for one operator to read the instructions and guide the second operator performing the steps.
- Hard-cap safety boots.

It is the user's responsibility to follow manufacturer's safety and operating instructions. The client's organization has the responsibility to develop and maintain occupational safety and create a safety culture where individuals are expected to follow safety instructions at all times. Any negligence towards safety instructions or failure to comply with safe practices should not be tolerated. It is the manufacturer's responsibility to produce goods that are safe to use when instructions are followed.

4 Installation process

For more thorough instructions, please refer to user documentation or visit the website to see the instructional video (www.kpatents.com, PR-23-SD Safe-Drive™ Operation Guide Video).

Installation of the SD sensor system consists of

- Cutting pipe opening for SDI2 isolation valve.
- Welding and assembling the SDI2 valve onto the processing piping.
- Installing the prism wash system.
- Installing the DTR transmitter.
- Installing the PR-23-SD sensor.

4.1 Spool piece assembly

If the SDI2 valve was supplied pre-welded and assembled onto a pipe spool piece for integration in existing piping on site, please skip ahead to installing prism wash.

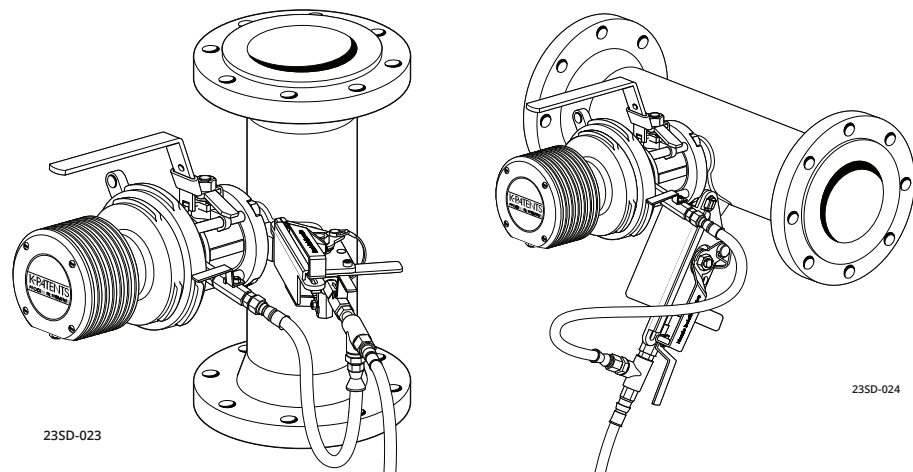


Figure 4 Vertical and horizontal spool piece assemblies (steam wash system)

4.2 Cutting installation opening for SDI2 valve

Use the installation guide sticker provided by Vaisala to determine the installation opening shape and size suitable for your process pipe. If you do not have the guide sticker at hand, please follow the instructions in the image below:

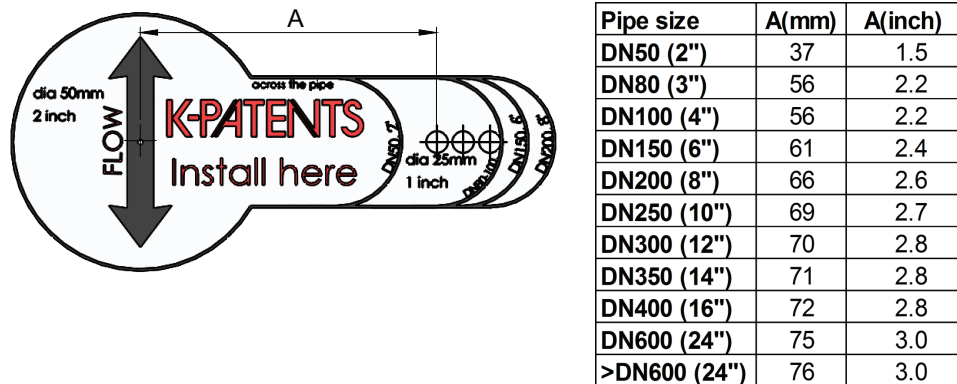


Figure 5 Installation guide

To cut the installation opening

1. Cut the installation guide sticker to match the pipe size.
2. Clean the surface of the pipe around the installation area and attach the sticker onto the pipe.
NOTE: Make sure that the FLOW marker is parallel to the pipe and points to the correct flow direction. On a horizontal pipe the nozzle points downwards and on a vertical pipe it points to right. The SD sensor system must always be installed in horizontal position and on the side of the pipe.
3. Drill two holes – 50 mm (2") and 25 mm (1") – as guided by figure 5.
4. Remove the bridge between the holes so that the opening is exactly the shape of the sticker.

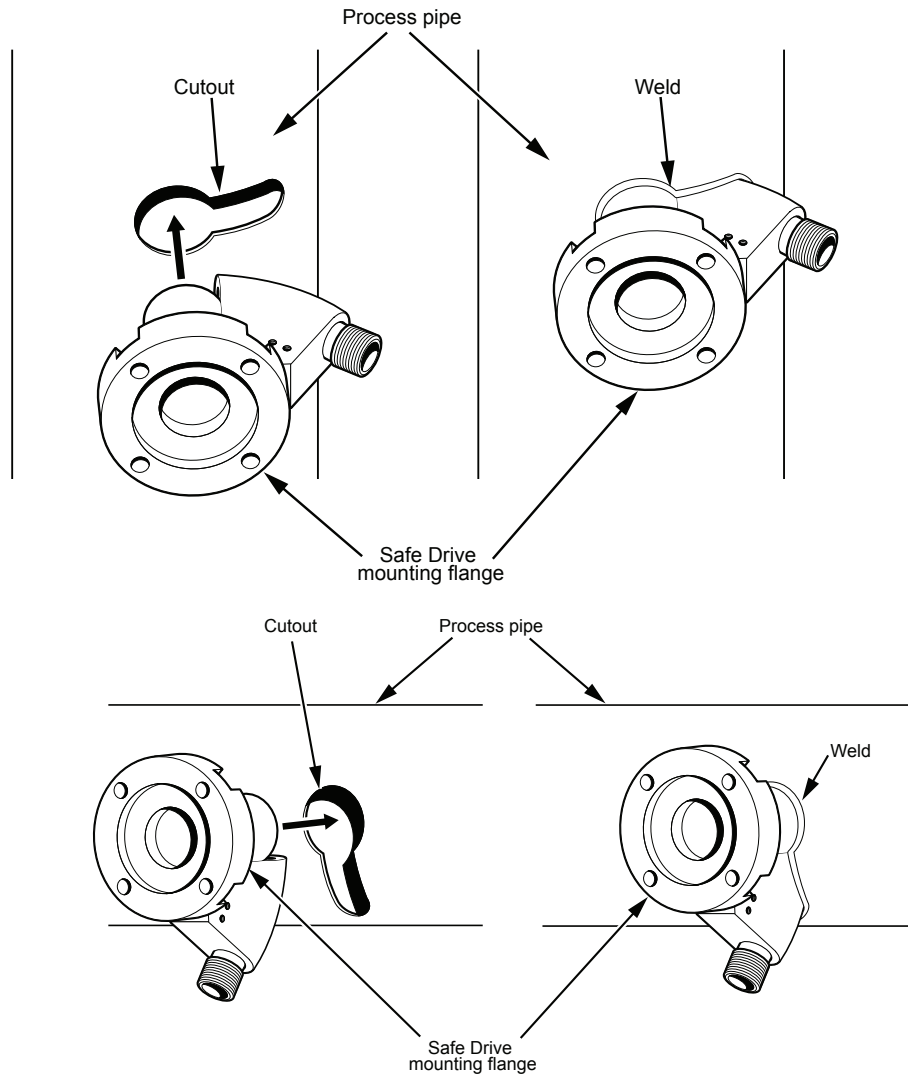


Figure 6 Installation on vertical and horizontal pipes

4.3 Disassembling SDI2 valve for welding

To avoid thermal damage to the isolation valve sealing, you must separate the valve body from the valve assembly before it is welded onto the pipe.

NOTE: Be very careful not to drop or lose any parts that come loose when separating the body from the assembly.

To disassemble the SDI2 valve, open the four (4) M10 allen key bolts with an 8 mm (5/16") allen key (1).

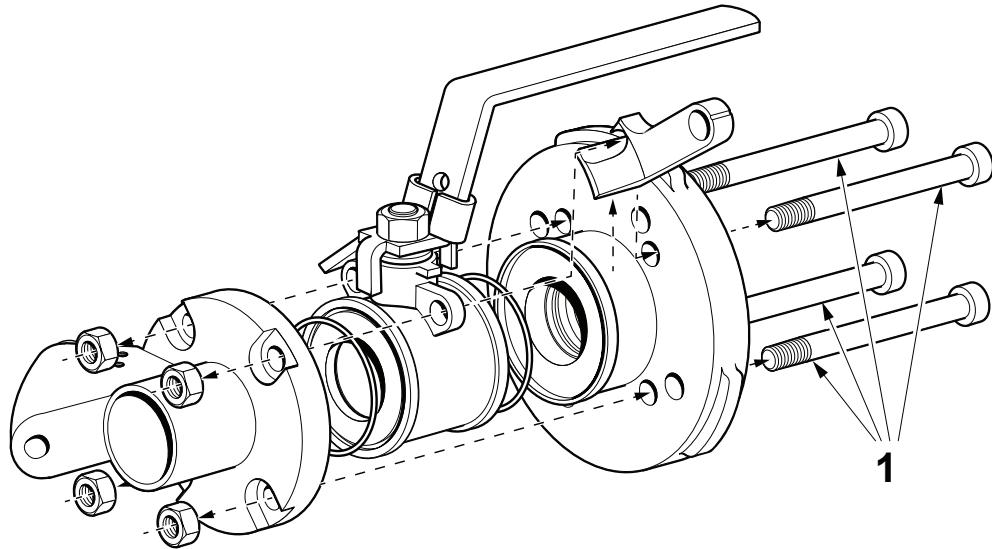


Figure 7 Disassembling valve

4.4 Welding SDI2 valve in place

After you have disassembled the SDI2 valve, the valve body is welded onto the process pipe.

- The material of the SDI2 valve body is Duplex steel SAF2205 (EN 1.4462, ASTM S32205/S31803). Choose the welding method and filler accordingly.
- See the attached drawings 2149 (MTG) and MTG472 for more detailed welding instructions.
- Follow all local requirements for welding.
- Vaisala recommends complying with the applicable EN / ASTM standards.
- Consider the materials and shapes of the welded objects when performing welding pre-processing (tools, cleaning, preheating).
- Consider the materials and shapes of the welded objects when performing welding post-processing (postheating, fluxing).

