PROCESS REFRACTOMETER
FOR CONCENTRATION
MEASUREMENT OF CHEMICALLY
AGGRESSIVE LIQUIDS

PROCESS REFRACTOMETER PR-23-W/M

SB:PR-23-W&M/5
January 2015
TYPICAL APPLICATIONS

K-Patents Saunders Body PR-23-W and K-Patents Teflon Body PR-23-M Refractometers provide accurate means for measuring liquid concentrations in chemically aggressive solutions that corrode, foul or otherwise destroy metal parts as well as in ultra-pure fine chemical processes, where metal parts cannot be used.

CHLOR-ALKALI INDUSTRY

CORROSIVE CHEMICALS

ULTRA PURE FINE CHEMICALS

ELECTRONIC CHEMICALS

Acetic acid CH₃COOH, Ammonium fluoride NH₄F, Ammonium hydroxide NH₄OH, Ammonium sulphate (NH₄)₂SO₄

Calcium hypochlorite Ca(ClO)₂, Copper chloride CuCl₂, Citric acid C₆H₈O₇, Chromic acid CrO₃

Ferric chloride FeCl₃, Fluosilic acid, Formic acid HCO₂H

Hydrochloric acid HCl, Hydrofluoric acid HF, Hydrogen peroxide H₂O₂, Buffered HF (BHF), Aqua Regia HNO₃/HCl

Lactic acid C₂H₄(OH)COOH

Magnesium chloride MgCl₂, Nickel chloride NiCl₂, Nitric acid HNO₃

Phosphoric acid H₃PO₄, Potassium carbonate K₂CO₃·11/2 H₂O, Potassium hydroxide KOH, Potassium thiocyanate KSCN, Potassium nitrate KNO₃

Sodium bicarbonate NaHCO₃, Sodium carbonate Na₂CO₃, Sodium chloride NaCl, Sodium dichromate Na₂Cr₂O₇·2H₂O, Sodium hydroxide NaOH, Sodium hypochlorite NaClO₂, Sulphuric acid H₂SO₄ and more.
INSTALLATION

SAUNDERS BODY
REFRACTOMETER PR-23-W

The K-Patents Saunders Body Refractometer PR-23-W is designed for use in chemically aggressive solutions and ultra-pure fine chemical processes in large-scale production and in large pipelines (diameter 50, 80 or 100mm/2”, 3” or 4”).

The K-Patents PR-23-W is delivered with a Saunders (diaphragm) valve body and can be mounted either in a vertical or horizontal pipe. The Saunders body material is Graphite cast iron, which provides a solid mechanical base for the sensor installation.

The cast iron is lined with 3mm PFA (Perfluoralkoxy) fluoroplastic that gives the body a high chemical resistance. The sensor wetted parts materials are Teflon® PTFE (Polytetrafluoroethylene) and Sapphire (Al₂O₃). The material of the sensor cover is stainless steel AISI 316 L.

TEFLON BODY
REFRACTOMETER PR-23-M

The K-Patents Teflon Body Refractometer PR-23-M is designed for small pipe sizes.

The sensor wetted parts Teflon® PTFE or Kynar® PVDF (Polyvinylidene fluoride), Sapphire (Al₂O₃), and Kalrez® are carefully selected because they have high chemical and mechanical resistance.

The external materials AISI 316L (sensor cover) and polyamid 6.6 (electrical connector) withstand chemically aggressive gases and splashes of the process liquid.

The measurement accuracy of either Refractometer model is not influenced by particles, bubbles, colour or temperature changes of the process liquid.
DIGITAL MEASUREMENT
PRINCIPLE

The light source sends light against the interface between the prism and the process solution, where the rays meet at different angles.

Depending on the angle, some rays are totally reflected. Some rays are only partially reflected, and most of the light is refracted into the process solution.

Thus an optical image with a dark sector and a light sector is created.

The angle corresponding to the shadow line is called the Critical Angle of Total Reflection. The Critical Angle is a function of the refractive index and hence the concentration of the solution.

A digital CCD-camera detects the optical image and the shadow line. The camera transforms the optical image point-by-point to an electrical signal. The exact shadow line position is located and converted to a reading in refractive index.

A built-in temperature sensor measures the temperature on the surface of the process liquid. The indicating transmitter converts the refractive index and temperature to concentration units.

