

# Best Practices

Vaisala K-PATENTS®  
Safe-Drive Process Refractometer  
**PR-23-SD Generation 1**

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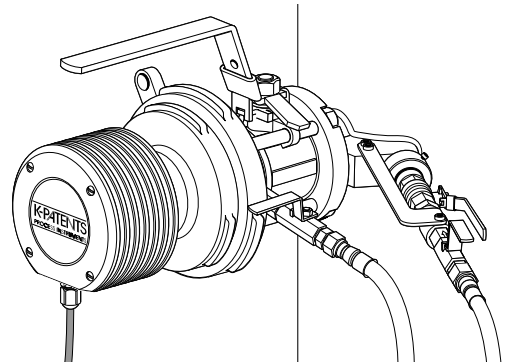
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# Safe-Drive Process Refractometer PR-23-SD Generation 1 Best Practices

## 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 1 model that has been manufactured in years 2006–2013. 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).

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

## 2 Before Installation

### 2.1 Installation Location Checklist

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.

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- Use suitable type of steam for cleaning the prism. Dry saturated steam and 10-12 bar (150-180 psi) are recommended.
  - Access to steam. The distance between the steam supply and the SD sensor system should be considered for the length of steam piping.
  - Access to drain for steam trap condensate outlet.
  - Emergency shower and eye wash should be easily accessible. Water can also be used for cleaning SDI 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 (110-230 VAC).

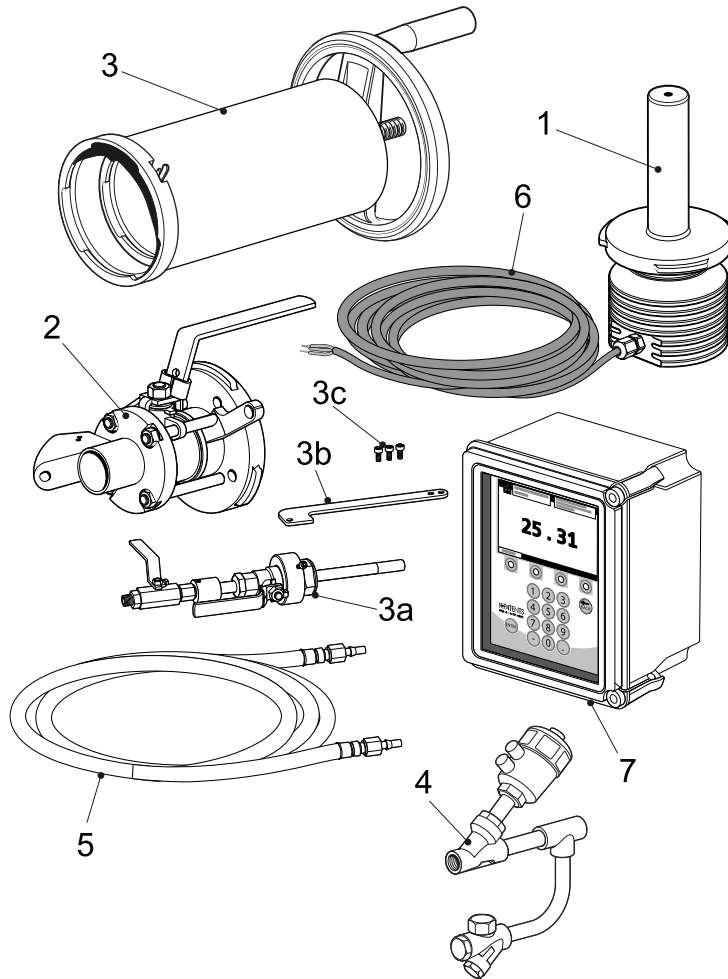
If these conditions do not apply, please reconsider the intended location for your installation or contact Vaisala.

## 2.2 Component Checklist

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 Vaisala delivery**

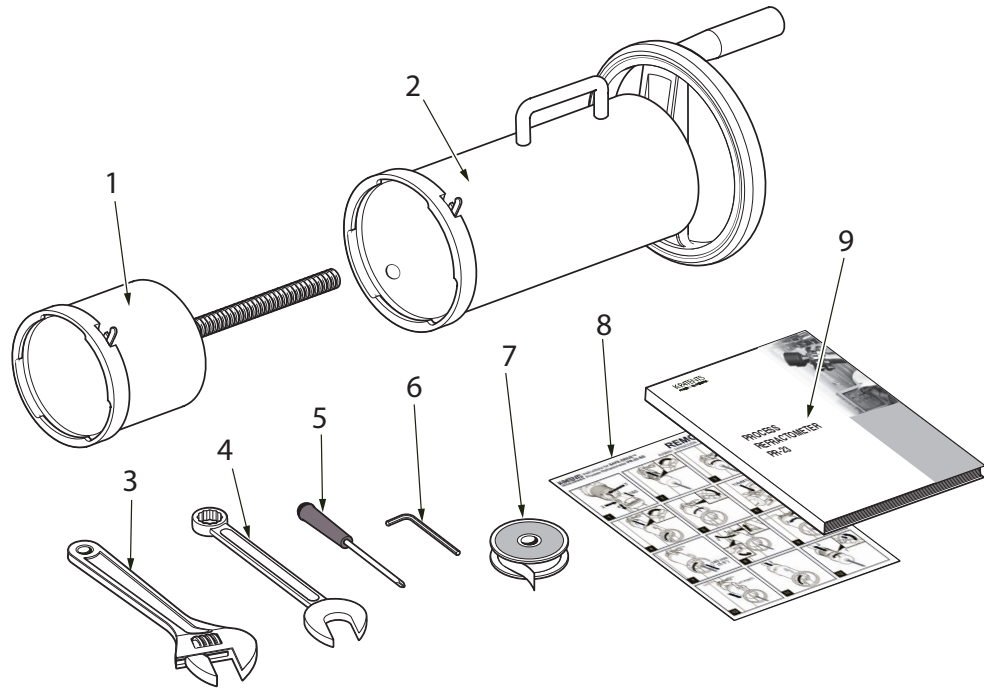


**Figure 1** System components included in Vaisala delivery

<input type="checkbox"/>	1	PR-23-SD sensor
<input type="checkbox"/>	2	SDI valve
<input type="checkbox"/>	3	Retractor tool
<input type="checkbox"/>	3a	Prism wash nozzle assembly
<input type="checkbox"/>	3b	Wash nozzle installation bolts
<input type="checkbox"/>	3c	M5x8 DIN912 A4-70
<input type="checkbox"/>	4	Compressed air operated solenoid shut-off valve with steam trap
<input type="checkbox"/>	5	Steam connection hose
<input type="checkbox"/>	6	Sensor connection cable
<input type="checkbox"/>	7	DTR transmitter

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

## 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	Adjustable wrench	
<input type="checkbox"/>	4	Combination wrench, 19 mm / 3/4 in	
<input type="checkbox"/>	5	Flat head screwdriver	
<input type="checkbox"/>	6	Allen key 8 mm / 5/16 in	
<input type="checkbox"/>	7	Thread seal tape	
<input type="checkbox"/>	8	Sensor insertion / removal instruction card	Supplied by Vaisala
<input type="checkbox"/>	9	Product user manual	Supplied by Vaisala

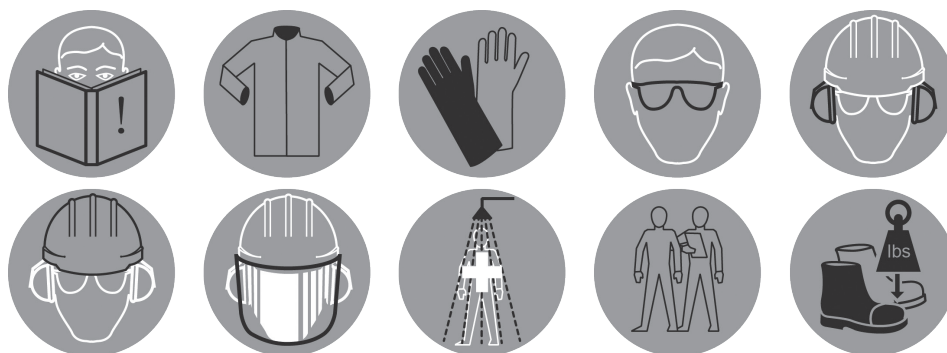
**NOTE:** The material of the SDI valve body that is welded onto a process pipe is Duplex steel SAF2205 (EN 1.4462, ASTM S32205/S31803). Choose the welding method and filler accordingly.

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).

For more information on safety issues, please see *Vaisala Safety Instructions*.