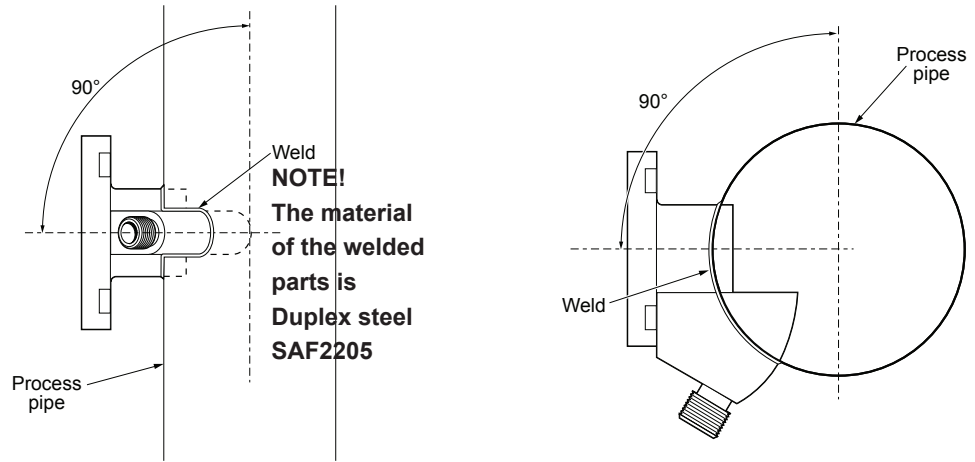
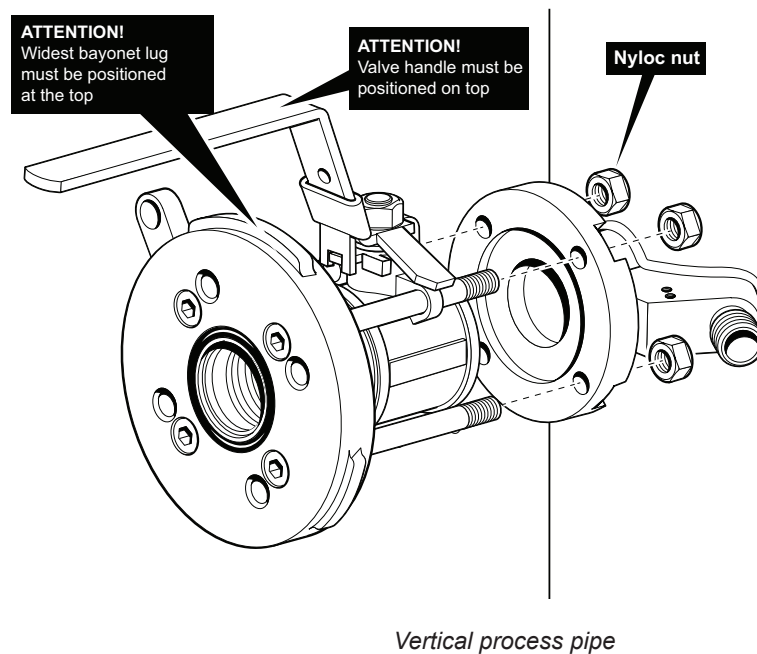


Figure 8 Welding on vertical and horizontal pipes

4.5 Reassembling SDI2 valve

After the SDI2 valve body has been welded in place, reassemble the valve in reverse order.

NOTE: Make sure that the seals for the ball valve are properly aligned.



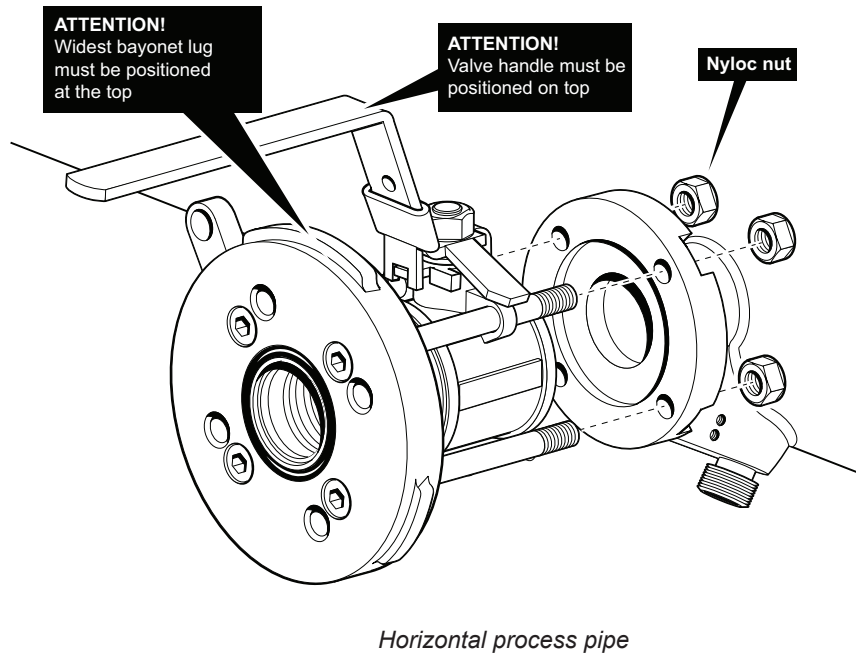


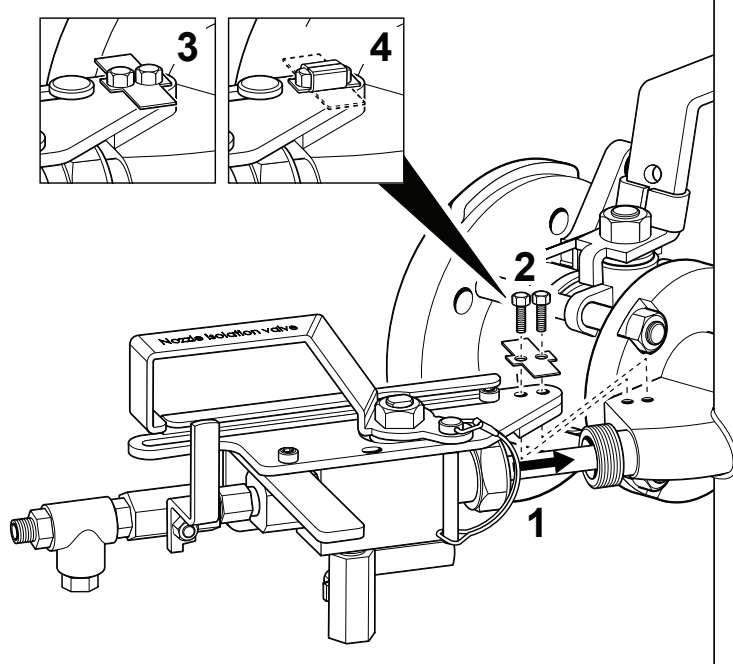
Figure 9 Reassembling valve on vertical and horizontal pipes

- Make sure that the SDI2 valve handle and the largest bayonet connection are on top. Otherwise, you will not be able to insert the sensor in its place.
- Use Nyloc nuts. Tighten the bolts to a torque of 17 Nm (13 lb-ft) with an 8 mm (5/16") allen key.

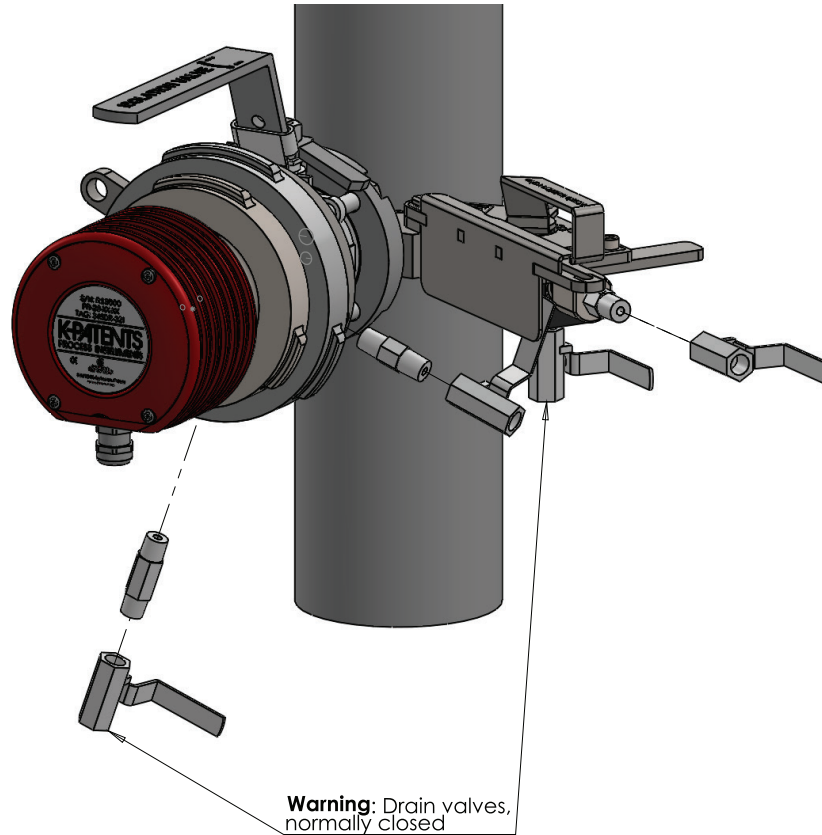
WARNING: Always shut the main steam/water valve before performing any work on the wash nozzle.

To re-install the wash nozzle assembly

1. Insert the wash nozzle assembly to its place (1).
2. Place the nozzle guide plate in the correct position and tighten the two (2) M5 bolts (2).
3. Secure the wash nozzle with a locking plate (3, 4).

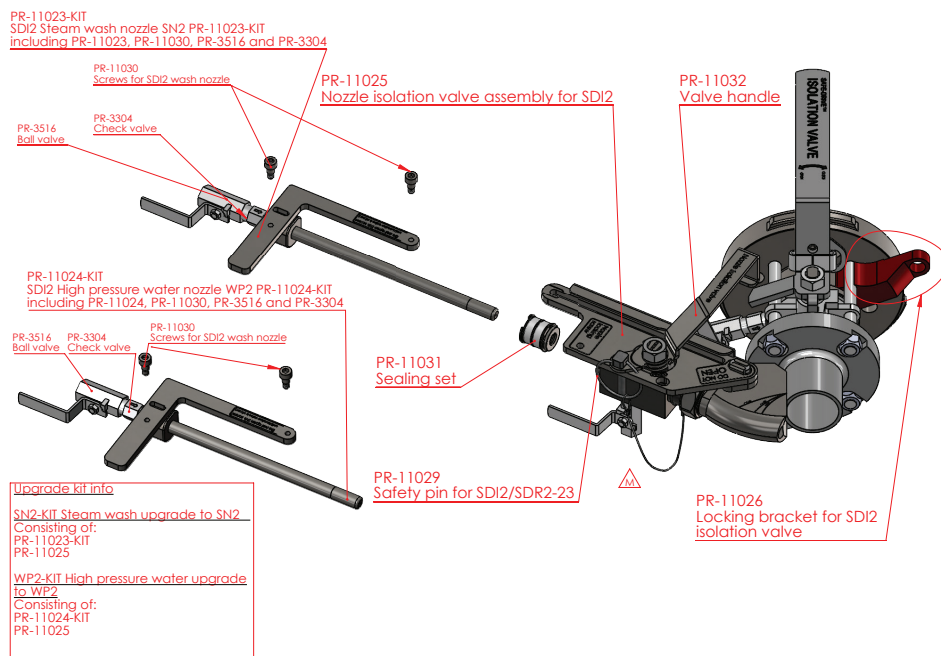


Unless otherwise indicated, the drain valves should be closed.



4.5.1 SDI2 wash nozzle upgrade

A Safe-Drive generation 1 wash nozzle system can be upgraded to SDI2 (incl. generation 2.1) with an upgrade kit.



4.6 Installing wash systems

In the process service material deposit, scaling or coating may occur on the prism surface. To avoid this, you need to install an integral prism steam wash (in black liquor) or high pressure water wash (in green liquor). The wash uses the retractable nozzle included in the SDI2 valve.

