

A COMPACT PROCESS
REFRACTOMETER FOR
IN-LINE MEASUREMENT
OF CONCENTRATIONS

K-PATENTS
PROCESS INSTRUMENTS



PROCESS REFRACTOMETER PR-03-D

TYPICAL APPLICATIONS

CHLOR-ALKALI INDUSTRY

Ammonia, Ammonium chloride, Calcium hypochlorite, Caustic Soda, Chlorine, Soda Ash, Sodium bicarbonate, Sodium hypochlorite, etc.

FIBERS

Acetate, Acrylics, Adipic acid, Caprolactam, Cyclohexanol, Cyclohexanon, Dimethylterephthalate, Dimethylformamide, Fiberglass, Hexamethylene diamine, Nylon salt, Polyamides, Polyesters, Rayon, Spandex, Vinyls. Finishing, coating and dyeing mediums of textiles.

ELECTROLYTIC INDUSTRIES

Alumina, Aluminium, Ammonia, Hydrochloric acid, Magnesium chloride, Phosphoric acid, Potassium hydroxide, Sodium chloride, Sodium dichromate, Sodium hydroxide, etc.

ION EXCHANGE CHROMATOGRAPHY

Regeneration chemicals of ion exchangers.

PAPER INDUSTRY

Alum, CMC, Latex, Sizing chemicals and binders, Starch, PVA, Retention chemicals.

PLASTICS INDUSTRY

Acrylate, Cellulose derivates, Polyamides, Polycarbonates, Polyethylene, Resins, Styrenes, Vinyls, etc.

POTASSIUM INDUSTRY

Potassium carbonate, Potassium chloride, Potassium hydroxide, Potassium nitrate, Potassium thiocyanate, Trona

SALT AND SODIUM COMPOUNDS

Brine, Glauber's salt, Sodium carbonate, Sodium chloride, Sodium sulfate, Sodium sulfite, etc.

SOAP AND DETERGENTS

Fatty acids, Fatty alcohols, Caustic potash, Caustic soda, Glycerol, Oleum, Salt, Soda ash, Sodium bicarbonate

MISC. CHEMICALS AND OTHERS

Acetic acid, Amine oxide, Amino acid, Ammonium fluoride, Ammonium hydroxide, Ammonium nitrate, Ammonium sulphate, Citric acid, Copper chloride, Chromium trioxide (or Chromic acid), Ethylene glycol, Fluorosilicic acid, Formaldehyde, Formic acid, Gelatine, Hydrochloric acid, Hydrogen peroxide, Iron chloride, Lactic acid, Lubricating oils, Nickel chloride, Nitric acid, Oleum, Sodium dichromate, Sodium gluconate, Sodium hydroxide, Sulphuric acid, Urea

and more.

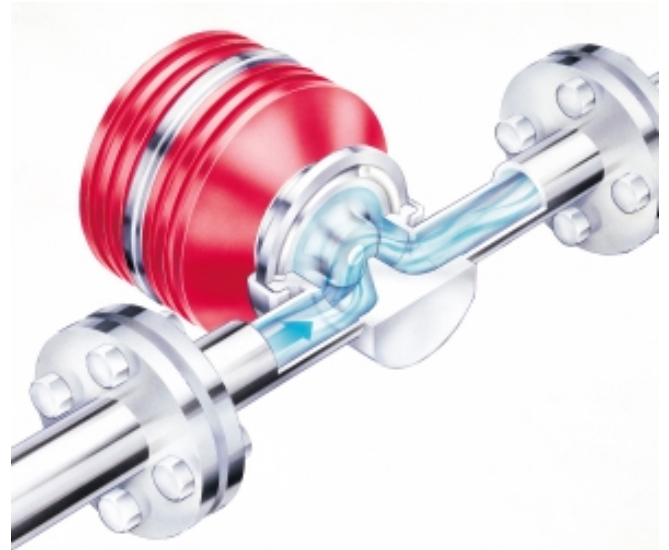


K-PATENTS PROCESS REFRACTOMETER PR-03-D

IN-LINE REFRACTOMETER FOR EXACT PROCESS CONTROL



Pipe sizes 2,5" (76.1mm) and larger



Pipe sizes 1" (25 mm)

EASY TO INSTALL AND OPERATE

K-Patents Process Refractometer PR-03-D provides truly accurate means for measuring liquid concentrations in various industrial applications.

The mounting site is freely selectable, because the K-Patents PR-03-D sensor and indicating transmitter are separate.