**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.
- Safety glasses and/or goggles.
- Hard hat or helmet.
- Protective gloves.
- Locate the nearest emergency shower and eye wash before starting the work.
- Never operate the Safe-Drive Retractor alone.
- Hard-cap safety boots.

## 4 Installation Process

For more thorough instructions, please refer to Vaisala user documentation or visit the Vaisala website to see the instructional video ([www.vaisala.com](http://www.vaisala.com), PR-23-SD Safe-Drive Operation Guide Video).

Installation of the SD sensor system consists of

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

### 4.1 Spool piece assembly

If the SDI 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.

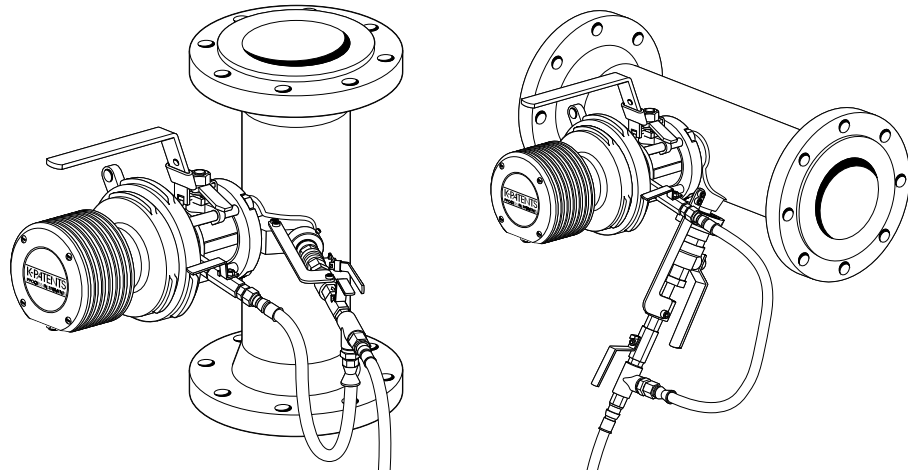
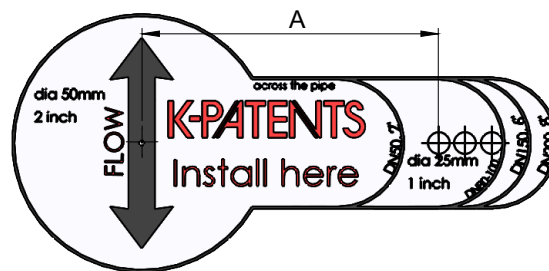


Figure 4 Vertical and horizontal spool piece assemblies

## 4.2 Cutting Installation Opening for SDI 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 images below:



Pipe size	A(mm)	A(inch)
DN50 (2")	37	1.5
DN80 (3")	56	2.2
DN100 (4")	56	2.2
DN150 (6")	61	2.4
DN200 (8")	66	2.6
DN250 (10")	69	2.7
DN300 (12")	70	2.8
DN350 (14")	71	2.8
DN400 (16")	72	2.8
DN600 (24")	75	3.0
>DN600 (24")	76	3.0

Figure 5 Installation guide sticker

**NOTE:** For larger pipes, use the same dimensions as for 24" (610 mm) pipes.

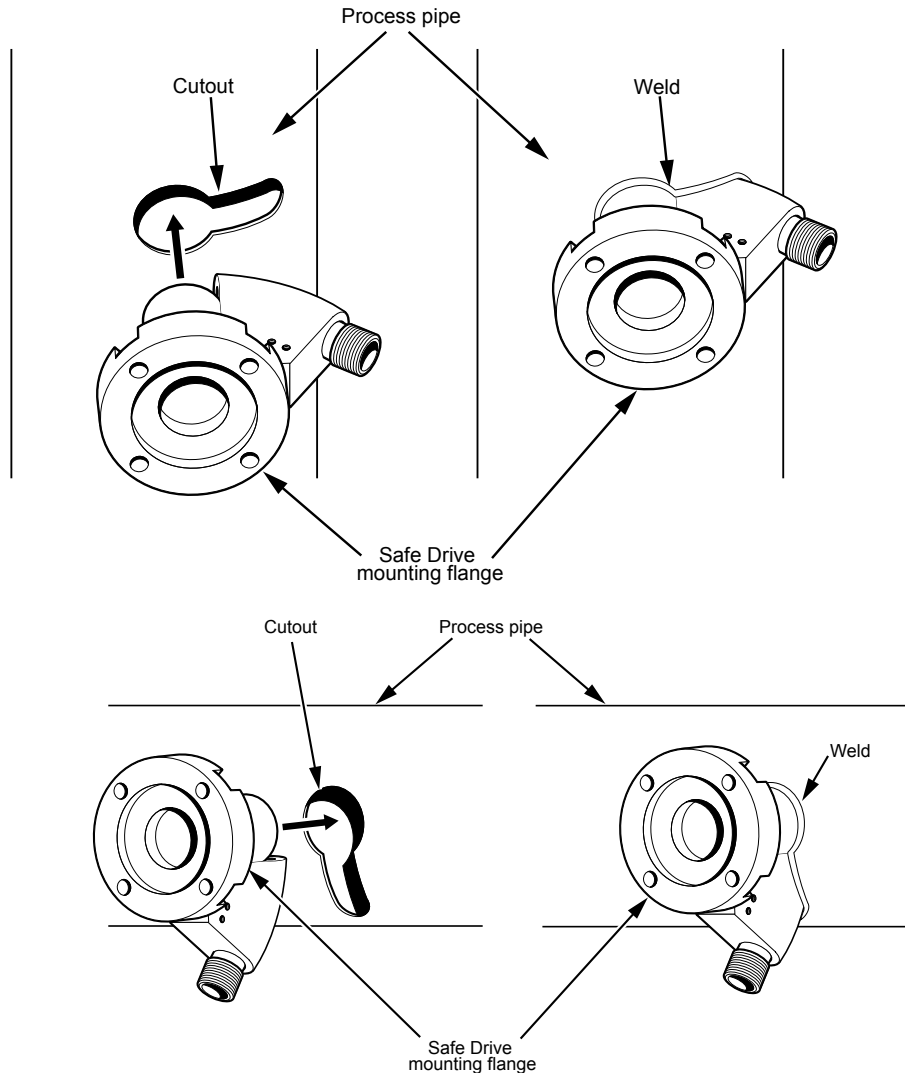
To cut the installation opening

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 the sticker.
4. Remove the bridge between the holes so that the opening is exactly the shape of the sticker.



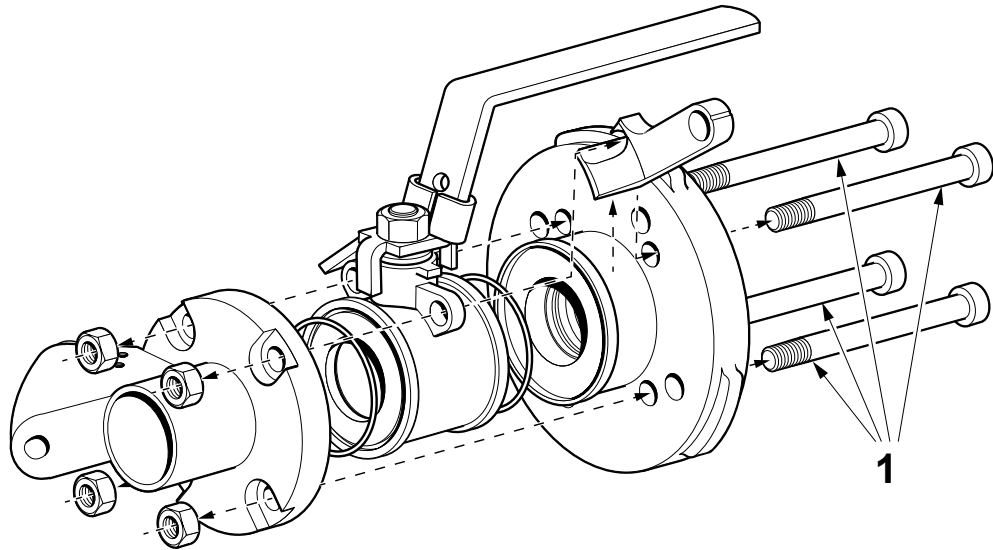
**Figure 6** Installation on vertical and horizontal pipes

### 4.3 Disassembling SDI 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 SDI 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 SDI Valve in Place

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

- The material of the SDI 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).