4.6.1 Steam prism wash system

Important steam prism wash considerations

- The distance from the steam nozzle on the SDI2 valve to the steam shut-off valve should be kept as short as possible to avoid condensate. The recommended length of the distance is 0.6 m (2 ft) or less.
- Separate or isolate the power to the solenoid from the power to the transmitter by installing a safety switch. This enables the steam wash to be serviced without having to power down the whole SD sensor system.
- Pipe the steam trap properly to drain so that the trap is not blowing hot steam.
- Steam piping upstream of shut-off valve is ½" or larger.
- In addition to the SDI2 valve steam fittings, the following components must be included in the steam wash installation:
 - steam shut-off valve
 - air-operated solenoid valve
 - steam trap
 - switch or terminal for power isolation

- OPTIONAL, in case of contaminants: To remove any contaminants within the steam source, installing a steam strainer is recommended.
- OPTIONAL, in case of excessive pressure: If the steam pressure exceeds to maximum pressure differential, a pressure reducing valve PR-3341-J needs to be installed to reduce the steam pressure to optimal design.

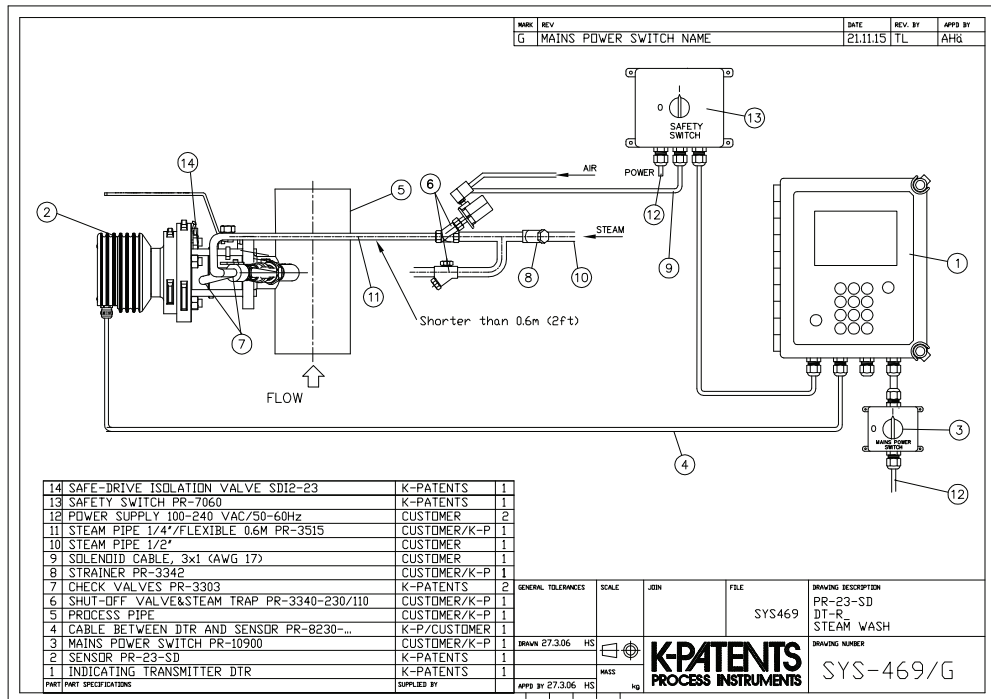


Figure 10 Mounting steam wash system

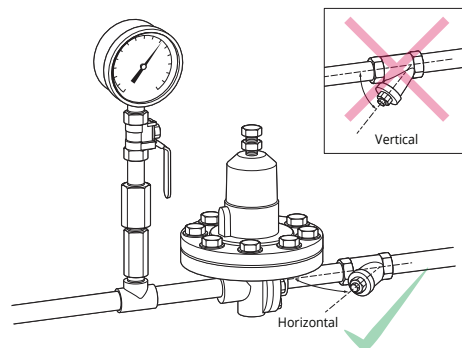


Figure 11 Strainer orientation for PR-3341-J

To install the wash system

1. Define the wash setting values for the wash system:
 - steam source minimum and maximum pressures
 - wash time – the time one wash will last (seconds)
 - recovery time – the time after the wash has finished, before the measurement is live data again (seconds)
 - interval – the time between washes (minutes)

Recommended steam prism wash settings

CONC % value	Minimum above process pressure	Maximum above process pressure	Wash time	Recovery	Interval
10-30 %	2 bar (30 psi)	4 bar (60 psi)	2-3 s	20 s	120-360 min
30-60 %	3 bar (45 psi)	6 bar (90 psi)	3 s	20 s	20-60 min
60-90 %	4 bar (60 psi)	8 bar (120 psi)	3-5 s	20 s	15-25 min

NOTE: Damage caused to prism by excessive pressure or washing is not covered by the product warranty.

Choose the correct steam source pressure by comparing it to the process pressure. The steam source pressure must be higher than process pressure to provide adequate washing, but excessive pressure may also cause premature damage or etching of the prism. Also, if the washing phase is programmed to last too long, the prism may wear out prematurely.

2. Install the steam pipes in the SDI2 valve, as instructed below.

NOTE: All the necessary wash fittings are included in the valve.

3. Connect the steam wash system power supply.

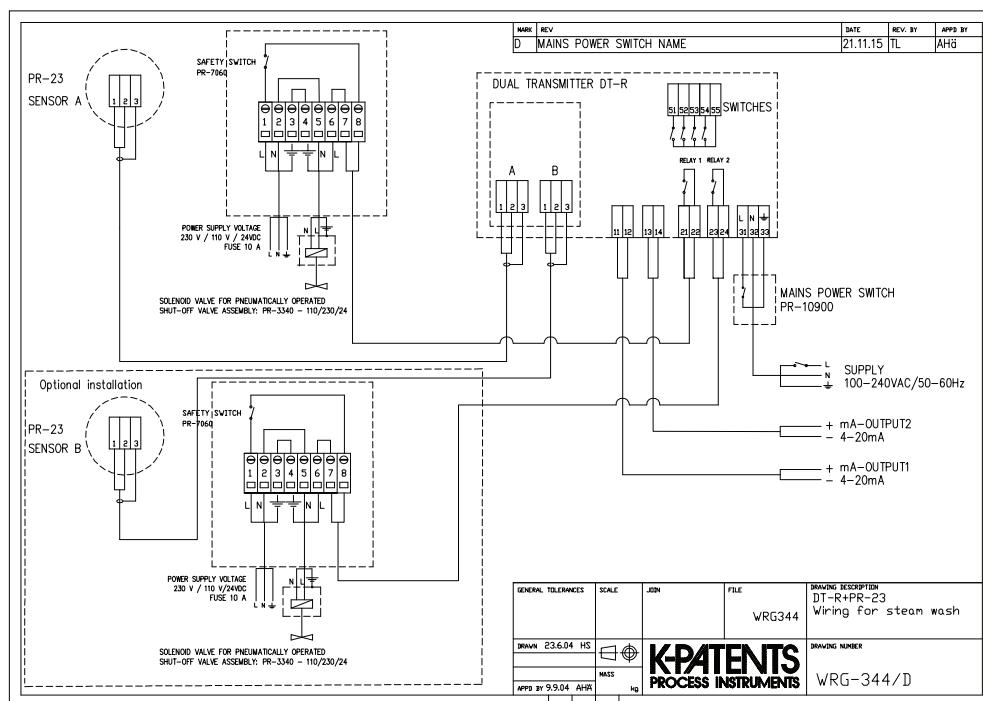


Figure 12 Wiring steam wash system

For more information on controlling the prism wash cycle, please refer to section Configuring relays in user documentation.

4.6.2 High pressure water prism wash system

Important high pressure water prism wash considerations

- The water has to be very hot, over 100°C (212°F)

To install the wash system

1. Define the wash setting values for the wash system:
 - water source minimum and maximum pressures
 - wash time – the time one wash will last (seconds)
 - recovery time – the time after the wash has finished, before the measurement is live data again (seconds)
 - interval – the time between washes (minutes)

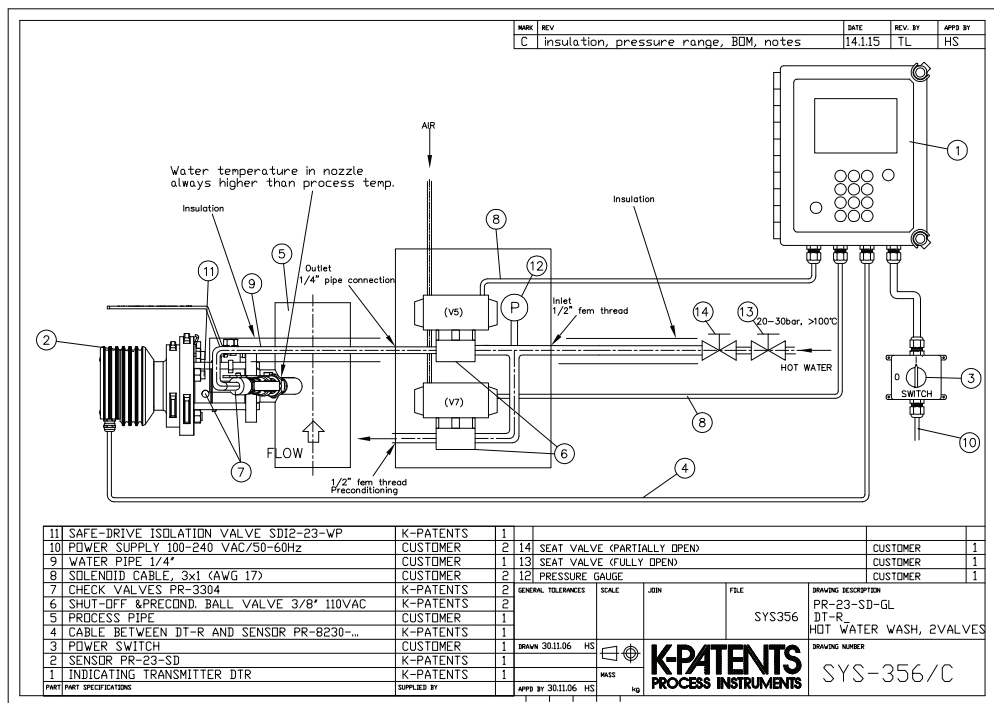


Figure 13 Mounting high pressure wash system

Recommended high pressure water prism wash settings

Minimum above process pressure	Maximum above process pressure	Wash time	Recovery	Interval
20 bar (290 psi)	30 bar (435 psi)	10-15 s	20 s	5-20 min

NOTE: Damage caused to prism by excessive pressure or washing is not covered by the product warranty.

Choose the correct source pressure by comparing it to the process pressure.

The source pressure must be higher than process pressure to provide adequate washing, but excessive pressure may also cause premature damage or etching of the prism. Also, if the washing phase is programmed to last too long, the prism may wear out prematurely.

2. Install the pipes in the SDI2 valve, as instructed above.

NOTE: All the necessary wash fittings are included in the valve.