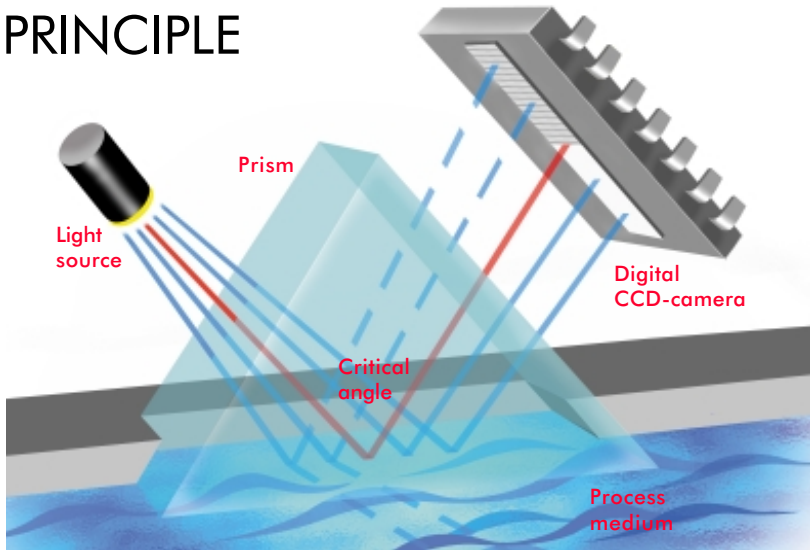
The sensor is mounted in a pipe bend by a clamp connection. For mounting in smaller

pipes K-Patents provides a specially designed flow cell. The mounting design creates optimum flow velocity on the measurement surface providing a self-cleaning effect.

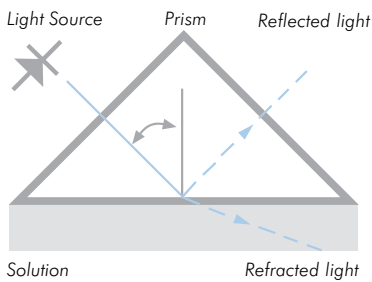
The K-Patents PR-03-D offers many advantages when aiming at exact process control. Low and high concentration alarms can be configured to allow smooth real-time operation of the process.

The measurement accuracy is not influenced by particles, bubbles, colour or temperature changes of the process liquid. Furthermore, the measuring system does not require recalibration or frequent maintenance.

MEASUREMENT PRINCIPLE

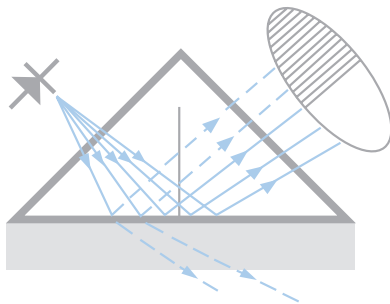


The light source sends light against the interface between a prism and the process solution, where the rays meet the surface at different angles.



Some rays are totally reflected; total reflection occurs. And some rays are partially reflected and partially refracted into the process solution.

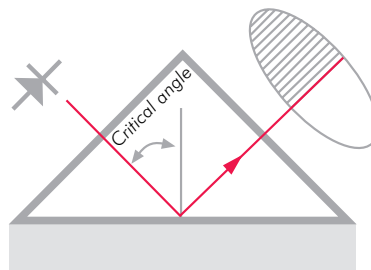
Thus an optical image with a dark sector and a light sector is created.



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

A digital CCD-camera detects the optical image and the shadow line.

The camera has a row of photocells in one chip to transform the optical image point-by-point to an electrical signal. The exact shadow line position is located and converted to a reading in concentration units.



The quality of the optical image is mathematically analysed and constantly monitored to ensure reliable measurement and high precision.

CALIBRATION

The K-Patents PR-03-D comes precalibrated to 0-100 % b.w. for the user's specific solution. The calibration is made using certified refractive index liquids and refractive index/concentration tables.

If desired, the measurement range and the measurement unit can be freely changed by keyboard entry. No mechanical adjustments or parts are needed. The change can be done, when the instrument is installed and operating.