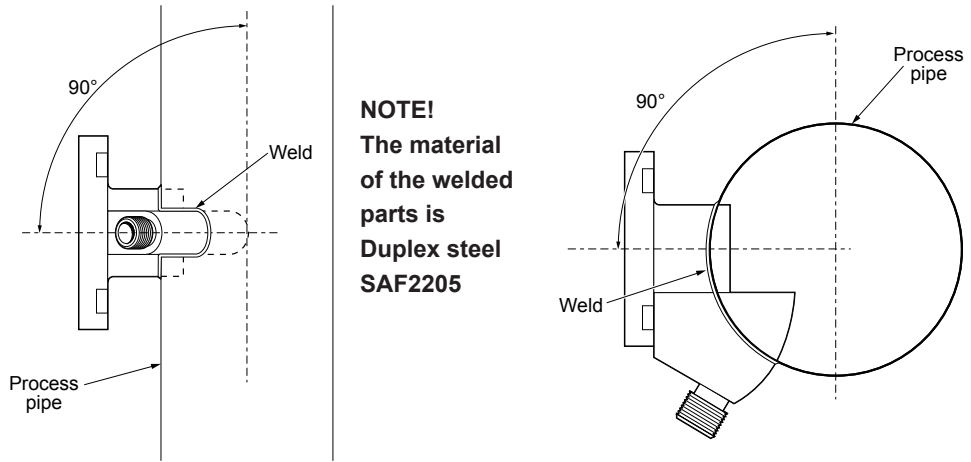
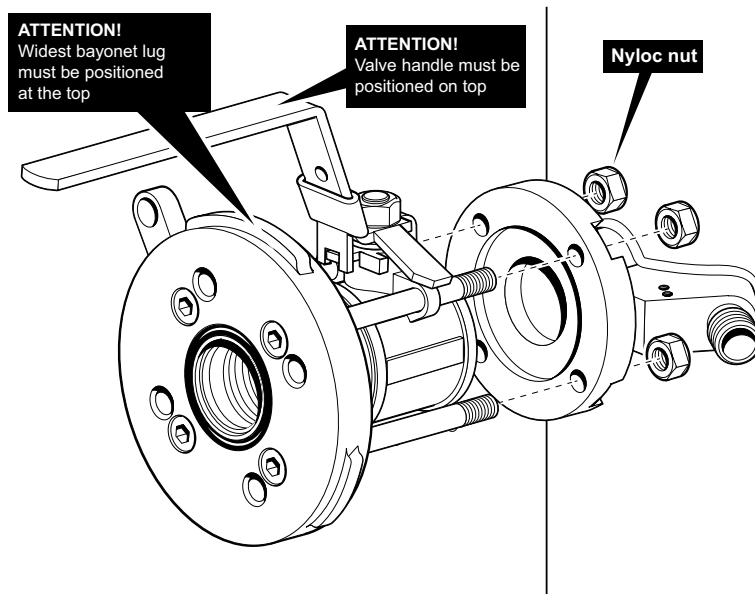


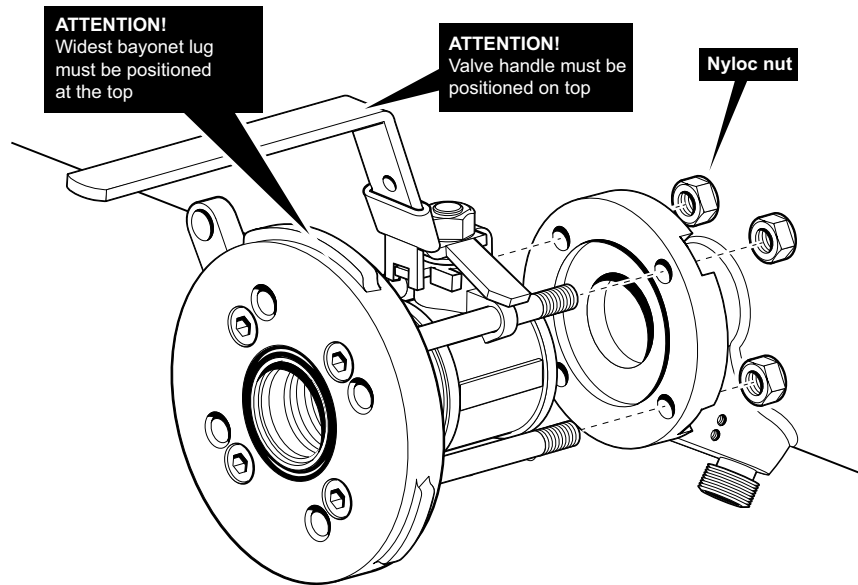
Figure 8 Welding on vertical and horizontal pipes

## 4.5 Reassembling SDI Valve

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

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

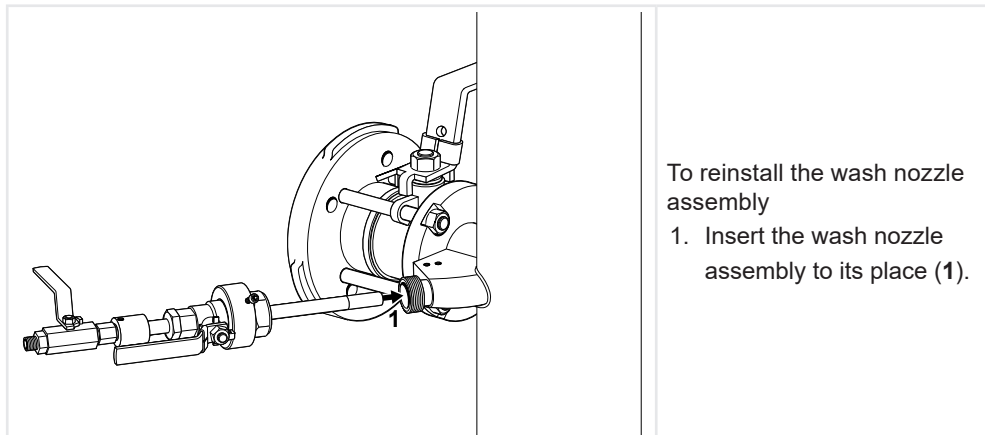


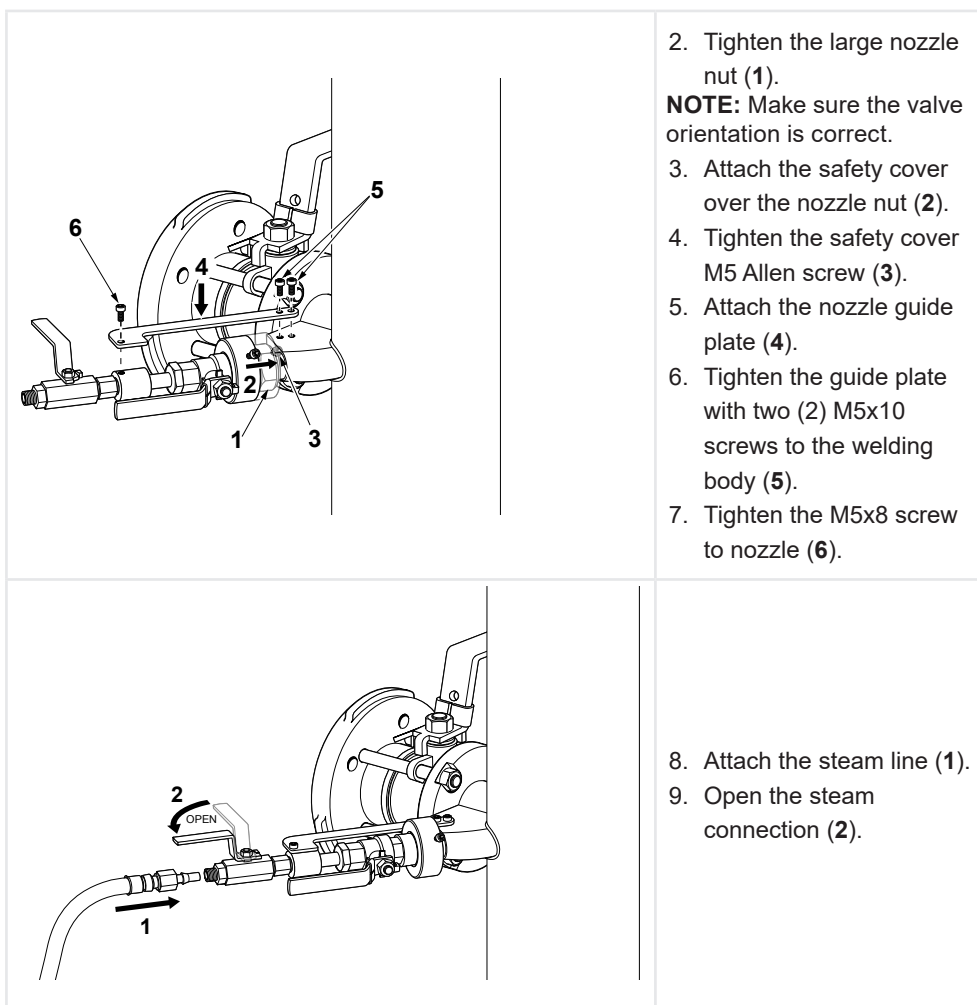


**Figure 9** Reassembling valve on vertical and horizontal pipes

- Make sure that the SDI valve handle and the largest bayonet connection are on top. Otherwise, you will not be able to insert the sensor in its place.
- Tighten the bolts to a torque of 36 N-m (26 lb-ft) with an 8 mm (5/16") allen key.

