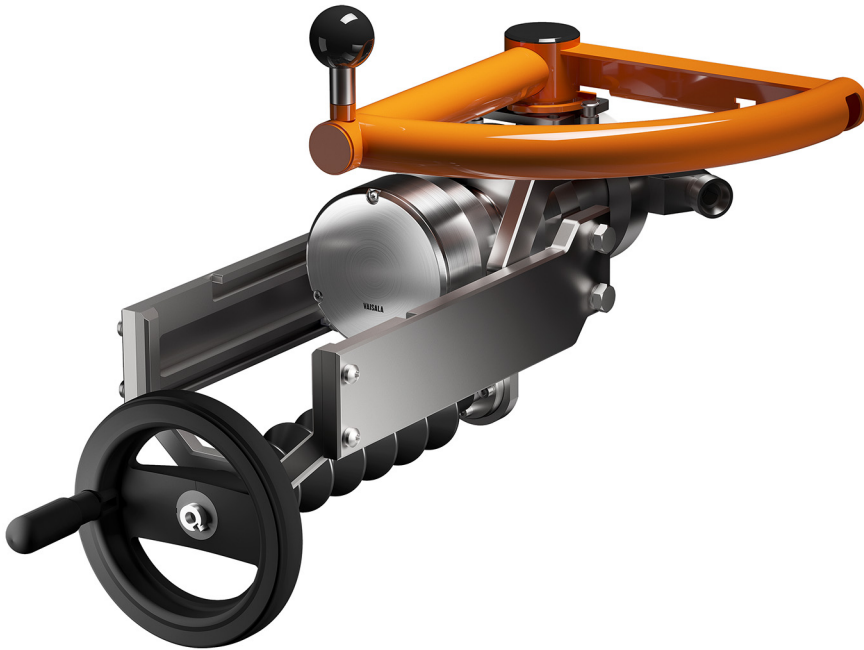




# Polaris™ PR53SD Safe-Drive Process Refractometer



## Features

- Designed for safe and easy retraction from pressurized process lines
- Reliable optical concentration measurements with refractive index
- Black liquor, green liquor, filtrates, and other liquids in chemical recovery line and fiberline
- SAF 2205 material for demanding environments
- Measurement not affected by bubbles, particles, suspended solids, or color
- Indigo520-compatible
- Built-in 4 ... 20 mA and Modbus RTU outputs

The retractable Vaisala Polaris PR53SD Safe-Drive process refractometer is designed for safety-critical measurements in pulp mills, such as firing liquor concentration. The newest design of the Safe-Drive retractor system allows insertion and removal of the measurement instrument when the process is running, ensuring operator safety. Prism wash systems enable reliable measurements in various installation positions, from fiberline to brown stock washing, evaporation, black liquor firing, slaker, and lime operations. The design complies with the **BLRBAC** Recommended Good Practice Safe Firing of Black Liquor in Black Liquor Recovery Boilers.

## Benefits

The optical measurement is based on the refractive index (RI). The outstanding long-term stability provides years of accurate, continuous, fast, and stable measurement for total dissolved solids and other concentration measurements, directly in the process stream. The PR53SD is designed for the critical safety measurements in pulp mills. The PR53SD measurement instrument can be retracted for maintenance without requiring process shutdown, minimizing measurement downtime. To ensure operator safety, the PR53SD and retractor prevents inadvertent errors in use: the Safe-Drive retractor tool is built into the isolation valve and ensures that

the isolation valve is always closed when the refractometer is removed from the pressurized line. The PR53SD continues the success of the Vaisala K-PATENTS® process refractometer series. Based on 40 years of experience and continuous development, the PR53 family is the latest generation of digital process refractometers.

## True dissolved solids measurement

Weak liquor and black liquor are a mixture of cooking chemicals and dissolved organic material. The RI measurement responds to all dissolved solids. Bubbles, foam, particles, suspended solids, or fibers do not affect

measurement. The measurement enables process optimization through advanced process control: continuous and accurate optical measurement for true dissolved solids allows immediate reaction to process variations.

## Fiberline and chemical recovery lines

Measurement is suitable for low and medium consistency pulp, filtrates, and process liquids. In black liquor applications, total dissolved solids concentrations up to 90 % can be measured directly inline. Field-proven prism wash systems allow accurate measurement in challenging process media and conditions.