3. Connect the wash system power supply.

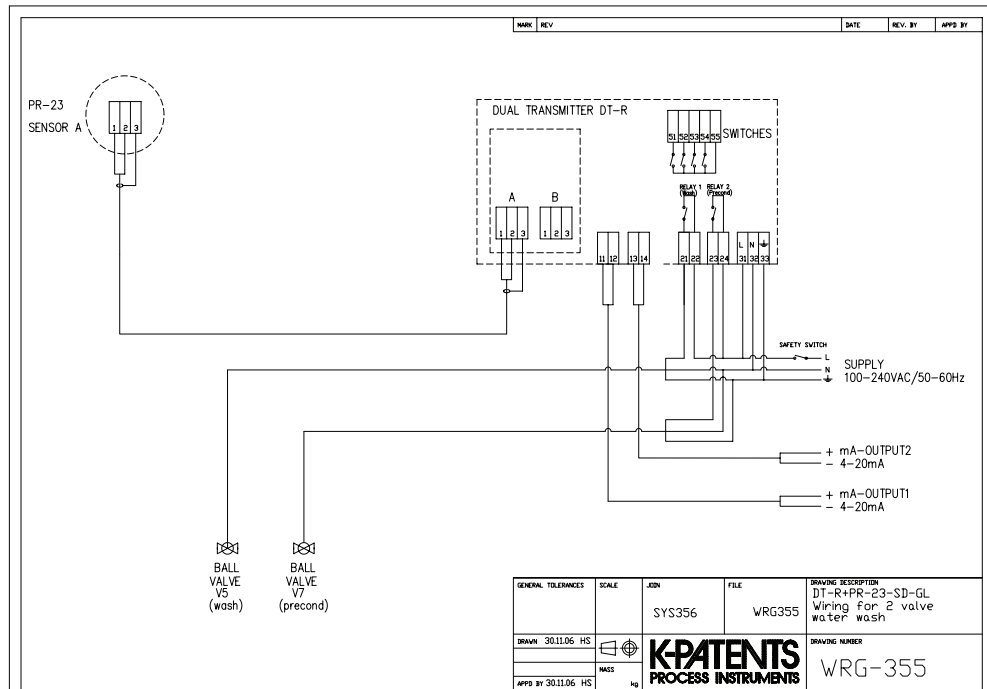


Figure 14 Wiring high pressure wash system

For more information on controlling the prism wash cycle, please refer to section Configuring relays in user documentation.

4.6.3 High pressure water wash with a pump

If high pressure water is not available, use of a high pressure pump is recommended.

Important considerations

- The feed water should be as hot as possible, but maximum 60 °C (140 °F) due to pump temperature tolerance. The feed water has to be clean (filtered) water, use of a strainer is recommended. The strainer must be cleaned directly after commissioning and then checked monthly. Minimum volume for feed water is 20 l/min with the feed water source preferably above the pump. Feed water pressure should be 0.5-10 bar (7-145 psi). The diameter of the feed water piping should be 1/2 to 3/4 inches.
- The pump is installed horizontally in an easily accessible location that is protected from dirt and water. Use of dampers is recommended. The distance (line length) from the nozzle should be 5-10 m (16-33 ft).

- It is recommended to install the power relay unit near the pump, with short cable routings.
- The pressure requirement for the high pressure piping is 140 bar (2030 psi). Insulation is recommended to keep the washing water hot. With trace heating the water temperature can be brought up to 90 °C (194 °F).

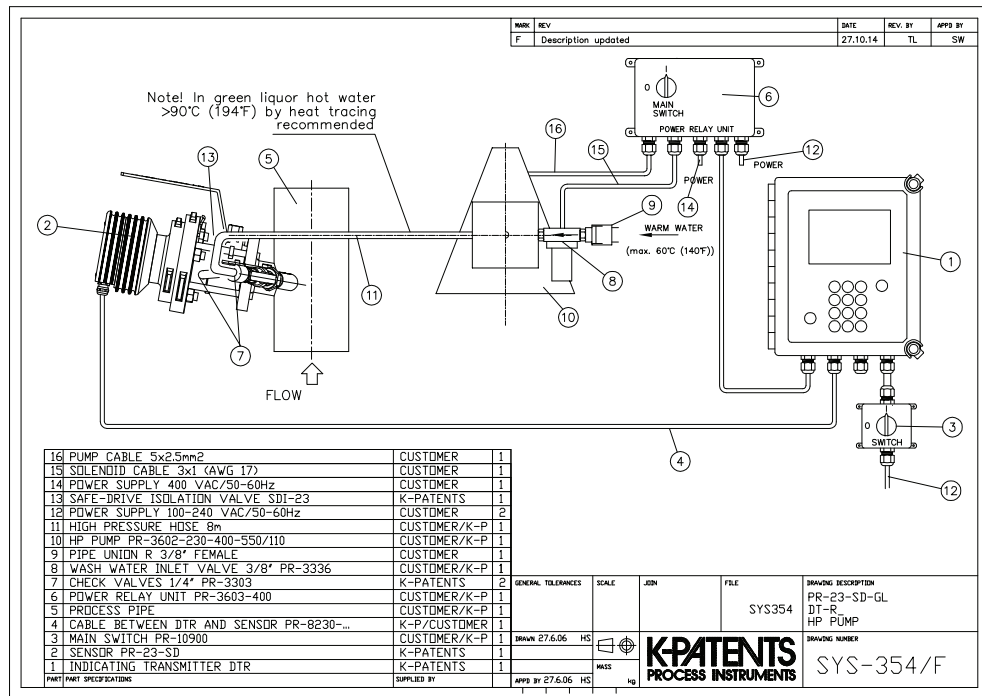


Figure 15 Mounting high pressure water wash with a pump

To install the wash system

1. Define the wash setting values for the wash system:
 - water source minimum and maximum pressures
 - wash time – the time one wash will last (seconds)
 - recovery time – the time after the wash has finished, before the measurement is live data again (seconds)
 - interval – the time between washes (minutes)

Recommended high pressure water prism wash settings

Minimum above process pressure	Maximum above process pressure	Wash time	Recovery	Interval
20 bar (290 psi)	30 bar (435 psi)	10-15 s	20 s	5-20 min

NOTE: Damage caused to prism by excessive pressure or washing is not covered by the product warranty.

Choose the correct source pressure by comparing it to the process pressure.

The source pressure must be higher than process pressure to provide adequate washing, but excessive pressure may also cause premature damage or etching of the prism. Also, if the washing phase is programmed to last too long, the prism may wear out prematurely.

2. Install the pipes in the SDI2 valve, as instructed above.
NOTE: All the necessary wash fittings are included in the valve.
3. Connect the wash system power supply.

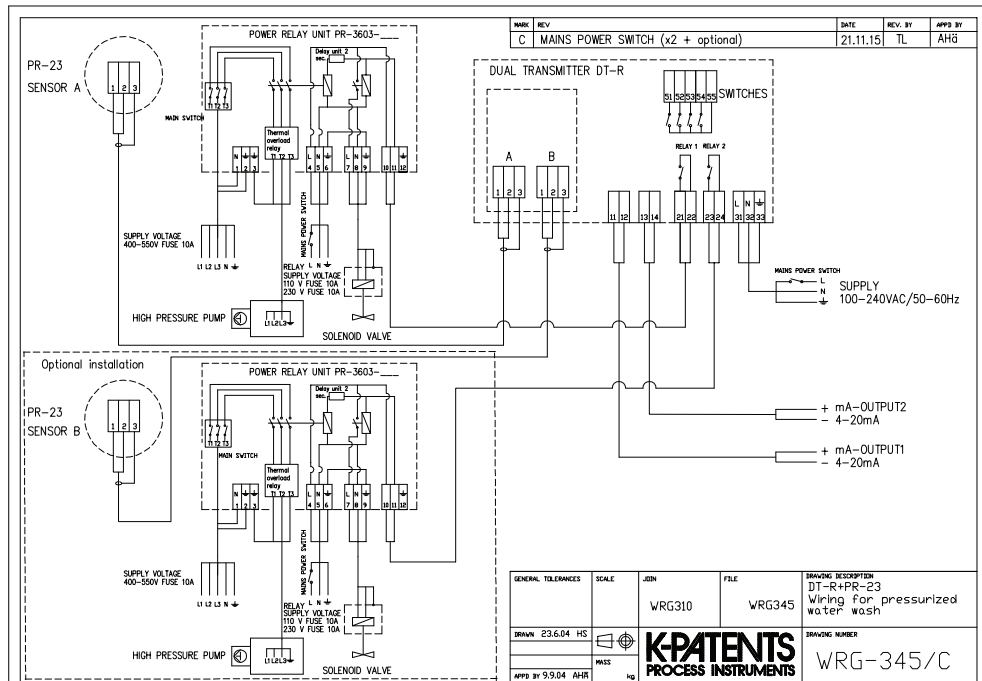


Figure 16 Wiring a high pressure water system with a pump (for wiring in the US see WRG-435-US)

For more information on controlling the prism wash cycle, please refer to section Configuring relays in user documentation.

4.7 Before inserting and removing PR-23-SD sensor

WARNING: Always use the Safe-Drive™ Retractor tool for inserting and removing the sensor. Removing the sensor without the Retractor tool may cause a life-threatening situation, if there is any pressure in the process pipe. Inserting or removing sensor without Retractor tool may also cause damage to the lip seal. Always store the Retractor tool indoors in a clean and dry location.

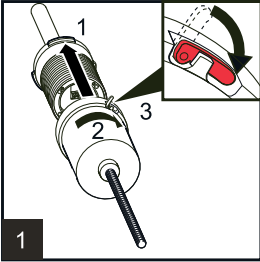
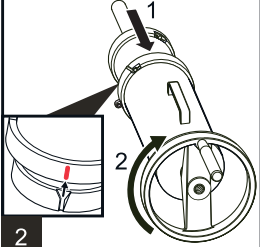
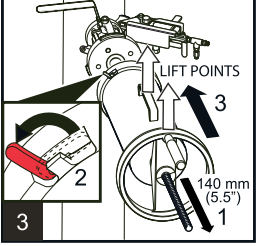
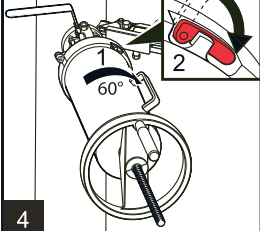
Successful sensor insertion and removal can only be guaranteed when the Retractor tool is used and the instructions for insertion or removal are carefully followed.

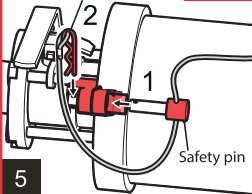
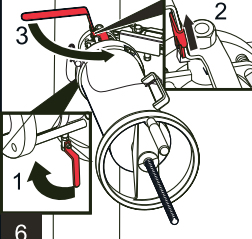
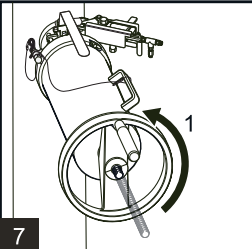
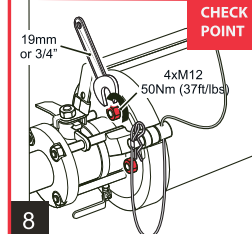
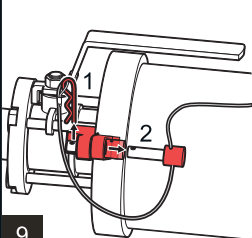
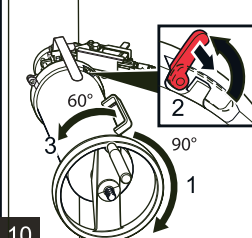
NOTE: Check the Retractor tool visually before starting insertion / removal process. Make sure the handwheel rotates freely.

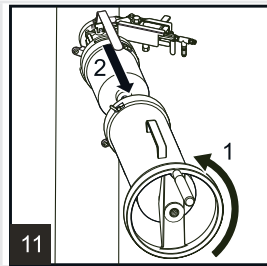
WARNING: If you detect leaking at any point of sensor insertion or removal process, revert immediately to the previous step in the process. Do not continue insertion / removal until the reason for leakage has been cleared and fixed.

Insert and remove the sensor as instructed in the following chapters. For more thorough instructions, please refer to user documentation or visit the website to see the instructional video on inserting and removing the sensor (www.kpatents.com, PR-23-SD Safe-Drive™ Operation Guide Video).