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





## 4.6 Installing Steam Prism Wash System

In black liquor service material deposit, scaling or coating may occur on the prism surface. To avoid this, you need to install an integral prism wash with steam that uses the retractable nozzle included in the SDI valve.

### Important Steam Prism Wash Considerations

- The distance from the steam nozzle on the SDI 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 SDI 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
- For Vaisala recommendations, please see *Vaisala Steam Instructions*.
- OPTIONAL, in case of contaminants: To remove any contaminants within the steam source, installing a steam strainer is recommended. See Vaisala list of recommended accessories.
  - OPTIONAL, in case of excessive pressure: If the steam pressure exceeds to maximum pressure differential, a pressure reducing valve (PRV) needs to be installed to reduce the steam pressure to optimal design. See Vaisala list of recommended accessories.

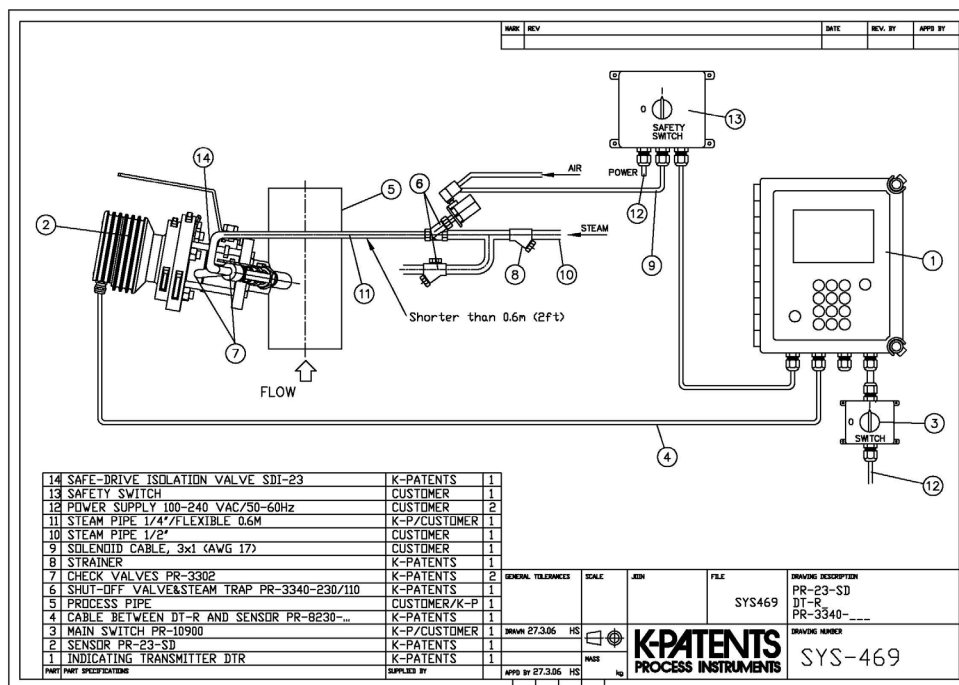


Figure 10 Mounting steam wash system

For more detailed information on steam-related issues, please see *Vaisala Steam Instructions*.

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**

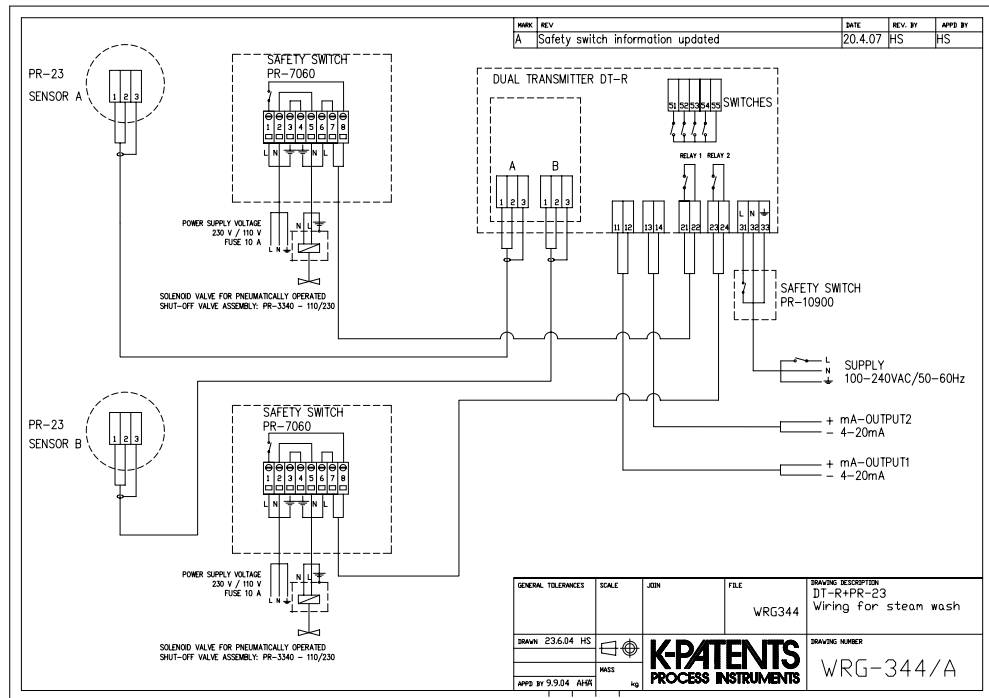
	Minimum above process pressure	Maximum above process pressure	Wash time	Recovery	Interval
<b>Steam (SN)</b>	5 bar (75 psi)	8 bar (115 psi)	3-5 s	20-30 s	20-30 min

**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 SDI valve, as instructed below.  
**NOTE:** All the necessary wash fittings are included in the valve.
3. Connect the steam wash system power supply.

For more information, please see *Vaisala Steam Instructions*.



**Figure 11** Wiring steam wash system

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

## 4.7 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.

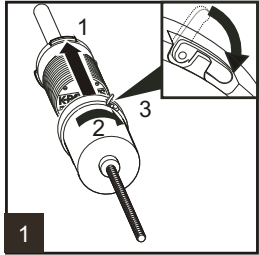
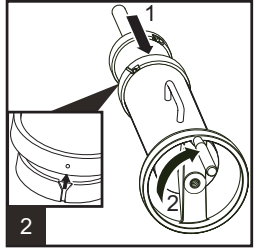
Successful sensor insertion and removal can only be guaranteed when the Retractor tool is used and the instructions for insertion or removal are carefully followed.

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

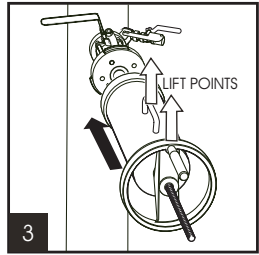
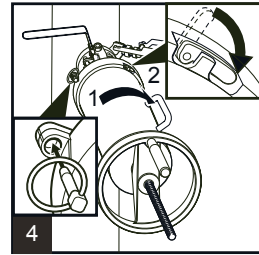
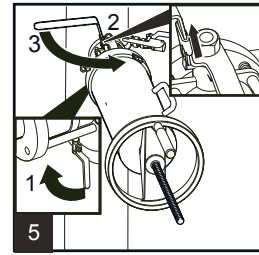
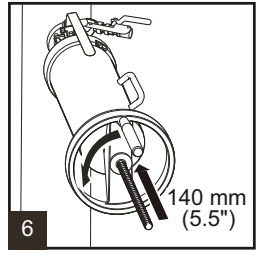
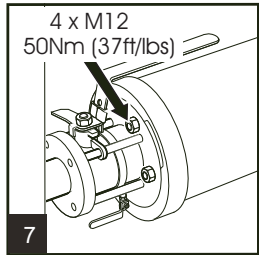
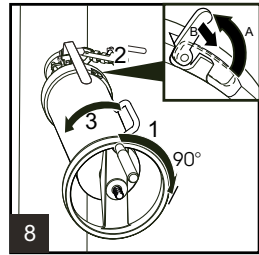
**WARNING:** If you detect leaking at any point of sensor insertiong or removal process, revert immediately to the previous step in the process. Do not continue insertion / removal until the reason for leakage has been cleared and fixed.