# Technical data

## Measurement performance

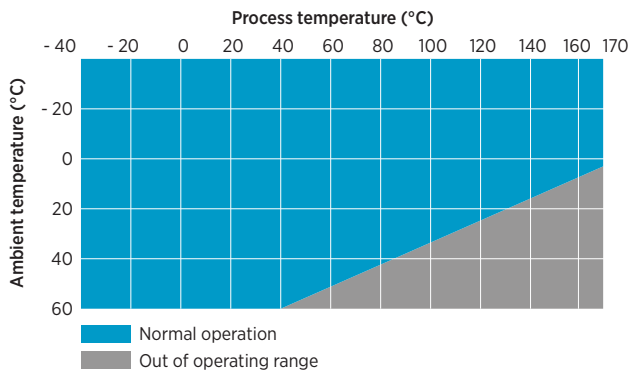
### Refractive index

Measurement range	1.32 ... 1.53 nD (0 ... 90 % total solids), normal-range prism 1.36 ... 1.57 nD (20 ... 100 % total solids), high-range prism (Corresponds to 0 ... 100 °Bx)
Accuracy	±0.00014 nD (0.1 °Bx) <sup>1)</sup>
Repeatability	±0.00002 nD <sup>2)</sup>
Resolution	±0.000015 nD
Response time T <sub>63</sub> with default damping	10 s <sup>3)</sup>
Measurement cycle	1 / s
Long-term stability	Max. 0.1 % full scale / a

### Temperature

Accuracy at 20 °C (68 °F)	±0.3 °C (0.54 °F) <sup>1)</sup>
Sensor class	F0.15 IEC 60751
Temperature coefficient	±0.002 °C / C

- 1) Accuracy specified with respect to calibration reference, including non-linearity, hysteresis at +20 °C.  
2) Repeatability, confidence level k=2, including random noise, at T<sub>a</sub> = +20 °C, with standard low-pass filtering.  
3) At standard low-pass filtering.



PR53SD process temperature (indicative)

## Operating environment

### Process parameters

Process temperature	-40 ... +170 °C (-40 ... +338 °F)
Design temperature	+180 °C (+356 °F) <sup>1)</sup>
Design pressure / maximum operating pressure	35 bar
Maximum retraction pressure	35 bar

### Operating environment

Storage temperature	-40 ... +65 °C (-40 ... +149 °F)
Operating temperature	-40 ... +60 °C (-40 ... +140 °F)
Maximum operating altitude	2000 m (approx. 6500 ft)
Operating humidity	0 ... 100 %RH
Storage humidity	0 ... 100 %RH, non-condensing
UL 50E (NEMA) rating	Type 4X
IP rating	IP66 IP67

- 1) Maximum momentary temperature peak.

## Inputs and outputs

### Supply

Operating voltage	24 V DC nominal (9 ... 30 V DC)
Power consumption	Less than 1 W
Protection class	3, PELV

### Outputs

Output parameters	RI, temperature, concentration, quality factor
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### Analog outputs

mA	Sourcing, isolated, NAMUR NE 43, configurable
mA range	3.8 ... 20.5 mA
Loop impedance	Max. 600 Ω
Accuracy of analog outputs at +20°C	±0.1 % of full scale (±0.00002 RI)

### Digital outputs

Digital output	RS-485, non-isolated
Maximum cable run	300 m (approx. 1000 ft) (digital)
Supported protocol	Modbus RTU

### Connectors

External connectors	1 × M12 F 4 pins, A-coded <sup>1)</sup> 2 × M16×1.5 cable gland, Cable D 5 ... 10 mm / Adapter for conduit entry M16×1.5 / NPT ½"
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- 1) For USB2 adapter and Insight software. See [www.vaisala.com/insight](http://www.vaisala.com/insight).

## Compliance

Electromagnetic compatibility (EMC)	EN 61326-1, industrial environment
Safety	IEC/EN/UL 61010-1
Pressure	CRN all territories, ASME BPVC Sec VIII Div. 1 Ed. 2021
Compliance marks	CE, China RoHS, RCM, UKCA

## Mechanical specifications

### Wetted parts

Sensor head	EN 1.4462 <sup>1)</sup>
Prism	Sapphire monocrystalline, 99.996 % Al <sub>2</sub> O <sub>3</sub> <sup>2)</sup>
Process gasket	Co-Cr-Ni Alloy (AMS 5876) lined PTFE <sup>2)</sup>
Prism gasket	Modified PTFE <sup>2)</sup>
SD flange	EN 1.4462 <sup>1)</sup>
Wash nozzle	EN 1.4462 <sup>2)</sup>