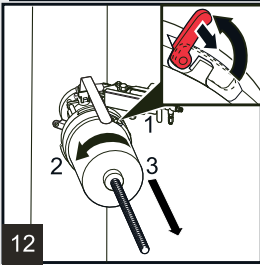
4.8 Inserting sensor

	<ol style="list-style-type: none"> 1. Insert the sensor into Inner casing. Make sure that the sensor cable gland has been taken off. Match the bayonet closing with sensor flange so that the latch is slightly to the left of the top and the sensor cable passage is straight down. 2. When sensor flange is flush with the bottom of Inner casing, rotate Inner casing 60 degrees clockwise to lock it to the flange. 3. Push down locking latch to secure the connection.
	<ol style="list-style-type: none"> 1. Fit Outer casing over Inner casing. To match the casings, check that the rail on the Inner casing matches the groove on Outer casing. The latch of Inner casing should be slightly to the right from the top and the handle of Outer casing should point up. 2. Turn the hand-wheel clockwise until it stops to draw the Inner casing with sensor into Outer casing.
	<ol style="list-style-type: none"> 1. The sensor should now be inside Retractor and about 140 mm (5.5") of the screw thread should stick out of the middle of the wheel. 2. Unlock the latch on Outer casing. 3. Take a firm hold of the hand-wheel and handle and lift Retractor (with sensor) over the isolation valve flange. Keep handle up.
	<ol style="list-style-type: none"> 1. Rotate Outer casing 60° clockwise to lock the bayonet. 2. Lock Outer casing latch.

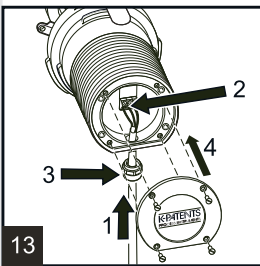
<p>MUST BE LOCKED CHECK POINT</p>  <p>5</p>	<ol style="list-style-type: none"> 1. Insert the safety pin. 2. Lock the safety pin with safety clip. <p>DO NOT PROCEED UNTIL YOU HAVE COMPLETED THIS STEP!</p>
 <p>6</p>	<ol style="list-style-type: none"> 1. Close the blow-out ball valve under Isolation valve. 2. Lift up the Isolation valve handle locking plate. 3. Open Isolation valve by turning the valve handle 90°. The valve is open when the ball valve handle is parallel to Retractor and sensor.
 <p>7</p>	<p>Now the sensor can be inserted into the process.</p> <ol style="list-style-type: none"> 1. Turn the hand-wheel counterclockwise until it stops, i.e. until the sensor flange connects with Isolation valve and only the end of the screw thread is visible. <p>Warning! If you detect leaking, revert immediately to the previous step. Do not continue the installation until the reason for leakage has been cleared and fixed.</p>
<p>CHECK POINT</p>  <p>8</p>	<p>Fit the four M12 nuts to the bolts holding the sensor to Isolation valve and screw them on with a 19 mm or 3/4" wrench. Important: Do not tighten the nuts too hard, set the torque at 50 Nm (37 ft/lbs).</p> <p>DO NOT PROCEED UNTIL YOU HAVE COMPLETED THIS STEP!</p>
 <p>9</p>	<ol style="list-style-type: none"> 1. Remove the safety clip. 2. Remove the safety pin.
 <p>10</p>	<ol style="list-style-type: none"> 1. Turn the wheel 90° clockwise. 2. Open the locking latch on Outer casing. 3. Rotate Outer casing handle 60° counterclockwise.



1. Turn the hand-wheel counterclockwise to drop the thread.
2. Lift off Outer casing.

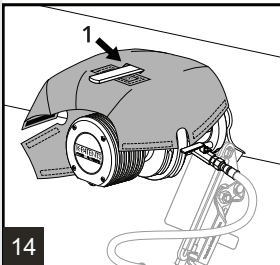


1. Lift up the latch of Inner casing to unlock it.
2. Rotate the casing 60° counterclockwise to release it from the flange.
3. Lift Inner casing away from the sensor head.

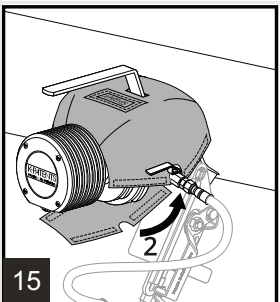


Ensure the DTR is switched off. Connect the sensor cable to the DTR.

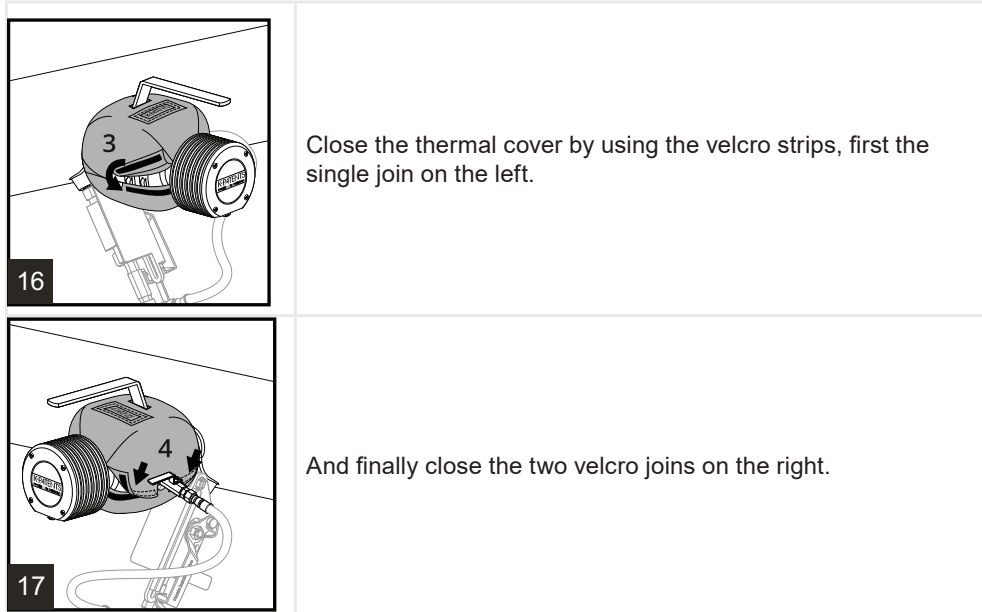
1. Push the interconnecting cable through the cable gland and into the sensor.
 2. Connect the interconnecting cable to the sensor.
 3. Tighten the cable gland onto the sensor
 4. Fit the nameplate onto the sensor and screw it on.
- Turn on DTR power to power up the Safe-Drive™ system.
Open wash valve.



To mount the thermal cover, pass the shut-off valve handle through the hole provided in the thermal cover, making sure the label is facing towards you.



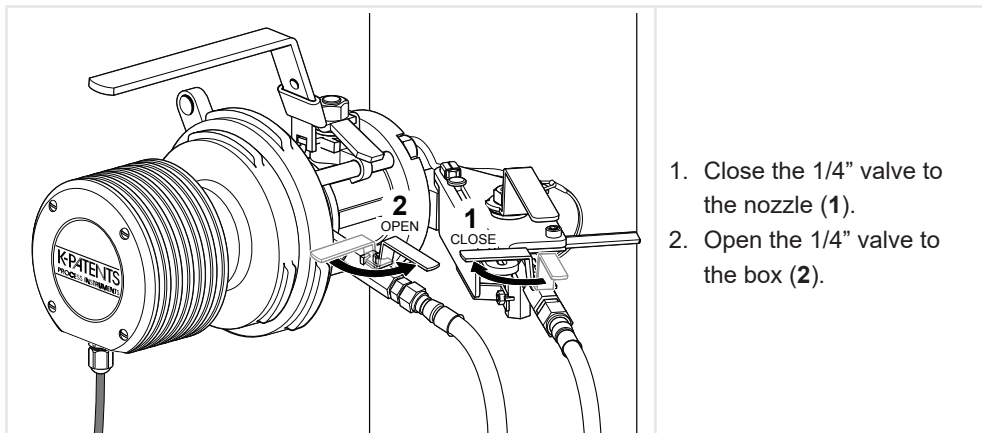
Wrap cover under and around the valve body aligning the cutouts with the drain valve.

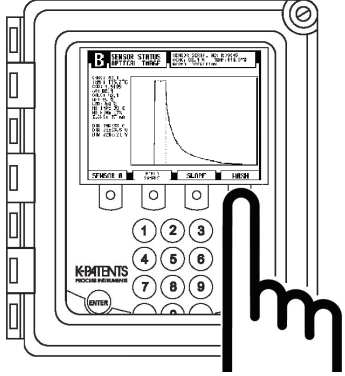
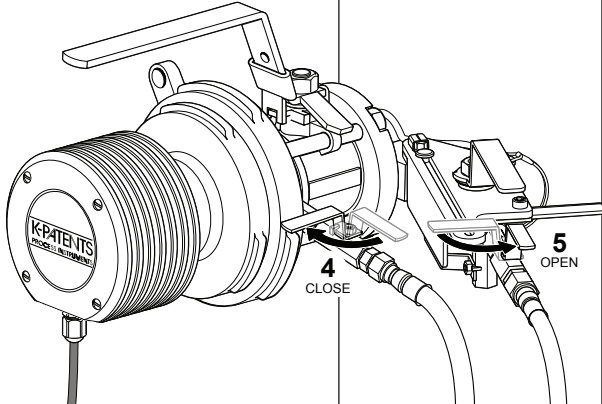


4.9 Box flushing (steam wash systems only)

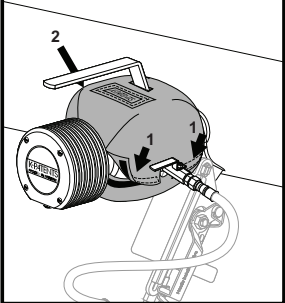
Carry out box flushing before sensor removal when the sensor has been in process for several months. Box flushing removes dried process medium from isolation valve and makes sensor removal easier.

WARNING: Do not activate box steam flush, if the sensor and the Retractor tool are not installed to the isolation valve!

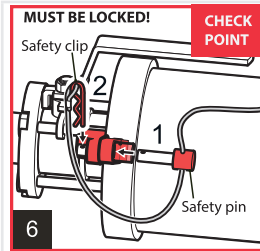


	<p>3. In the DTR transmitter, go to MENU › SENSOR STATUS and activate wash by pressing WASH button.</p> <p>Repeat the wash 3–5 times.</p>
	<p>4. Close the 1/4" valve to the box (4).</p> <p>5. Open the 1/4" valve to the nozzle (5).</p>

4.10 Removing sensor

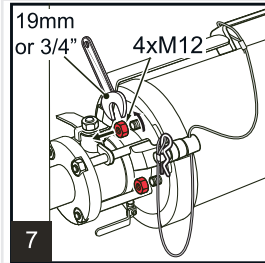
	<p>Before sensor removal process, remove the thermal cover.</p> <ol style="list-style-type: none"> 1. First open the two velcro fasteners on the right. 2. Then open the single fastener on the left. <p>Unwrap the cover underneath the sensor and then remove the cover.</p>
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	<p>Switch off the DTR to cut off power from the sensor. Close wash valve.</p> <ol style="list-style-type: none"> 1. Unscrew and remove sensor nameplate 2. Loosen the cable gland 3. Unscrew the wires 4. Remove the sensor cable and cable gland <p>Note: If another in-line sensor is connected to the same DTR, disconnect the loose cable from the DTR and turn on power again.</p>
	<ol style="list-style-type: none"> 1. Lift up the latch of Inner casing to unlock it. Lift Inner casing over the sensor head. The latch of Inner casing should be slightly to the left.
	<ol style="list-style-type: none"> 1. Rotate Inner casing 60° clockwise to lock it onto the flange. 2. Lock Inner casing latch.
	<ol style="list-style-type: none"> 1. Open the locking latch on Outer casing. Grab Outer casing with one hand on the handle and the other hand on the wheel. Fit Outer casing over Inner casing. 2. Turn the hand-wheel clockwise to get the thread of Inner casing running through the hand-wheel.
	<ol style="list-style-type: none"> 1. Rotate Outer casing 60° clockwise to lock the bayonet. 2. Lock Outer casing latch.