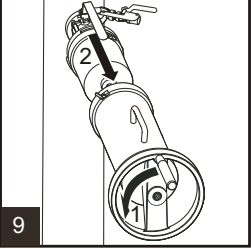
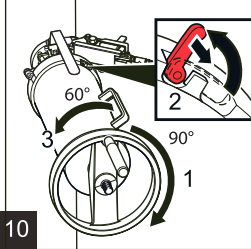
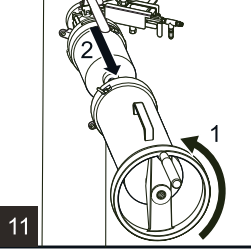
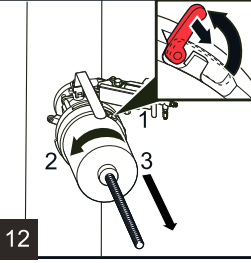
Insert and remove the sensor as instructed in the following chapters. For more thorough instructions, please refer to Vaisala user documentation or visit the Vaisala website to see the instructional video on inserting and removing the sensor ([www.vaisala.com](http://www.vaisala.com), PR-23-SD Safe-Drive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

## 4.8 Inserting Sensor

	<p>Before you start</p> <ul style="list-style-type: none"><li>• check that the gaskets and gasket surfaces are clean and undamaged</li><li>• remove the sensor cable gland and unlock Inner casing</li></ul> <ol style="list-style-type: none"><li>1. Insert the sensor to Inner casing so that the inner casing latch is slightly to the left of top and sensor cable passage is straight down.</li><li>2. When sensor flange is flush with the bottom of Inner casing, turn Inner casing 1/6 turn clockwise to lock it to the flange.</li><li>3. Push down the locking latch.</li></ol>
	<p>Put the Safe-Drive 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"><li>1. Fit Outer casing over Inner casing so that the groove on Inner casing matches the dot on Outer casing.</li><li>2. Turn the hand-wheel clockwise until it stops to draw the sensor into the Retractor.</li></ol>



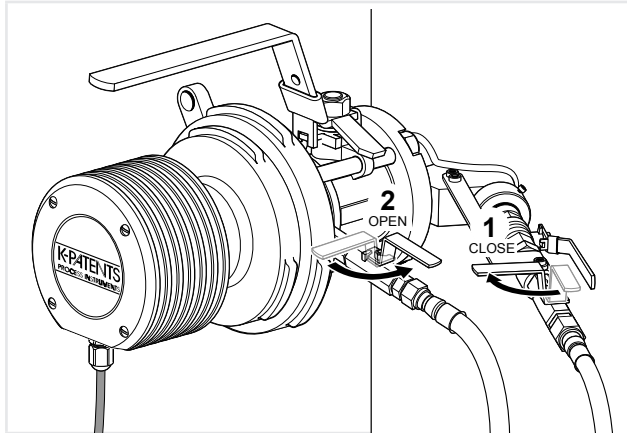
	<p>Lift the Retractor (with sensor) handle up over the isolation valve flange.</p>
	<ol style="list-style-type: none"> <li>1. Turn the Retractor a 1/6 turn to the right to lock the bayonet.</li> <li>2. Push down the latch on Outer casing.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Close the blow-out ball valve underneath the isolation valve,</li> <li>2. Lift up the isolation valve handle locking plate.</li> <li>3. Open the isolation valve by turning the valve handle a quarter turn to the right.</li> </ol>
	<p>Turn the hand-wheel counterclockwise until it stops.</p> <p><b>WARNING:</b> If you detect leaking, revert immediately to the previous step. Do not continue insertion until the reason for leakage has been cleared and fixed.</p>
	<p>Fit the four M12 nuts to the bolts holding the sensor to the isolation valve and screw them on with a 19 mm or 3/4" wrench.</p> <p><b>NOTE:</b> Set the torque at 50 Nm.</p>
	<ol style="list-style-type: none"> <li>1. Turn the wheel a quarter turn to the right.</li> <li>2. Unlock the latch of the outer casing.</li> <li>3. Turn the casing to the left until the handle is up on top.</li> </ol>

 <p>9</p>	<ol style="list-style-type: none"> <li>1. Turn the hand-wheel to the left to drop the thread.</li> <li>2. Lift off Outer casing.</li> </ol>
 <p>10</p>	<ol style="list-style-type: none"> <li>1. Lift up the latch of the inner casing to unlock.</li> <li>2. Turn the casing a 1/6 turn to the left to release it from the flange.</li> </ol>
 <p>11</p>	<p>Lift Inner casing away from the sensor head.</p>
 <p>12</p>	<ol style="list-style-type: none"> <li>1. Take off sensor nameplate and the gasket underneath.</li> <li>2. Put interconnecting cable through the cable gland.</li> <li>3. Connect the interconnecting cable to the sensor.</li> <li>4. Screw the cable gland to the sensor.</li> <li>5. Fit the gasket and nameplate onto the sensor and screw the nameplate back on.</li> </ol> <p>Turn on transmitter power to power up the SD sensor system.</p>

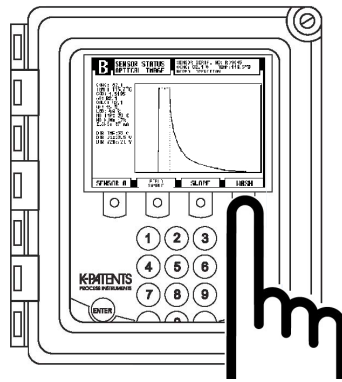
## 4.9 Box Flushing

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!

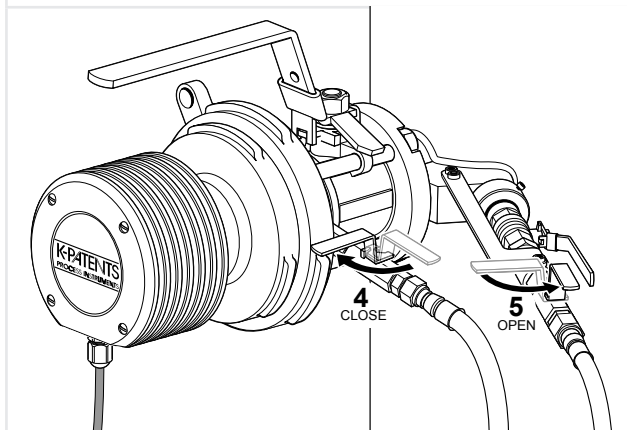


1. Close the 1/4" valve to the nozzle (1).
2. Open the 1/4" valve to the box (2).



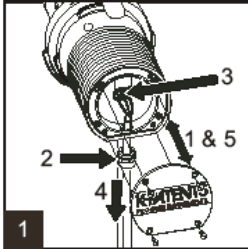
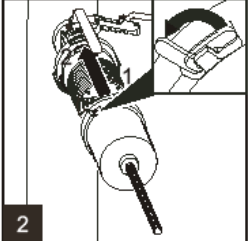
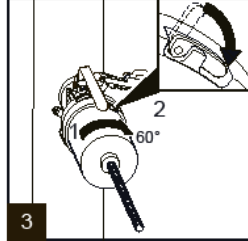
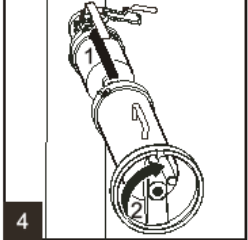
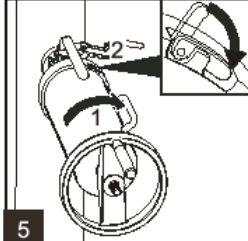
3. In the DTR transmitter, go to MENU > SENSOR STATUS and activate wash by pressing *WASH* button.

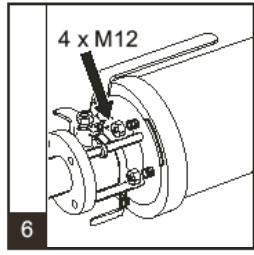
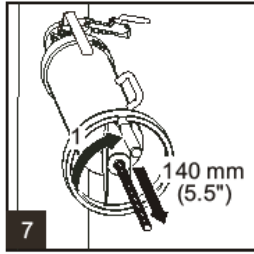
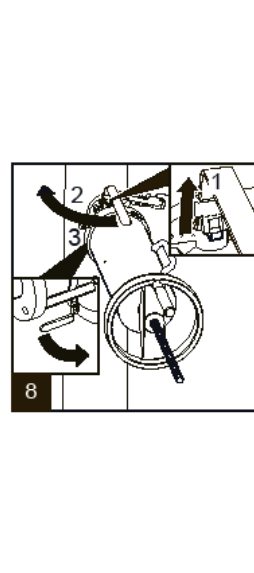
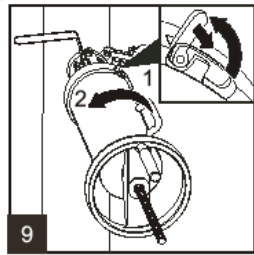
Repeat the wash 3–5 times.