### Non-wetted parts

Housing	EN 1.4404
Screws, TX20 torque 2.0 Nm	EN 1.4404 (AISI 316L)
Stud bolts, M12 torque 75 Nm, M10 torque 40 Nm	EN 1.4435 (AISI 316L), grade 8.8
Flanges (3 pcs)	EN 1.4462 (AISI 2205) ASME B16.5, DIN 2543
Cable	4×22 AWG PUR, black 10 m multistrand, with ferrules Flame-retardant acc. to IEC 60332-1-2, FT1, VW1
<b>Weight</b>	Retractor and wash connection 15 kg (33.07 lb) Refractometer 5.4 kg (11.9 lb)

- 1) EN 10204 / 3.1 certificate included.  
2) Manufacturer's declaration included.

## Mounting accessories

### Item

Blind flange

SD5 mounting flange plug system

SD5 mounting nozzle plug system

## Calibration accessories

### Item

RI liquid kit for RI field calibration, standard  
1.33, 1.37, 1.42, 1.47, 1.52

RI liquid kit for RI field calibration, large  
1.32, 1.33, 1.35, 1.38, 1.41, 1.44, 1.47, 1.50, 1.52, 1.53

Sample holder and cover

## Accessories

### Item

USB adapter for service port, for Insight service software (see [www.vaisala.com/insight](http://www.vaisala.com/insight))

### Code

USB2

Fiberglass brush for prism cleaning

Instrument cable, 4×22 AWG, PUR jacket, black, open ends, 10 m

Flame-retardant acc. to IEC 60332-1-2, FT1, VW1

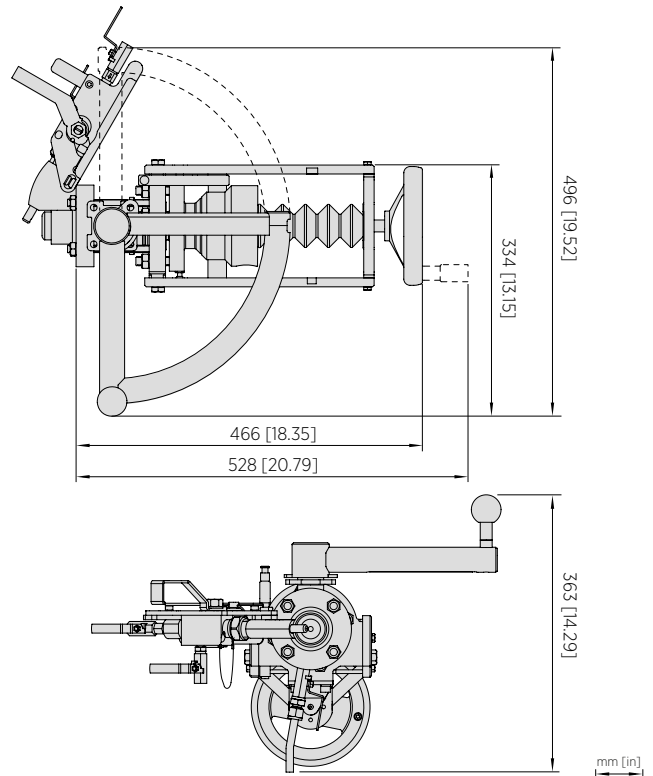
Instrument cable, 4×22 AWG, PUR jacket, black, open ends, 30 m

Flame-retardant acc. to IEC 60332-1-2, FT1, VW1

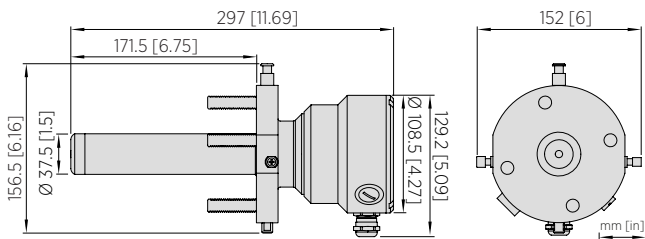
Instrument cable, 4×22 AWG, PUR jacket, black, open ends, 50 m

Flame-retardant acc. to IEC 60332-1-2, FT1, VW1

Cooling cover



Dimensions PR53 SDI5 Safe-Drive isolation valve and retractor



Dimensions PR53SD

**VAISALA**

[www.vaisala.com](http://www.vaisala.com)

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