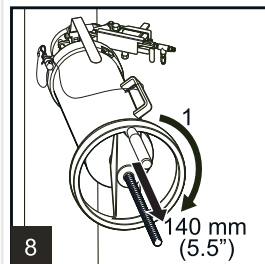


1. Insert the safety pin.
2. Lock the safety pin with the safety clip.

DO NOT PROCEED UNTIL YOU HAVE COMPLETED THIS STEP!

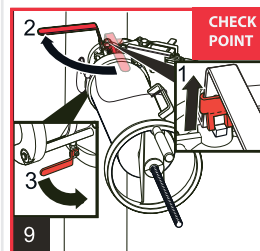


Open and remove the four M12 nuts on the bolts holding the sensor to Isolation valve using a 19 mm or 3/4" wrench.



1. To remove the sensor from the process, turn the hand-wheel clockwise until it stops. At this stage about 140 mm (5.5") of the thread should stick out from the middle of the wheel.

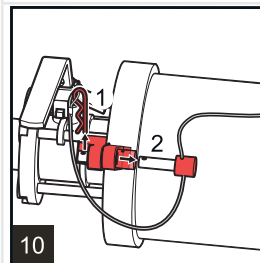
Warning! If you detect leaking, revert immediately to the previous step. Do not continue removal until the reason for leakage has been cleared and fixed.



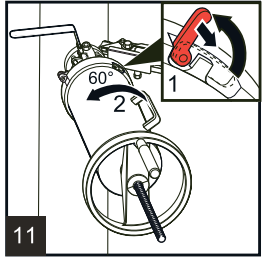
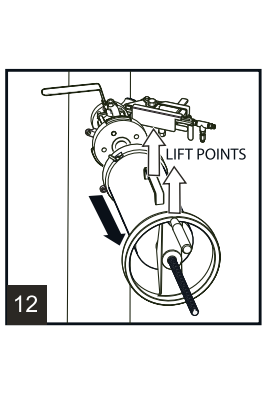
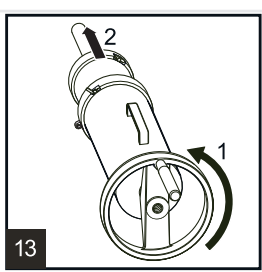
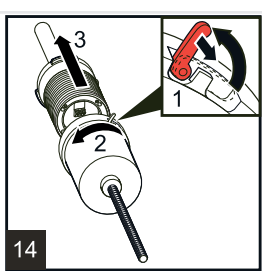
1. Lift up Isolation valve handle locking plate.
2. Close Isolation valve by turning the handle 90°
Important: Isolation valve is properly closed when the handle points away from the sensor and the locking plate drops down over the handle.
3. Open the blow-out valve under Isolation valve for box cleaning to get rid of any process liquid inside Isolation valve.

Warning! Some process liquid will leak out through the small ball valve, beware of splashing!

DO NOT PROCEED UNTIL YOU HAVE COMPLETED THIS STEP!



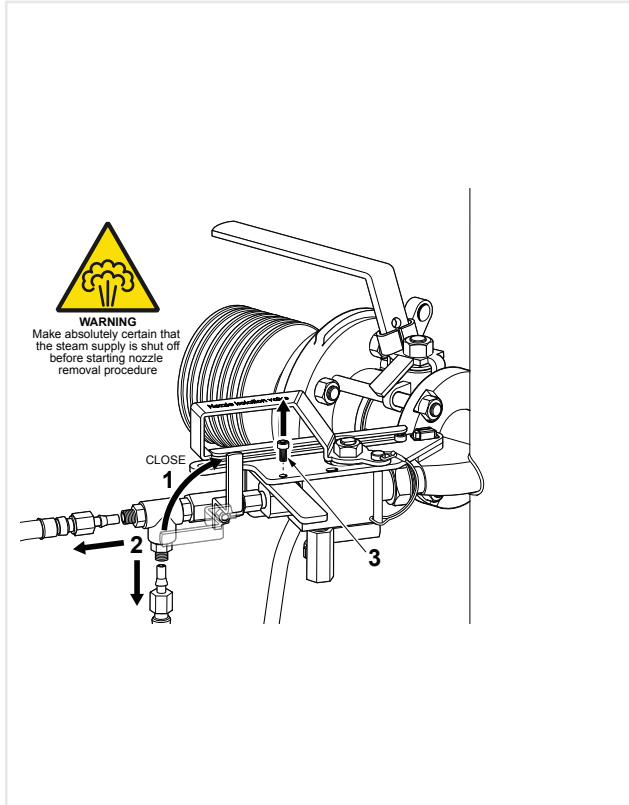
1. Remove the safety clip.
2. Pull out the safety pin.

 <p>11</p>	<ol style="list-style-type: none"> 1. Lift open Outer casing locking latch. 2. Rotate Outer casing 60° counterclockwise so that the handle comes up on top.
 <p>12</p>	<p>Take a firm hold on the hand-wheel and the handle and pull out Retractor with sensor inside.</p> <p>Warning! A firm hold of the tool is essential as the combination of the tool and the sensor is noticeably heavier than Retractor alone.</p> <p>Note: To ensure Isolation valve after the Safe-Drive tool with the sensor has been removed, you can bolt a standard ANSI 1.5" 105 lbs blind flange to Isolation valve with 1/2" (M12) bolts and nuts.</p> <p>A lock can be added to Isolation valve handle.</p> <p>Warning! The sensor tip is hot and may be covered with liquor. It is recommended to rinse the sensor tip and Isolation valve with hot water.</p>
 <p>13</p>	<p>Put Retractor with sensor onto a table or similar surface so that the hand-wheel has space to turn.</p> <ol style="list-style-type: none"> 1. Turn the hand-wheel counterclockwise to drop the thread, i.e. until Outer casing is no longer connected to the parts inside. 2. Pull off Outer casing
 <p>14</p>	<ol style="list-style-type: none"> 1. Open the latch on Inner casing. 2. Keep sensor steady with one hand and rotate Inner casing counterclockwise with the other hand to unlock Inner casing from sensor. 3. Pull off the sensor.

4.11 Removing wash nozzle

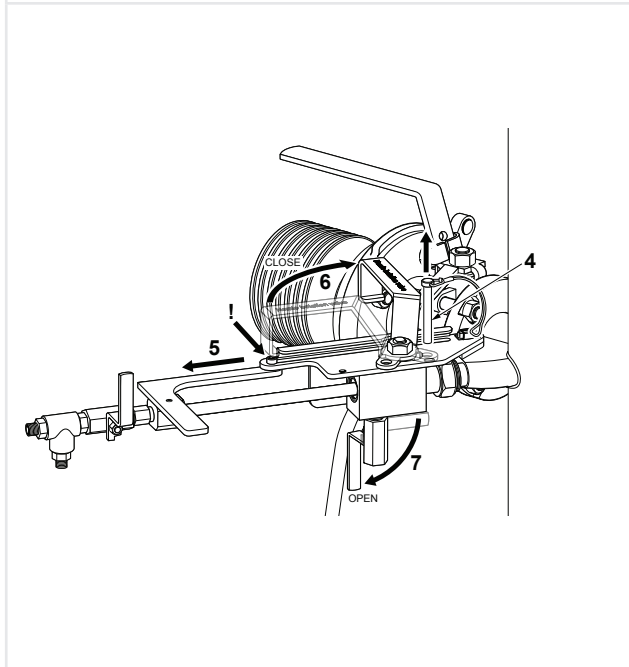
Remove the wash nozzle as instructed in the following illustrations: For more thorough instructions, please refer to user documentation or visit the website to see the instructional video on inserting and removing the sensor (www.kpatents.com, PR-23-SD Safe-Drive™ Operation Guide Video).

WARNING: Always shut the main steam valve before performing any work on the wash nozzle.



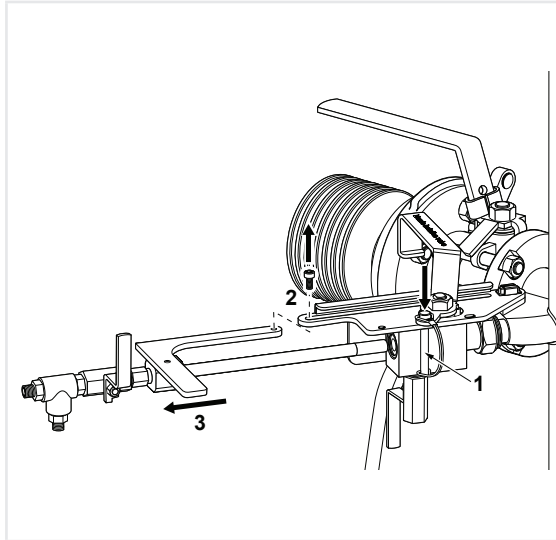
WARNING: Make absolutely certain that the steam or water supply is shut off before starting nozzle removal procedure.

1. Close the nozzle valve (1).
2. **2.1 STEAM:** Remove the steam supply line (2) and the sensor flush flexible line (2) from the nozzle T-piece.
- 2.2 **WATER:** Remove the water supply line (2) from the nozzle.
3. Remove the special M5x10 nozzle guide locking screw (3) using a 5 mm allen key. Be careful, the process pressure will try to push the nozzle out of the process!



4. Remove the safety pin (4).
5. Slide the nozzle out from the process (5) until the guide plate stops it.
6. Close the nozzle isolation valve (6) by turning the handle clockwise.
7. Open the check port 1/4" valve under the isolation valve (7).

NOTE: Only little process liquid should flow from the nozzle. If process liquid keeps on flowing, the nozzle isolation valve is damaged and it is not safe to remove the nozzle. Do not proceed with nozzle removal.



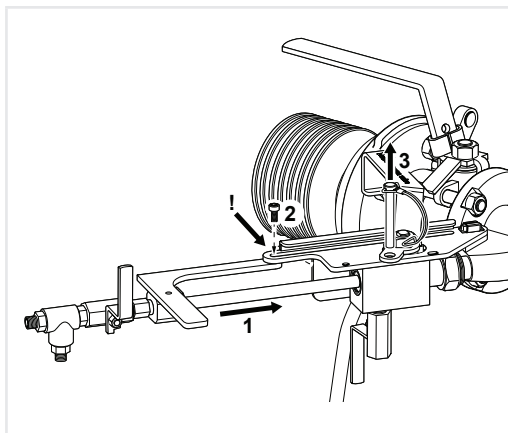
1. Lock the isolation valve handle with the safety pin (1).
2. Remove the special 5x10 guide plate screw (2) using a 5mm allen key
3. Remove the nozzle from the isolation valve completely (3).

WARNING: The nozzle tip is hot and may be covered with liquor. It is recommended to rinse the nozzle tip and the isolation valve with hot water.

4.12 Inserting wash nozzle

Insert the wash nozzle as instructed in the following illustrations: For more thorough instructions, please refer to user documentation or visit the website to see the instructional video on inserting and removing the sensor (www.kpatents.com, PR-23-SD Safe-Drive™ Operation Guide Video).

WARNING: Always shut the main steam valve before performing any work on the wash nozzle.