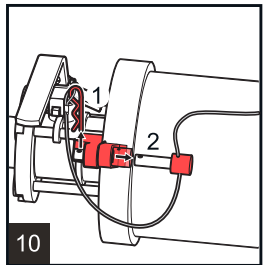
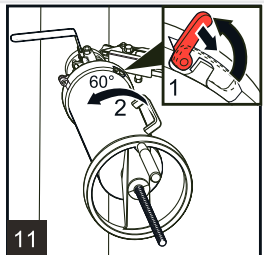
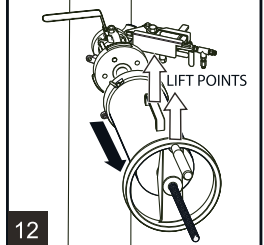


4. Close the 1/4" valve to the box (4).
5. Open the 1/4" valve to the nozzle (5).

## 4.10 Removing Sensor

	<p>Switch off the DTR to cut off power from the sensor.</p> <ol style="list-style-type: none"> <li>1. Remove the sensor nameplate and the gasket underneath.</li> <li>2. Screw off the cable gland.</li> <li>3. Disconnect the interconnecting cable</li> <li>4. Remove the cable from sensor</li> <li>5. Place gasket and nameplate on the sensor head and screw the sensor nameplate back on.</li> </ol> <p><b>NOTE:</b> If another inline sensor is connected to the same DTR, disconnect the loose cable from the DTR and turn power on again.</p>
	<ol style="list-style-type: none"> <li>1. Unlock the latch on Inner casing.</li> <li>2. Lift Inner casing over the sensor head. Connect the casing to the sensor flange bayonet.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Turn the casing a 1/6 turn to the right to lock it onto the flange.</li> <li>2. Lock the inner casing latch.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Grab Outer casing with one hand on the handle and the other hand on the wheel. Fit Outer casing over Inner casing and all the way to the isolation valve bayonet keeping the handle upwards.</li> <li>2. Rotate the hand wheel clockwise to get thread of the inner casing running through the wheel.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Turn Outer casing a 1/6 turn to the right to lock it onto the isolation valve.</li> <li>2. Push down the outer casing latch.</li> </ol>

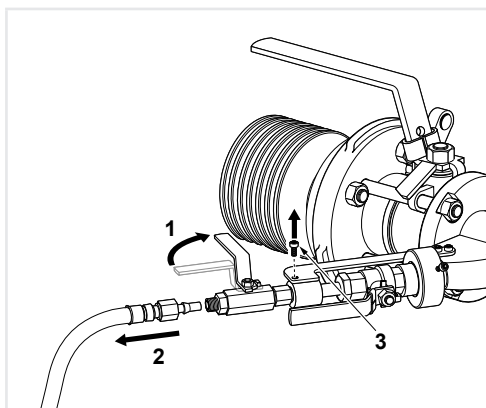
	<p>Open and remove the four M12 nuts on the bolts holding the sensor to the isolation valve using a 19 mm or 3/4" wrench.</p>
	<p>Turn the hand wheel clockwise until it stops to remove the sensor from process.</p> <p><b>WARNING:</b> If you detect leaking, revert immediately to the previous step. Do not continue removal until the reason for leakage has been cleared and fixed.</p>
	<ol style="list-style-type: none"> <li>1. Lift up the isolation valve handle locking plate.</li> <li>2. Close the isolation valve on by turning the handle a quarter turn to the left.</li> </ol> <p><b>IMPORTANT:</b> The isolation valve is properly closed when the handle points away from the sensor and the locking plate drops down over the handle.</p> <ol style="list-style-type: none"> <li>3. Open the blow-out valve under the isolation valve.</li> </ol> <p>Some process liquid should leak from the valve. If there is none, the valve may be defective.</p> <p><b>WARNING:</b> Watch out for splashing!</p> <ol style="list-style-type: none"> <li>4. Carry out box flushing to get rid of any process liquid inside the isolation valve. See chapter 4.9 <i>Box Flushing</i> for instructions.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Lift the outer casing locking latch.</li> <li>2. Turn Outer casing a 1/6 turn to the left so that the handle comes up on top.</li> </ol>

 <p>10</p>	<p>Take a good grip on the hand wheel and the handle and pull out the Safe-Drive Retractor with the sensor inside.</p> <p>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><b>NOTE:</b> To ensure the isolation valve after the Safe-Drive tool with the sensor have been removed, you can bolt a standard ANSI 1.5" 105 lbs blind flange to it with 1/2" (M12) bolts and nuts.</p> <p><b>WARNING:</b> The sensor tip is hot and may be covered with liquor. It is recommended to rinse the sensor tip and the isolation valve with hot water.</p>
 <p>11</p>	<p>Put the Safe-Drive 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"> <li>1. Turn the wheel counterclockwise until the trapezoidal thread is all the way inside the outer casing and loose from the wheel.</li> <li>2. Pull the outer casing off.</li> </ol>
 <p>12</p>	<ol style="list-style-type: none"> <li>1. Open the latch on the inner casing.</li> <li>2. Keep sensor steady with one hand and turn Inner casing counterclockwise with the other hand to unlock Inner casing from sensor.</li> <li>3. Pull off the sensor.</li> </ol>

## 4.11 Removing Wash Nozzle

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

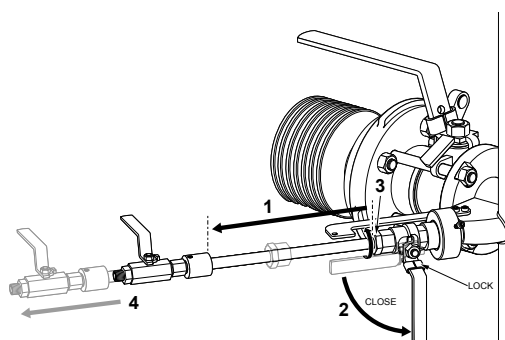
**WARNING:** Always shut the main steam valve before performing any work on the wash nozzle.



1. Close the steam supply.
2. Close the 1/4" ball valve (1).
3. Remove the incoming steam pipe from the 1/4" ball valve (2).

**NOTE:** Do not remove the check valve!

4. Remove the nozzle guide (3).



5. Loosen the nozzle nut 1/4 turn at time with a 22 mm / 7/8 in wrench until you can pull the nozzle about 150 mm / 6 in outwards (1).

**IMPORTANT:** Do not open the nozzle nut for more than 2 turns.

6. Close the 3/8" ball valve (2).
7. Loosen the nozzle nut entirely (3).

**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.

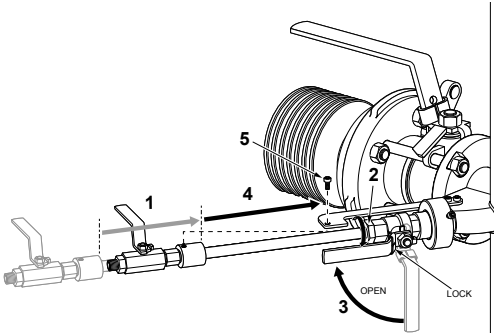
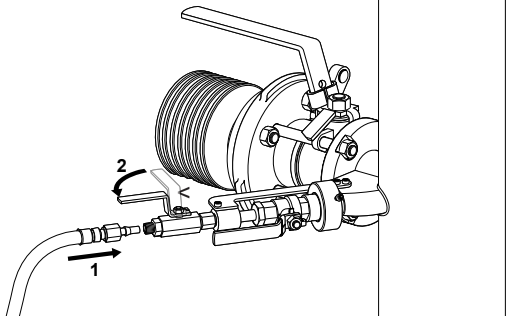
8. Pull the nozzle out of the isolation valve (4).

**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 Vaisala user documentation or visit the Vaisala website to see the instructional video on inserting and removing the sensor ([www.vaisala.com](http://www.vaisala.com), PR-23-SD Safe-Drive Operation Guide Video).

