

PROCESS REFRACTOMETER
FOR CONCENTRATION
MEASUREMENT OF CHEMICALLY
AGGRESSIVE LIQUIDS

K-PATENTS
PROCESS INSTRUMENTS



PROCESS REFRACTOMETER PR-23-W/PR-23-M

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

SEMICONDUCTOR INDUSTRY AND ELECTRO-CHEMICALS

Acetic acid CH_3COOH , Ammonium fluoride NH_4F , Ammonium hydroxide NH_4OH , Ammonium sulphate $(\text{NH}_4)_2\text{SO}_4$

Calcium hypochlorite $\text{Ca}(\text{ClO})_2$, Copper chloride CuCl_2 , Citric acid $\text{C}_6\text{H}_8\text{O}_7$, Chromic acid CrO_3

Ferric chloride FeCl_2 , Fluosilic acid, Formic acid HCO_2H

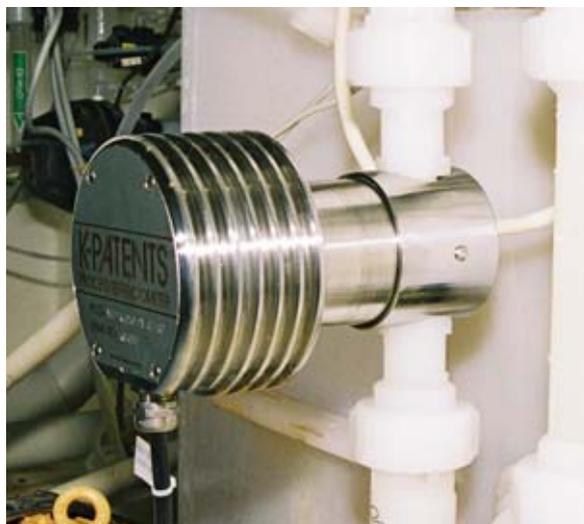
Hydrochloric acid HCl , Hydrofluoric acid HF , Hydrogen peroxide H_2O_2 , Buffered HF (BHF), Aqua Regia HNO_3/HCl

Lactic acid $\text{C}_2\text{H}_4(\text{OH})\text{COOH}$

Magnesium chloride MgCl_2 , Nickel chloride NiCl_2 , Nitric acid HNO_3

Phosphoric acid H_3PO_4 , Potassium carbonate $\text{K}_2\text{CO}_3 \cdot 11/2 \text{H}_2\text{O}$, Potassium hydroxide KOH , Potassium thiocyanate KSCN , Potassium nitrate KNO_3

Sodium bicarbonate NaHCO_3 , Sodium carbonate Na_2CO_3 , Sodium chloride NaCl , Sodium dichromate $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$, Sodium hydroxide NaOH , Sodium hypochlorite NaClO_2 , Sulphuric acid H_2SO_4 and more.



PROCESS REFRACTOMETER PR-23-W/PR-23-M

INSTALLATION

2" pipe size



3" pipe size



4" pipe size



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 (Fluorinated ethylene propylene) fluoroplastic that gives the body a high chemical resistance. The sensor wetted parts materials are Teflon® PTFE, Spinel ($MgAl_2O_4$) and Sapphire (Al_2O_3). The material of the sensor cover is stainless steel AISI 316 L.



Vertical line



Horizontal line

TEFLON BODY REFRACTOMETER PR-23-M

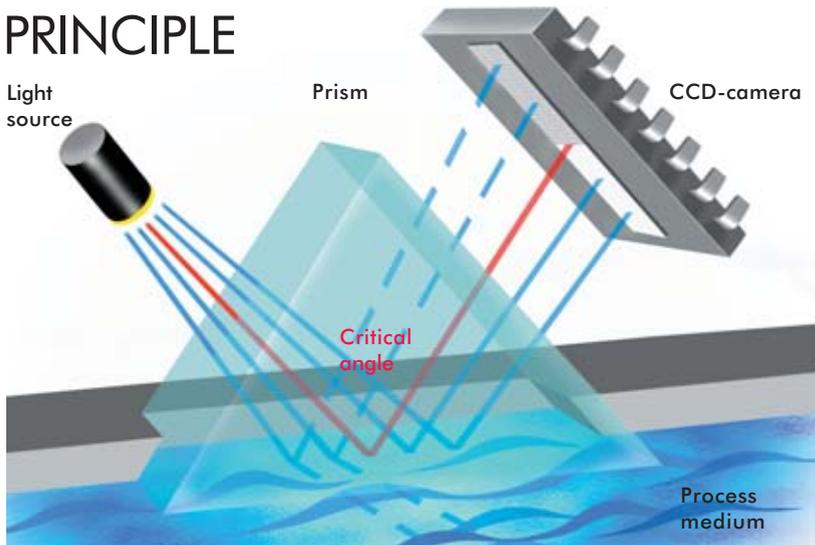
The K-Patents Teflon Body Refractometer PR-23-M is designed for small pipe sizes.

The sensor wetted parts Teflon®, Sapphire (Al_2O_3), Kalrez®, and Spinel ($MgAl_2O_4$) are carefully selected because they have high chemical and mechanical resistance.

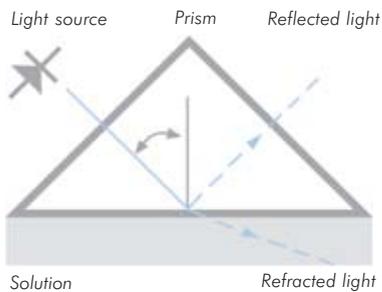
The external materials AISI 316L (sensor cover) and polyamid 6.6 (electrical connector) withstand chemically aggressive gases and splashes of the process liquid.