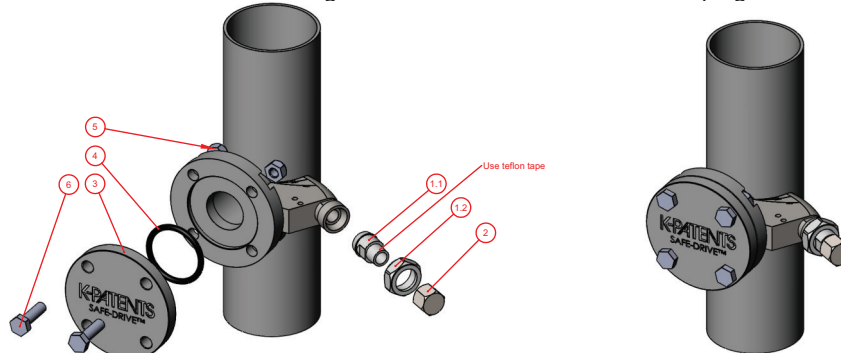
Check the nozzle and valve before installing the wash nozzle. Use thread seal tape for all thread connections.

1. Insert the nozzle into the isolation valve (1).
2. Attach the nozzle to the nozzle guide with one special M5x10 screw (2) using a 5mm allen key.
3. Remove the safety pin (3).

	<ol style="list-style-type: none"> 1. Close the 1/4" check port valve under the nozzle isolation valve (1). 2. Open the isolation valve (2) by turning the handle counterclockwise. 3. Push the nozzle to the process (3). 4. Attach the nozzle to the nozzle guide with one special M5x10 screw (4) using a 5mm allen key. 5. Lock the isolation valve handle with the safety pin (5).
	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> 1.1 STEAM: Connect the steam line and sensor flush flexible line to the nozzle T-piece (1,2). 1.2 WATER: Connect the water line to 1/4" valve (1,2). 2. Open the steam supply line valve (3). 3. Check the functionality of washing from the optical image window.

4.13 Blinding the SD system

A SD connection that is no longer used can be secured with blind plugs.



ITEM NO.	PART NUMBER	SPARE PART	DESCRIPTION	QTY.
1	1203003	PR-9336	Tapered connector , DN10	1
2	1202303		Conical hat, DN10	1
3	3825	PR-9335	PR-23-SD-PG	1
4	-		O-ring	1
5	DIN985, A4, M10		Stainless nylon insert lock nut	4
6	DIN933		Hexagonal bolt DIN933 x 35 A4	4

4.14 Installing Indicating transmitter DTR

The indicating transmitter DTR is a specialized computer designed to process data received from one or two sensors. The transmitter consists of a protecting enclosure, a front panel, an LCD display and a keyboard. Knockout padlock provisions are included for locks to prevent unauthorized access.

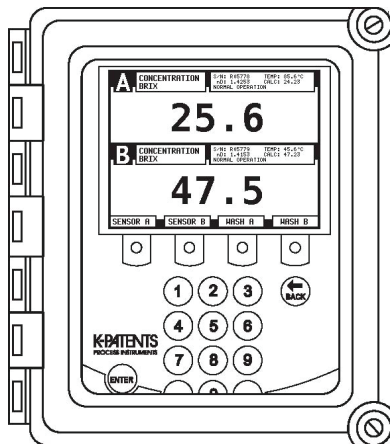


Figure 17 DTR transmitter

- DTR transmitter location:
 - easily accessible
 - well lit, but no direct sunlight
 - dry
 - ambient temperature range of the transmitter is 0–45 °C (32–113 °F)
 - free of vibration or other such disturbances

- Consider the interconnecting cable length when choosing the installation location. The standard delivery is 10 meter (33 feet) of cable and the maximum allowed length is 200 meters (660 feet). You can use your own cable as long as it meets IEC 61158-2 type A standard requirements. For more information, please refer to chapter *Interconnecting cable specifications* in user documentation.
- Consider installing a drip shield to protect the transmitter from rain, sun and dust, especially if the transmitter is installed outside.

WARNING: The transmitter does not have a built-in power switch so it is always powered when connected to a power source. Vaisala recommends mounting an external power switch to control the power supply.

To install the transmitter

1. Install the transmitter vertically on an upright surface (wall) using the four mounting feet, preferably on the eye level of the user.

WARNING: Do not drill mounting holes in the enclosure. That will affect the protection class of the enclosure and damage the electronics.

2. Connect the PR-23-SD sensor:

- Remove the four (4) screws holding the sensor nameplate.
- Connect the signal wires to terminals 1 and 2.
- Connect the cable shield to terminal 3.
- Tighten up the cable gland.
- Screw the nameplate back on.

NOTE: To avoid damage from stray voltages and short-circuiting, always disconnect the sensor cables from the transmitter before removing the sensor.

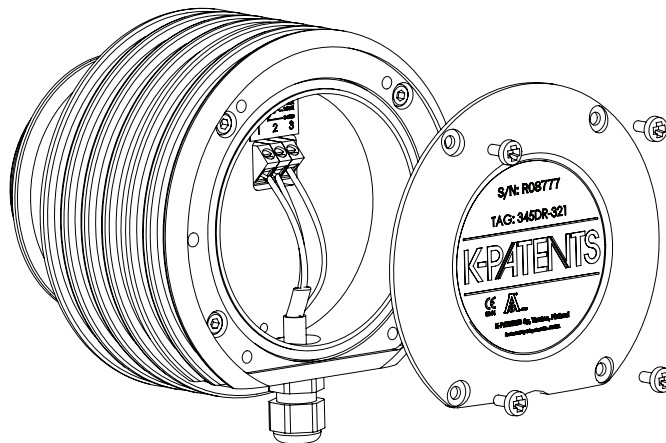


Figure 18 Sensor electrical connections

3. Open the front panel by loosening the front panel screw.

WARNING: Always check that the power is off before opening the front panel. If the green power indicator light is on, there is still power in the system. To completely turn off the power, disconnect the power supply cord or use the external power switch (if installed).

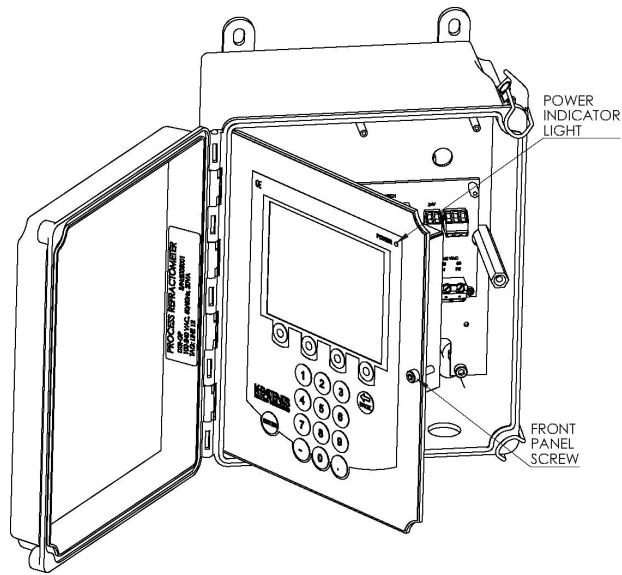


Figure 19 Opening transmitter front panel

4. Connect the primary AC power to a separate terminal strip in the lower right-hand corner of the motherboard. The three terminals are marked 31/L, 32/N, and 33/PE (protective earth), which is directly connected to the exposed metal parts of the transmitter.
5. Connect the wiring wash relay to solenoid valve from the RELAYS terminals.
6. Connect the 4-20mA output.

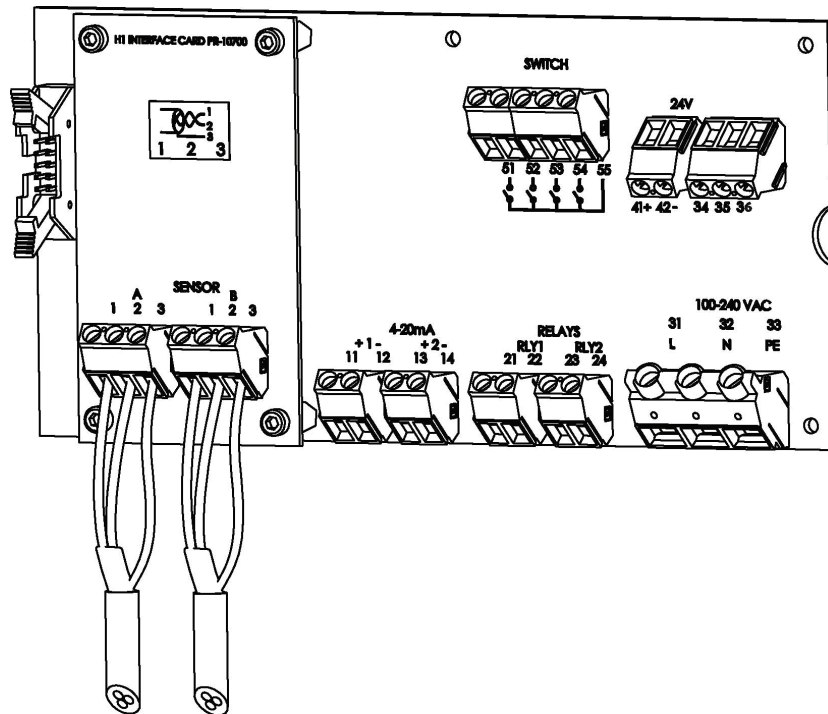


Figure 20 Transmitter H1 and motherboard connections

H1

A 1 2 3	Connection for Sensor A, signal wires (1, 2), cable shield (3).
B 1 2 3	Connection for Sensor B, signal wires (1, 2), cable shield (3).

Motherboard

11 12	4–20 mA output 1, positive (11), negative (12), max. load 1000 Ohm, galvanically isolated.
13 14	4–20 mA output 2, positive (13), negative (14), max. load 1000 Ohm, galvanically isolated.
21 22	Relay 1, one contact output, max. 250 V AC, max. 3 A.
23 24	Relay 2, one contact output, max. 250 V AC, max. 3 A.
31 32 33	Power, L (31), N (32), protective earth (33), 100-240 V AC, 50–60 Hz. An external power switch is recommended.
41 42	24V terminal for DTR internal use only. NOTE: Connecting terminal to external 24V supply will void warranty. Connecting external devices to 24V terminal will void warranty.
51 52 53 54 55	Switch inputs: switch 1 (51), switch 2 (52), switch 3 (53), switch 4 (54) and common (55). A voltage of 3 V DC is provided over each switch. The switch terminals are galvanically isolated.

7. OPTIONAL: Setting up an Ethernet connection. Data can be downloaded from the transmitter to a computer via an Ethernet connection. The Ethernet connector can be found on the underside of the front panel.

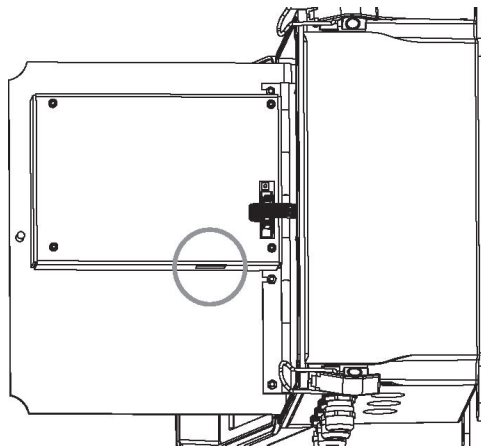


Figure 21 Ethernet connection location

For more information on Ethernet connection, please refer to chapter Ethernet connection specification in user documentation.