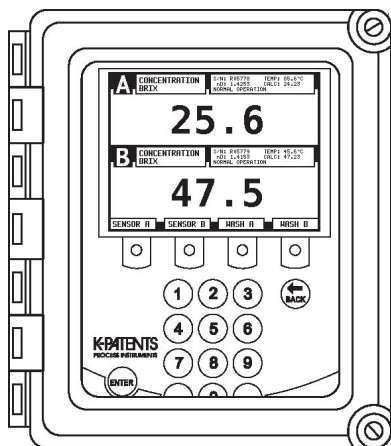
**WARNING:** Always shut the main steam valve before performing any work on the wash nozzle.

	<p>Check the nozzle and valve before inserting the wash nozzle. Use teflon tape for all thread connections.</p> <ol style="list-style-type: none"><li>1. Fasten the nozzle to the 3/8" isolation valve (1).</li><li>2. Tighten the nozzle nut (2).</li><li>3. Carefully open the 3/8" nozzle isolation valve (3).</li></ol> <p><b>NOTE:</b> If process liquid is leaking severely, close the isolation valve immediately and do not proceed with nozzle insertion.</p> <ol style="list-style-type: none"><li>4. Push nozzle into the process pipe (4).</li><li>5. Fasten the nozzle guide (5).</li><li>6. Tighten up nozzle nut (2).</li></ol>
	<ol style="list-style-type: none"><li>7. Attach steam pipe to 1/4" ball valve (1).</li><li>8. Open the 1/4" ball valve (2).</li><li>9. Open the steam supply.</li></ol>



## 4.13 Installing DTR Transmitter

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 12** 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 Vaisala 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.

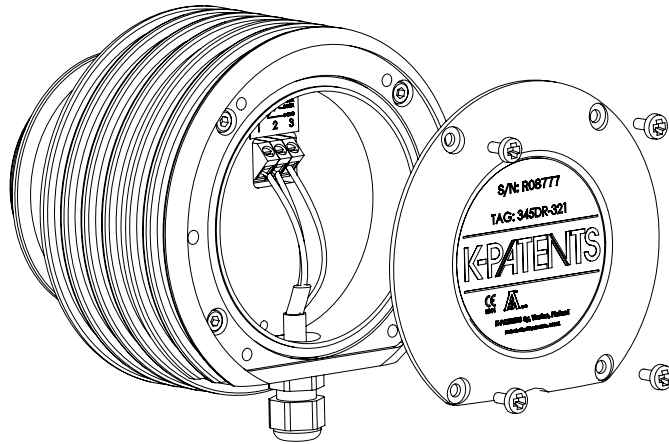
To install the transmitter

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.

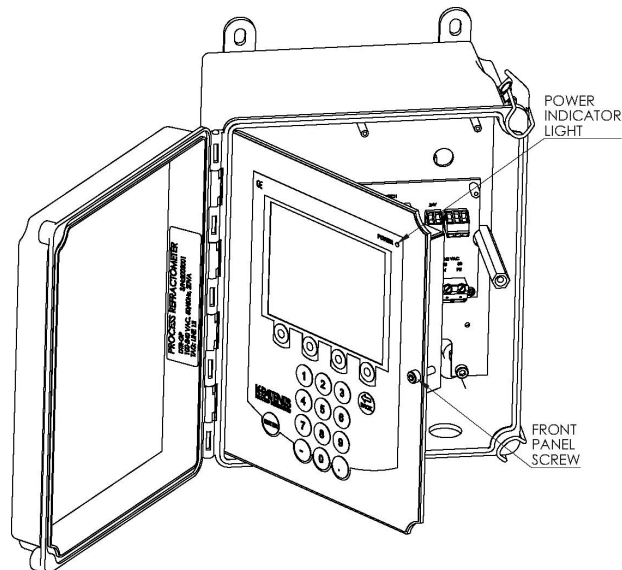
**NOTE:** To avoid damage from stray voltages and short-circuiting, always disconnect the sensor cables from the transmitter before removing the sensor.



**Figure 13** Sensor electrical connections

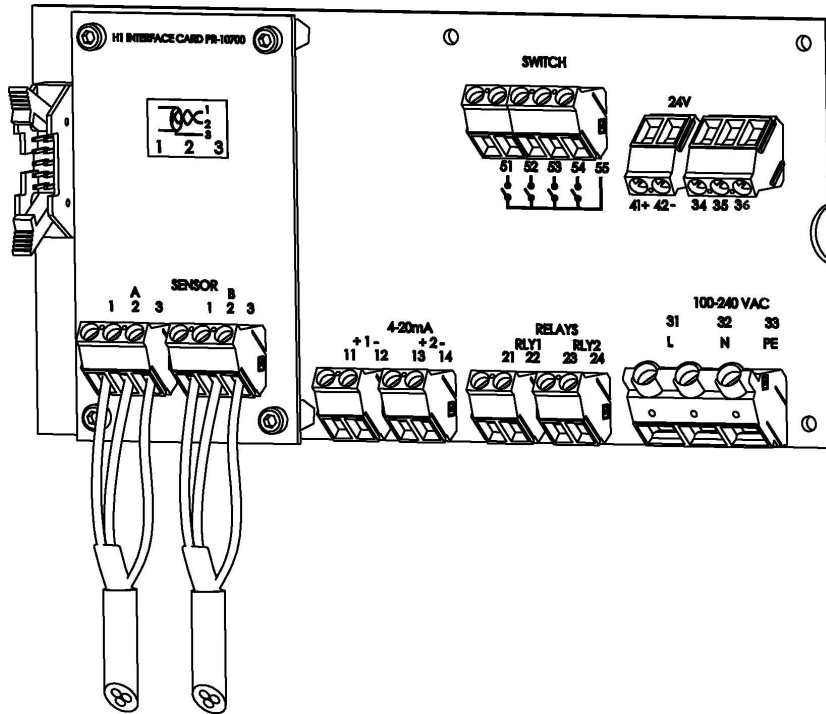
3. Open the front panel by loosening the front panel screw.

**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, unplug the power supply cord or use the external power switch (if installed).



**Figure 14** 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 15** Transmitter H1 and motherboard connections

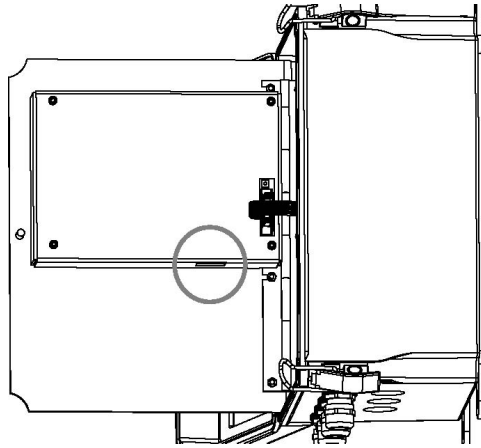
**H1**

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

**Motherboard**

<b>11 12</b>	4–20 mA output 1, positive (11), negative (12), max. load 1000 Ohm, galvanically isolated.
<b>13 14</b>	4–20 mA output 2, positive (13), negative (14), max. load 1000 Ohm, galvanically isolated.
<b>21 22</b>	Relay 1, one contact output, max. 250 VAC, max. 3 A.
<b>23 24</b>	Relay 2, one contact output, max. 250 VAC, max. 3 A.
<b>31 32 33</b>	Power, L (31), N (32), protective earth (33), 100-240 VAC, 50–60 Hz. An external power switch is recommended.
<b>41 42</b>	24V terminal for DTR internal use only. <b>NOTE:</b> Connecting terminal to external 24V supply will void warranty. Connecting external devices to 24V terminal will void warranty.
<b>51 52 53 54 55</b>	Switch inputs: switch 1 (51), switch 2 (52), switch 3 (53), switch 4 (54) and common (55). A voltage of 3 VDC 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 16** Ethernet connection location

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

## 5 Commissioning SD Sensor System

After installing the SDI 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 Vaisala user documentation or visit the Vaisala website to see the instructional video ([www.vaisala.com](http://www.vaisala.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)	<input type="checkbox"/>	<input type="checkbox"/>		
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 chapter <i>Configuring mA Outputs</i> in Vaisala PR-23 User Guide.
Configure prism wash relay (relay 1 or 2).	<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATION › RELAYS	For more information, see chapter <i>Configuring relays</i> in Vaisala PR-23 User Guide.
<b>Prism wash test</b>				
<b>Task</b>	<b>OK</b>	<b>Failed</b>		<b>Notes</b>
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 decreasing - QF value decreasing or increasing	<input type="checkbox"/>	<input type="checkbox"/>		For more information, see chapter 5.1 <i>Prism Wash Test</i> in these instructions and chapter <i>Prism wash</i> in Vaisala PR-23 User Guide.
<b>Calibration check</b>				
<b>Task</b>	<b>OK</b>	<b>Failed</b>		<b>Notes</b>
Check that calibration corresponds to the lab results	<input type="checkbox"/>	<input type="checkbox"/>	CALIBRATION › CHEMICAL & FIELD PARAMETERS › FIELD PARAMETERS	For more information, see chapter 5.2 <i>Calibration Check</i> in these instructions and chapter <i>Calibrating the concentration measurement</i> in Vaisala PR-23 User Guide.