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

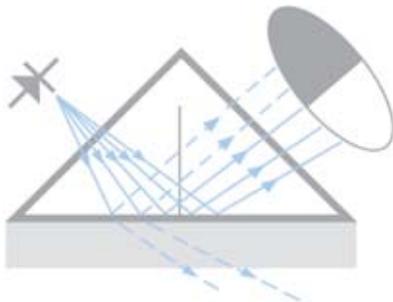
DIGITAL MEASUREMENT PRINCIPLE



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

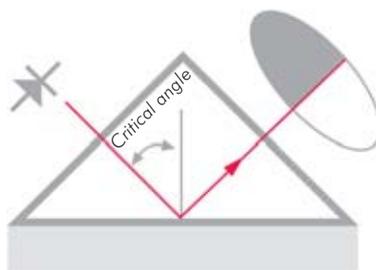


Depending on the angle, some rays are totally reflected. Some rays are only partially reflected, and most of the light is refracted into the process solution.



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_D and temperature T in standard units. Each sensor has identical calibration $n_D = 1.32...1.53$ (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_D 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.

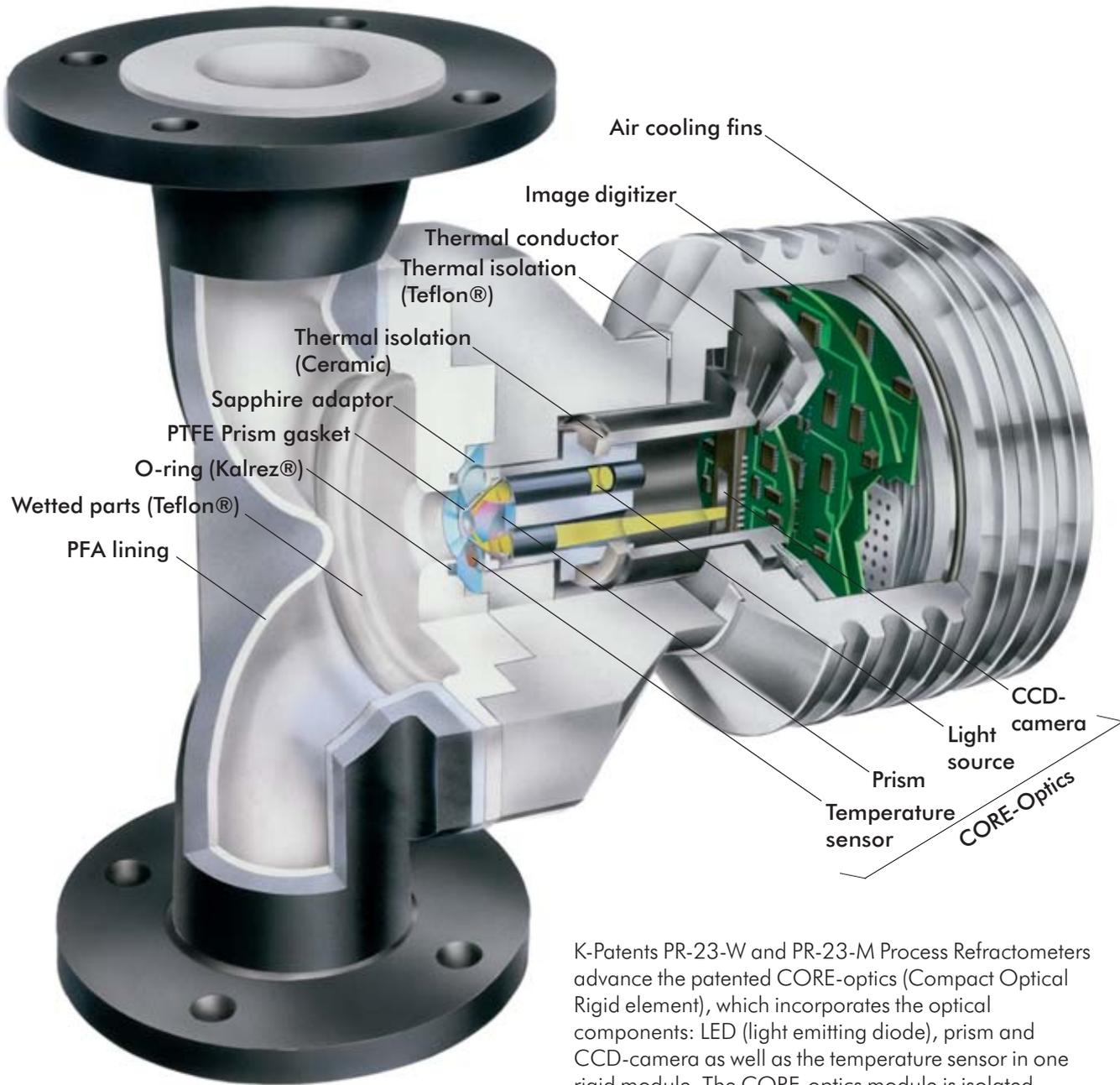
DATA LOGGING VIA ETHERNET

K-Patents PR-23-W/M includes an Ethernet based communications solution which allows connection to computer networks (LAN) and to the Internet. Real-time measurement data and diagnostic information may be obtained through this interface, and this makes it also a valuable service tool for parameter changes and software updates.

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

DESIGN



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 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 module is patented.
(US Patent Nos. US6067151 and US6760098 B2,
German Patent No. DE19855218).