5 Commissioning SD sensor system

After installing the SDI2 valve, PR-23-SD sensor, and DTR transmitter, go through the following check list to make sure the SD sensor system is functioning correctly.

For more thorough instructions, please refer to user documentation or visit the website to see the instructional video (www.kpatents.com, PR-23-SD Safe-Drive™ Operation Guide Video).

Commissioning checklist**Safe-Drive™ start-up**

Task	OK	Failed	Menu path	Notes
Check that the wiring has been done according to the attached wiring diagram.	<input type="checkbox"/>	<input type="checkbox"/>		
Connect the power.	<input type="checkbox"/>	<input type="checkbox"/>		
Check that the status is NORMAL OPERATION (if there is a sample) NO SAMPLE (if the process pipe is empty)	<input type="checkbox"/>	<input type="checkbox"/>		
Check process temperatures.	<input type="checkbox"/>	<input type="checkbox"/>		
Check the serial number.	<input type="checkbox"/>	<input type="checkbox"/>		
Check that the parameters are set according to the delivery data sheet (DDS).	<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATION › CHEMICAL & FIELD PARAMETERS	
Configure the mA output.	<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATION › OUTPUTS › mA OUTPUTS	For more information, see section <i>Configuring mA Outputs</i> in PR-23 Instruction Manual.
Configure prism wash relay (relay 1 or 2).	<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATION › RELAYS	For more information, see section <i>Configuring relays</i> in PR-23 Instruction Manual.

Prism wash test

Task	OK	Failed	Menu path	Notes
Observe the temperature and optical image for slight changes that indicate that wash is functioning. One or more of the following changes should take place: - nD value decreasing (most apparent change) - T value increasing - QF value decreasing or increasing	<input type="checkbox"/>	<input type="checkbox"/>		For more information, see section 5.1 <i>Prism Wash Test</i> in these instructions and chapter <i>Prism wash</i> in PR-23 Instruction Manual.

Calibration check

Task	OK	Failed	Menu path	Notes
Check that calibration corresponds to the lab results	<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATION › CHEMICAL & FIELD PARAMETERS › FIELD PARAMETERS	For more information, see section 5.2 <i>Calibration Check</i> in these instructions and section <i>Calibrating the concentration measurement</i> in PR-23 Instruction Manual.

5.1 Prism wash test

Prism wash system is essential for a fully functional refractometer. Regular testing of the prism wash is highly recommended.

The curve should react to the wash and the temperature change slightly.

NOTE: Your transmitter may not look exactly like the image above during the wash. The visible changes in the curve and the temperature depend on viscosity, steam pressure and temperatures of solids and steam and also to your version of the software.

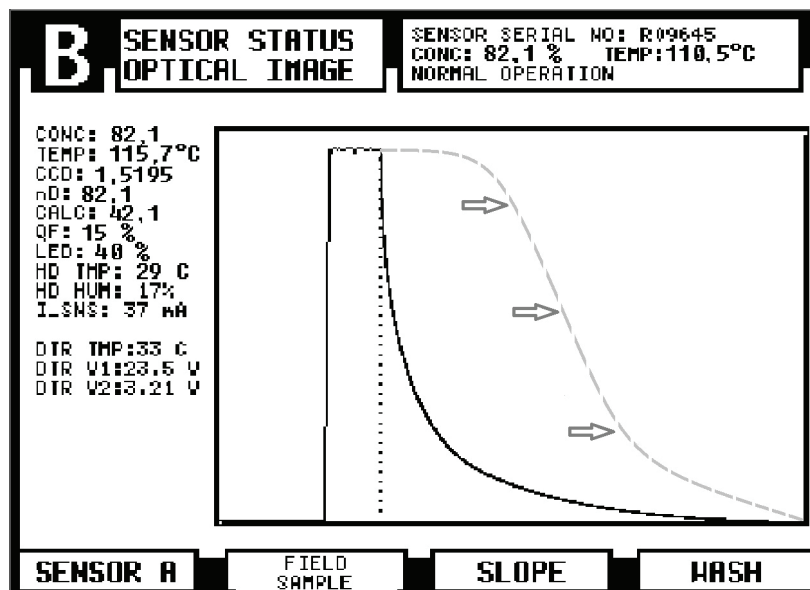


Figure 22 Changes in concentrations during successful prism wash

5.2 Calibration check

Extract 3-5 samples in a couple of days' time. Results from these samples can be used as a reference for calibration.

In case there are deviations from the lab results, check that washes are functioning correctly (see Prism wash test in the commissioning checklist).

When comparing lab results if there is a consistent offset, perform a BIAS adjustment from CALIBRATION menu. For more information, see section *Calibrating the concentration measurement* in PR-23 Instruction Manual.

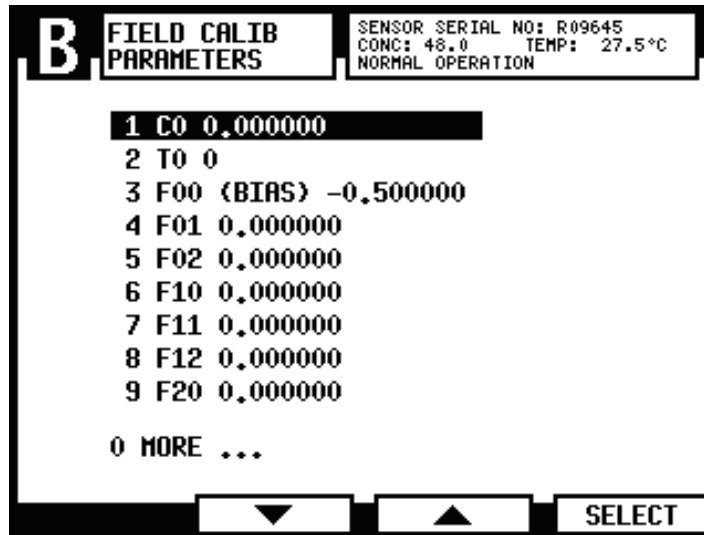


Figure 23 BIAS

If there is a need for frequent calibration, make sure that wash is functional and remove the sensor to check visually that the prism is clean and has not been damaged. Re-install the sensor and run complete field calibration (see section *Entering field calibration parameters* in PR-23 Instruction Manual). After this, contact your local supplier.

6 Operating and monitoring SD sensor system

The SD sensor system runs automatically and does not need to be separately operated. If there are no alarming changes in the diagnostic values or no alarm messages, you do not need to adjust the operation. The main task of the operator is to make sure that the washes and steam connections are functioning as they should.

To rehearse the use of DTR transmitter, please visit demo.kpatents.net.

Vaisala recommends that all new users participate in Vaisala training before using the product.

6.1 Preventive maintenance plan (PMP)

Preventive Maintenance Plan (PMP) should be adopted in order to prevent bigger maintenance procedures. Here are the recommended tasks:

Task	Weekly	Annual	Notes
Check the functionality of diagnostics:	X		See the attached PMI checklist.
CONC (measurement value of output)			This value should be closely monitored daily for a week to set the default reading for weekly inspections
CALC (chemical curve of calibration)			This is the default reading from the chemical curve concentration reading set in calibration, to which you can compare the CONC values to.
TEMP (temperature)			Process temperature.
QF (quality factor)			Typically 30-100. If QF drops 20 units below the normal level, perform a prism wash test (see Commissioning checklist).
LED (exposure time)			Typically <30. If the LED value increases significantly, perform a prism wash test (see Commissioning checklist).
HD HUM (internal humidity% of sensor)			If HUM HD rises above 50%, the system issues an alarm to replace the desiccant. For more information, see PR-23 Instruction Manual.
Check the functionality of wash system.	X		See Prism wash test in Commissioning checklist.
Check the steam pressure. (In steam wash systems)	X		Typically 5-6 bar (75-90 psi) over process pressure.
Check high pressure water pressure (In high pressure water wash systems)	X		20-40 bar (300-600 psi)
Check hot water temperature (in high pressure water wash systems)	X		Temperature over 100°C (212 °F)
Remove the sensor and check the prism visually for dirt and wear.		X	If the prism looks worn, run an nD verification and replace the prism, if needed. For more information on nD verification, see PR-23 Instruction Manual
Inspect the check valve: clean the small holes and see that the valve sealing is intact.		X	Replace the check valve every 2 years. For more information, see chapter 6.3 <i>Check Valve Maintenance</i> .
Clean the filter in the steam connection line. (In steam wash systems)		X	
Verify calibration.			Do this as often as your own quality system and local requirements demand.

Please use the attached Preventive Maintenance Inspection (PMI) Checklist for recording the weekly preventive maintenance tasks.

6.2 Check valve maintenance

Check valve is one of the few moving parts in the wash system. Checking the valve sealing and cleaning the small holes in case of dirt particles annually is essential.

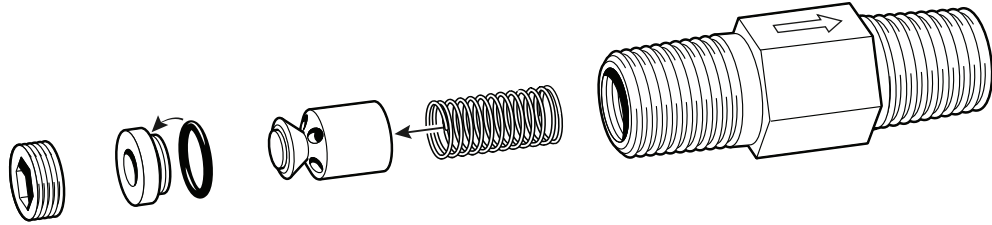


Figure 24 Taking check valve apart for maintenance

6.3 Resetting SD sensor system

If the SD sensor system needs to be reset, you can either

- Switch the power off and back on again,
- Restart the sensor through transmitter from MENU › SENSOR STATUS › SLOPE › SENSOR RESTART or
- Press the reset button, as instructed below.
 1. Open the DTR transmitter front panel.
 2. Press the reset button on the inside of the front panel using a thin stick or a similar tool.

The display will black out for a few seconds. The SD sensor system will be back up in operation within 30 seconds.

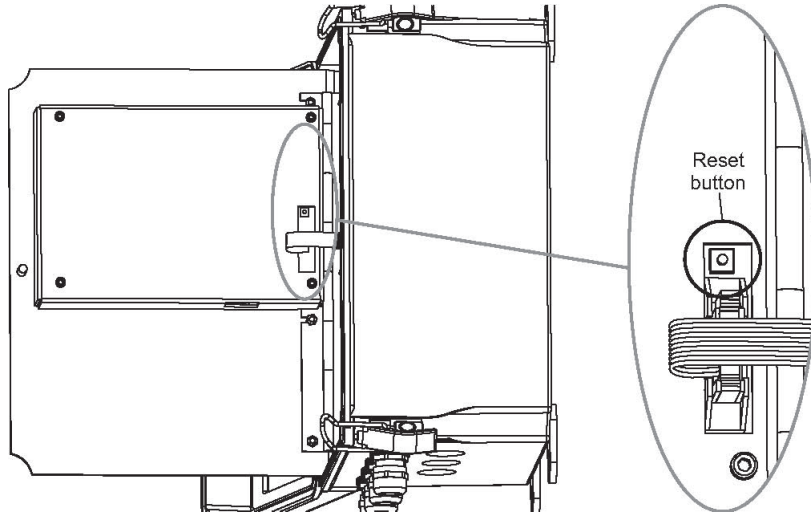


Figure 25 Reset button

7 Appendices

Preventive Maintenance Inspection Weekly Checklist

Data Sheets for Accessories

Welding diagrams

Installation diagrams (MTG DIM)

Wiring Diagrams (WRG)

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