## 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.

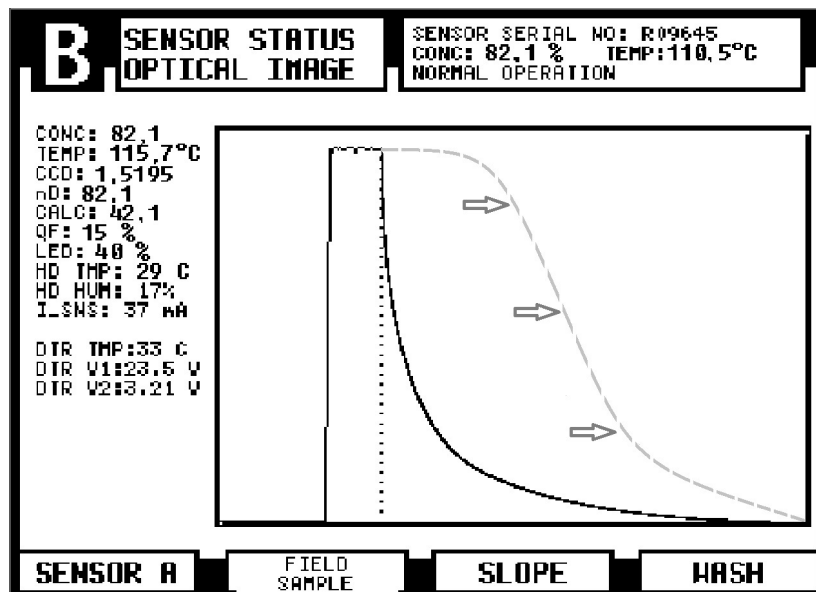


Figure 17 Changes in concentrations during successful prism wash

## 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 chapter *Calibrating the concentration measurement* in Vaisala PR-23 User Guide.

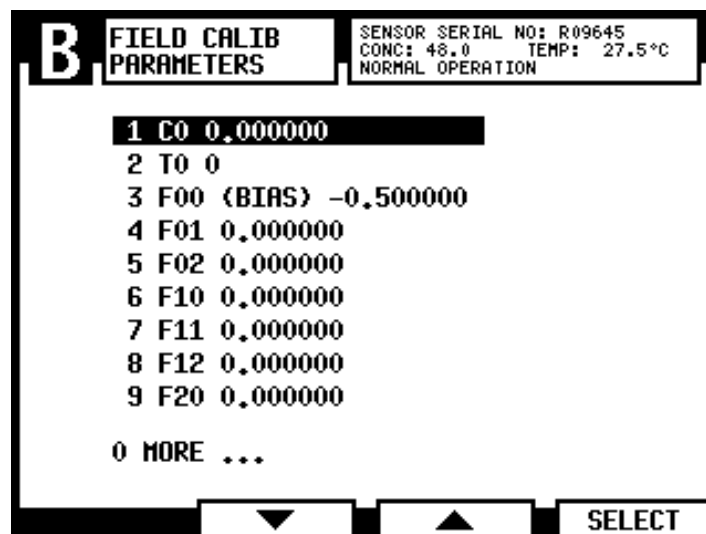


Figure 18 BIAS

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 chapter *Entering field calibration parameters* in Vaisala PR-23 User Guide). 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](http://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 Vaisala PR-23 User Guide.
Check the functionality of wash system.	X		See Prism wash test in Commissioning checklist.
Check the steam pressure.	X		Typically 5-6 bar (75-90 psi) over process pressure.
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 Vaisala PR-23 User Guide
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.  
Verify calibration.

X

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.

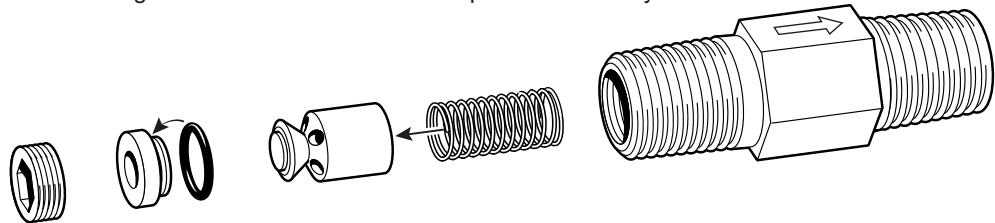


Figure 19 Taking check valve apart for maintenance

## 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.

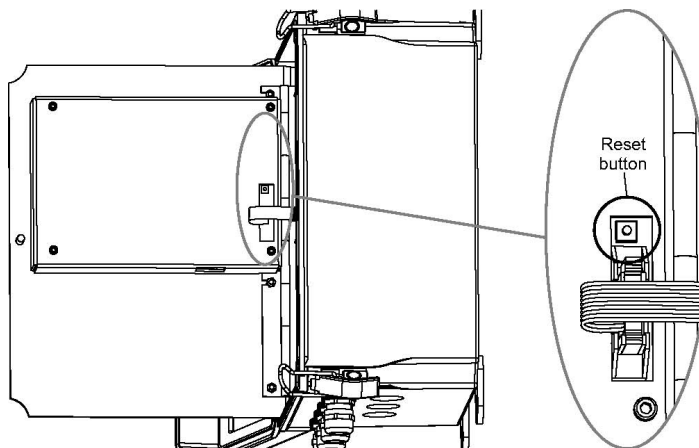


Figure 20 Reset button



## 7 Appendices

**Preventive Maintenance Inspection Weekly Checklist**

**Inspection report**




**Inspection report**  
 TS13026

# Inspecta

Antti Ylinen

14.5.2013

1 (2)

Orderer: K-Patents Oy  
 Elannontie 5, Box 77  
 FI-01511 Vantaa, Finland

Reference: Mr Harri Salo

The subject: Safe-Drive™ Retractor tool with Wash Nozzle

---

**Operational Safety Assessment for Safe-Drive™ Retractor tool of Process Refractometer PR-23-SD Generation 1 sensor**


---

Client: K-Patents Oy

Inspection date: 20.03.2013

Inspector(s): Mr Antti Ylinen

**General**

The Safe-Drive™ Retractor tool is mandatory equipment for inserting and removing PR-23-SD sensor to or from a pressurized pipe. Removing the sensor without the Retractor tool may cause a life-threatening situation, if there is any pressure in the process pipe.

The Wash Nozzle is essential part of the sensor installation system. It is possible to install or remove the nozzle to or from pressurized process pipe.

**Applied laws, standards and documents**

The Retractor tool is not a machine such as the Machine Directive 2006/42/EY describes. Because there is not any standard for this kind of tools the assessment has been made applying the standard EN ISO 12100 Appendix B: Examples of hazards, hazardous situations and hazardous events.

Technical specifications for example, the strength calculations are excluded in the assessment.

The Best Practices manual has been assessed applying the standard EN ISO 1200 chapter 6.4.5.1 Accompanying documents (in particular – instruction handbook), Contents.

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Antti Ylinen

14.5.2013

2 (2)

## Inspections and notes

The tool's operations in practice and operation instructions were inspected on the K-Patents's headquarters in 20.03.2013. Notes of the instruction manuals are written in a document Muistio 21.3.2013 Antti Ylinen, Inspecta Tarkastus Oy.

Corrections to the Instruction manuals of the Retractor tool have been checked and verified with positive results in 30.4.2013.

K-Patents Steam Instructions have been added to the K-Patents Safety Instructions.

The Best Practices manual fulfils the requirements of the standard EN ISO 1200 chapter 6.4.5.1 Accompanying documents (in particular – instruction handbook), Contents.

## Summary

It has been assessed that the use of the Safe-Drive™ Retractor tool and installing or removing Wash Nozzle is safe by following instructions of the Safe-Drive™ Retractor tool of Process Refractometer PR-23-SD Generation 1 Best Practices.

Safety Requirements on the chapter 3 of the manual Safe-Drive™ Retractor tool of Process Refractometer PR-23-SD Generation 1 Best Practices and K-Patents Steam Instructions must be followed.

National laws, official regulations, and local instructions must be followed when using this equipment.

Hämeenlinna, 14.5.2013



Juha Alkio

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BP-EN-SDGEN1