



## Polaris™ PR53M PTFE-Body Process Refractometer



### Features

- Non-metallic wetted parts, integrated ultra-pure PTFE and sapphire flow cell for demanding environments
- Reliable optical concentration measurements with refractive index
- Potassium hydroxide, sodium hydroxide, hydrochloric acid, and more than 500 concentration curves
- Measurement not affected by bubbles, particles, suspended solids, or color
- Various fittings and connections available for ½ inch tubing
- Indigo520-compatible
- Built-in 4–20 mA and Modbus RTU outputs

The Vaisala Polaris PR53M PTFE-body process refractometer is designed to measure concentrations of aggressive chemicals, such as hydrochloric acid (HCl), sodium hydroxide (NaOH), sodium chloride (NaCl), and sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) in the chemical and semiconductor industries. The integrated ultra-pure PTFE flow cell has no metallic wetted parts, minimizing contamination risk and making it suitable for contact with aggressive chemicals. The PR53M can be mounted to ½ inch process lines with a standard NTP-threaded connection.

### Benefits

The optical measurement is based on the refractive index (RI). The RI can be measured from practically any liquid, and it responds to dissolved material. Because bubbles, particles, or crystals in the process do not affect measurement, the RI allows accurate measurement for different chemicals, also slurries. Typical applications include different chemical-mixing and monitoring installations in the fine chemical and semiconductor industries. In addition to a wide selection of product options, Vaisala offers the possibility to customize the product for specific needs. The outstanding long-term stability provides years of accurate, continuous, fast, and stable concentration measurement directly in the process stream. Inline process refractometers are easy to install and have no moving parts that require regular maintenance.

The PR53M 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.

### Accurate and reliable

The optical measurement principle offers accurate and drift-free measurement. Because temperature measurement is incorporated inside the process refractometer, the changing process temperature does not affect the concentration measurement.

### Plug and play to Indigo

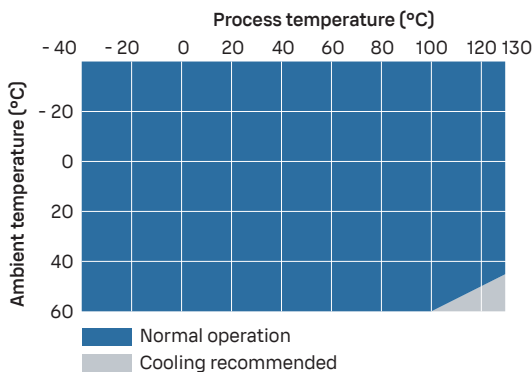
The refractometer can be interfaced directly, or it can be connected to a Vaisala Indigo520 transmitter. It provides access to features such as data storage, graphical interface, and analog and digital interface. Changing settings, measurement parameters, or other servicing updates can be done directly from the Indigo520, or through a USB cable using Vaisala software.

# Technical data

## Measurement performance

| Refractive index                                   |                                            |
|----------------------------------------------------|--------------------------------------------|
| Measurement range                                  | 1.32–1.53 nD<br>(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                             |

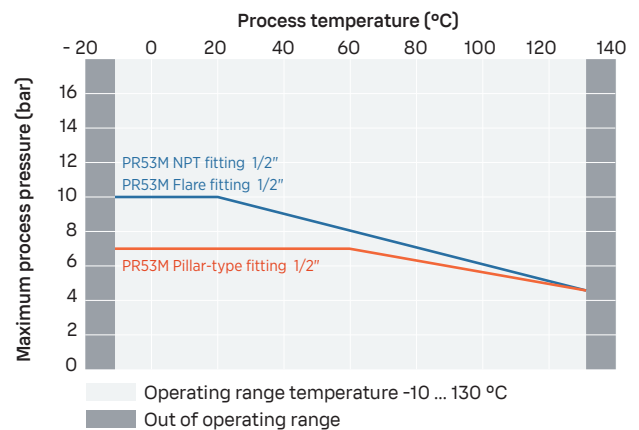
- 1) Accuracy specified with respect to calibration reference, including non-linearity, hysteresis at +20 °C.  
2) Repeatability, confidence level k=2, including random noise, at T<sub>a</sub> = +20 °C, with standard low-pass filtering.  
3) With standard low-pass filtering.



PR53M process temperature (indicative)

## Operating environment

| Process parameters         |                                                                             |
|----------------------------|-----------------------------------------------------------------------------|
| Process temperature        | –10 ... +130 °C (+14 ... +266 °F)                                           |
| Pressure                   | 10 bar at 20 °C, 4.5 bar at 130 °C<br>(145 psi at 68 °F, 652 psi at 266 °F) |
| 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<br>IP67                                                                |



PR53M process pressure

## 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                                                                                                   |
| 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 M 4 pins, A-coded <sup>1)</sup><br>2 × M16×1.5 cable gland, Cable D 5–10 mm / Adapter for conduit entry M16×1.5 <sup>2)</sup> / NPT 1/2" |

- 1) For USB2 adapter and Insight software, see [www.vaisala.com/insight](http://www.vaisala.com/insight).  
2) Conduit hub is not compatible with PR53 Safe-Drive system.