The diagnostics program ensures that the measurement is reliable.

OPERATION

K-Patents Refractometer PR-23-W/M sensor is factory calibrated to measure refractive index \( n_0 \) and temperature \( T \) in standard units. Each sensor has identical calibration \( n_0 = 1.32 \ldots 1.53 \) (corresponding to 0-100% b.w.). One or two sensors can be connected to one indicating transmitter.

Because the sensors have identical calibration, and each sensor gives Refractive Index \( n_0 \) and temperature as output, all sensors can be freely interchanged without optical calibration or parameter changes.

Each sensor comes with a calibration certificate comparing a set of standard liquids to the actual sensor output. The calibration and accuracy can be easily verified on-site with certified refractive index liquids and K-Patents documented verification procedure.

REMOTE USABILITY

The PR-23-W/M ease-of-use is significantly improved by a built-in web server that can be accessed via Ethernet. It is possible to obtain a remote display with real-time measurement data and diagnostics, and remotely alter instrument configuration settings or update program versions without having to go to the field.

Only a cross-over cable and data acquisition software are needed for collecting the data from a PR-23-W/M refractometer. The communication is built on standard protocols (UDP/IP) and K-Patents offers ready-to-install software for the data acquisition.

The K-Patents data acquisition software is expandable in case the user wants to modify the program. The program is written in Java and is therefore system independent. It can be tailored to almost any computing environment.
K-Patents PR-23-W and PR-23-M Process Refractometers advance the patented CORE-optics (Compact Optical Rigid element), which incorporates the optical components: LED (light emitting diode), prism and CCD-camera as well as the temperature sensor in one rigid module. The integral probe type temperature sensor responds fast to the changes of the process liquid temperature. The CORE-optics module is isolated from the sensor body and therefore external forces like pressure, flow and temperature changes do not influence the measurement.

The CORE-optics is patented.
**SPECIFICATIONS**

**SENSOR PR-23-W**
- Process connection with PFA (Perfluoroalkoxy) lined Saunders (diaphragm)
- Valve body 2", 3" or 4"; valve body material Graphite cast iron
- Saunders body process connection: DIN-flange DN50 PN 16/DIN-flange DN80 PN 16/DIN-flange DN100 PN 16/ANSI-flange 4" 150 lbs/ANSI-flange 3" 150 lbs/ANSI-flange 2" 150 lbs
- Process temperature: -20 °C...45 °C (-4 °F...113 °F), Indicating transmitter: 0 °C...45 °C (32 °F...122 °F)
- Sensor temperature: Sensor: -20 °C...45 °C (-4 °F...113 °F)

**SENSOR PR-23-M**
- Process connection with Thread G1/2" (F) or Thread NPT 1/2" (F)
- Sensor wetted parts: Teflon® PTFE or Kynar® PVDF (Polyvinylidene fluoride), prism gasket Teflon® PTFE, prism sapphire, O-ring Kalrez, adaptor sapphire
- Sensor weight: 5.5 kg (12 lbs)

**INDICATING TRANSMITTER DTR**
- Display: 320x240 pixel graphical LCD with LED backlight, keypad with 8 membrane keys
- Current output: Two independent current outputs, 4-20 mA, max. load 1000 Ohm, galvanic isolation 1500 VDC or AC (peak), hold function during prism wash
- Ethernet connection: 10/100 Mbit/s, data acquisition over UDP/IP Protocol with data logging software
- Alarm/Wash relays: Two built-in signal relays, max. 250 V/3 A
- Sensor connectivity: One or two sensors can be connected to one DTR. Sensors independent with own parameter sets and usable in different applications. Two current outputs configurable independently to indicate process concentration or temperature of either sensor.
- Indicating transmitter weight: 4.5 kg (10 lbs)
- Transmitter protection class: Enclosure IP66, Nema 4X (indoor use)
- INTERCONNECTING CABLE: IEC 61158-2 compliant two-wire cable
- Interconnecting cable length: Standard 10 m (33 ft), max. 200 m (660 ft). Cable fittings to Indicating transmitter: European cable glands M20x1.5 or US conduit hubs
- PATENTS: See www.kpatents.com

**ORDERING INFORMATION:**
- Sensor type and process connection
- Desired scale
- Properties of process solution
- Process temperature range
- Process pipe size
- Process flow rate
- Supply voltage and frequency
- Options and accessories

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