## Compliance

|                                     |                                    |
|-------------------------------------|------------------------------------|
| Electromagnetic compatibility (EMC) | EN 61326-1, industrial environment |
| Safety                              | IEC/EN/UL 61010-1                  |
| Compliance marks                    | CE, China RoHS, RCM, UKCA          |
| Vibration and shock                 | Tested according to IEC 60068-2    |

Mechanical specifications

| Wetted parts               |                                                                                                                                       |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Prism and sapphire plate   | Sapphire monocrystalline, 99.996 % Al <sub>2</sub> O <sub>3</sub> <sup>1)</sup>                                                       |
| Flow cell                  | Ultra pure PTFE <sup>1)</sup>                                                                                                         |
| Prism gasket               | Modified PTFE <sup>1)</sup>                                                                                                           |
| Process gasket             | Kalrez W240UP <sup>1)</sup>                                                                                                           |
| Non-wetted parts           |                                                                                                                                       |
| Housing                    | Stainless steel (AISI 316)                                                                                                            |
| Coating                    | Cerakote, white (PR53M with integrated fittings)                                                                                      |
| Screws TX20, torque 2.0 Nm | EN 1.4404 (AISI 316L)                                                                                                                 |
| Cable                      | 2×2×0.5 mm <sup>2</sup> (AWG 21), PUR jacket, gray 10 m multistrand, with ferrules<br>Flame-retardant acc. to IEC 60332-1-2, FT1, VW1 |

1) Manufacturer's declaration included.

Mounting accessories

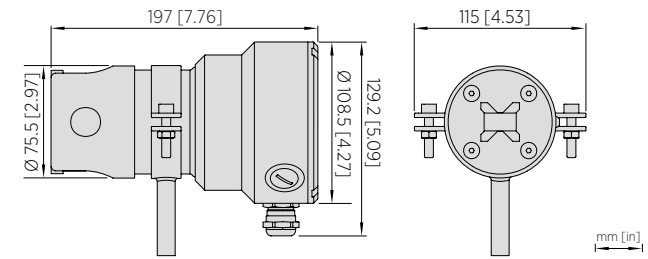
| Item                  |
|-----------------------|
| Flare fitting nut     |
| Pillar nut and sleeve |

Calibration accessories

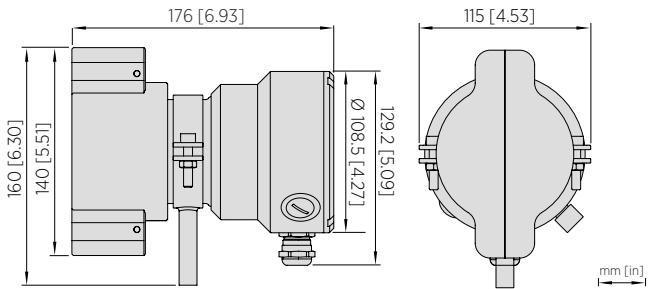
| Item                                                                                                  | Item code |
|-------------------------------------------------------------------------------------------------------|-----------|
| Verification kit<br>1.33, 1.37, 1.42, 1.47, 1.52                                                      | 280380SP  |
| Calibration kit<br>1.32, 1.33, 1.35, 1.36, 1.37, 1.38, 1.40, 1.42, 1.45, 1.47, 1.50, 1.52, 1.53, 1.57 | 278292SP  |
| High-range special kit<br>1.42, 1.47, 1.53, 1.57, 1.60, 1.62, 1.67, 1.72                              | 278293SP  |
| Sample holder and cover                                                                               | 278295SP  |

Accessories

| Item                                                                                                                                              | Item code     |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| USB adapter for service port, for Insight service software (see <a href="http://www.vaisala.com/insight">www.vaisala.com/insight</a> )            | USB2          |
| Instrument cable, 2×2×0.5 mm <sup>2</sup> (AWG 21), PUR jacket, grey, open ends, 10 m (33 ft)<br>Flame-retardant acc. to IEC 60332-1-2, FT1, VW1  | CBL211266-10M |
| Instrument cable, 2×2×0.5 mm <sup>2</sup> (AWG 21), PUR jacket, grey, open ends, 30 m (98 ft)<br>Flame-retardant acc. to IEC 60332-1-2, FT1, VW1  | CBL211266-30M |
| Instrument cable, 2×2×0.5 mm <sup>2</sup> (AWG 21), PUR jacket, grey, open ends, 50 m (164 ft)<br>Flame-retardant acc. to IEC 60332-1-2, FT1, VW1 | CBL211266-50M |
| Cooling cover                                                                                                                                     | ASM214675SP   |



Dimensions of PR53M flow cell end plate bolts (NPT fitting)



Dimensions of PR53M flow cell end plate bolts (integrated fittings, Flare and Pillar-type)