EASY FINETUNING BY FIELD CALIBRATION

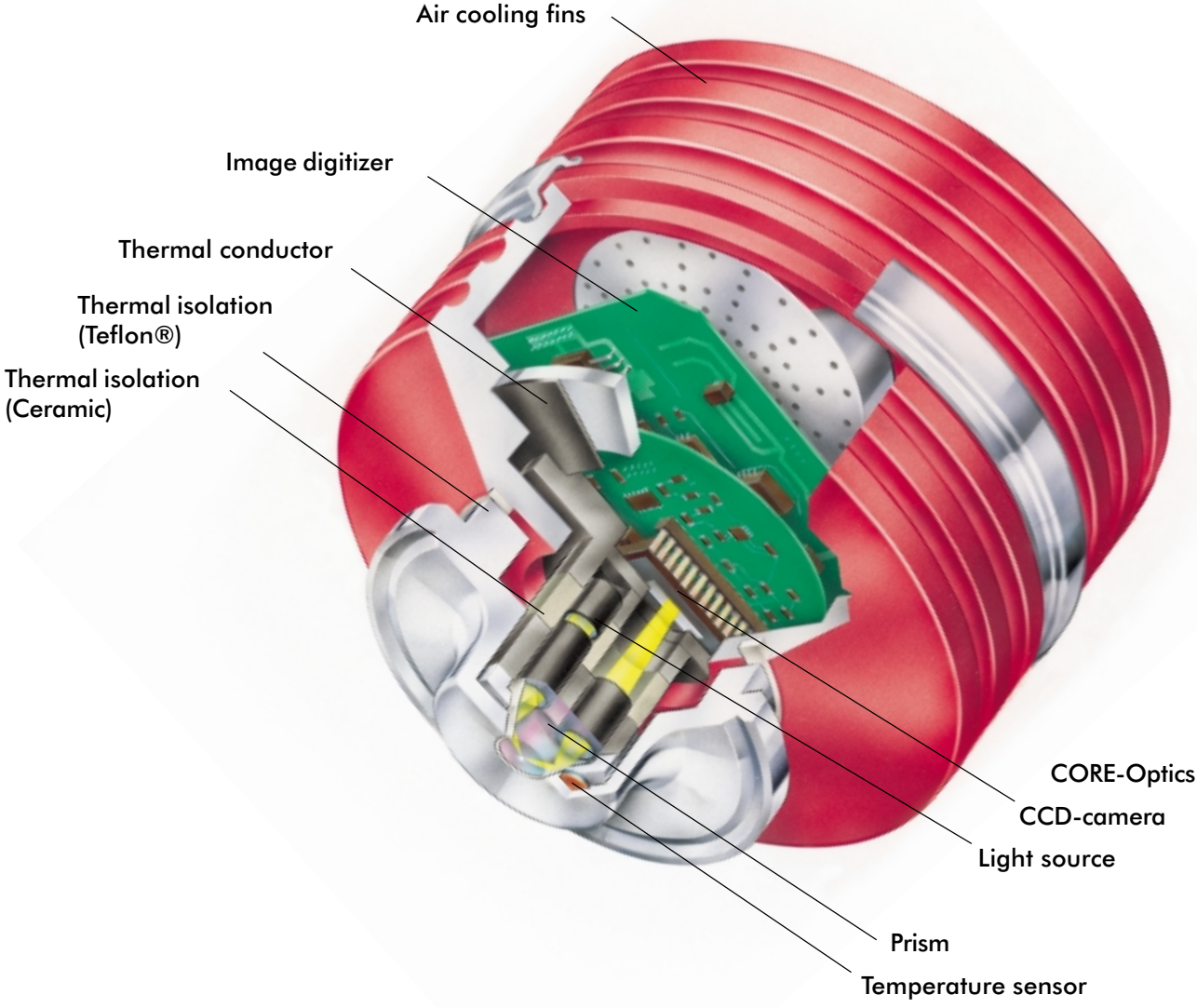
Because the K-Patents PR-03-D is fully digital instrument the final calibration can be finetuned in-line according to the user's standard laboratory determinations.

The user collects samples under different process conditions and takes simultaneous display readings. A computer program calculates new parameters and they are entered through the keyboard.

VERIFICATION USING CERTIFIED REFRACTIVE INDEX LIQUIDS

The K-Patents PR-03-D calibration and accuracy can be easily verified on-site with Refractive Index liquids. Thus the calibration is traced to national standards. This is needed for the ISO 9000 or other quality systems.

DESIGN

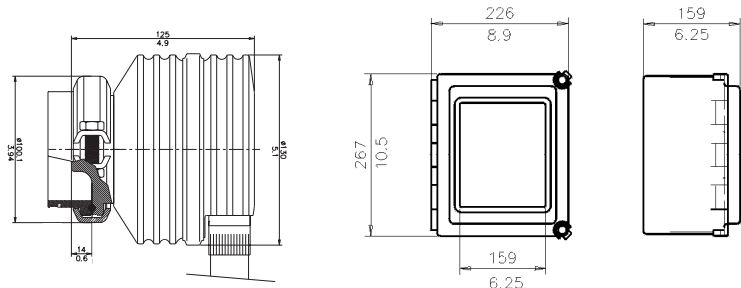


Patented CORE (Compact Optical Rigid Element) Optics:

All measuring components are in one solid module. The design provides error-free operation under vibrating conditions and varying temperatures and pressures.

(US Patent No. 6067151)

SPECIFICATIONS



Refractive Index range, standard	R.I. 1.3100...1.5400 (corresponds to hot water...100 Conc% b.w.) with spinel prism	
Accuracy:	R.I. ± 0.0002 (corresponds typically to $\pm 0.1\%$ by weight).	
	Repeatability and stability correspond to accuracy.	
Speed of response:	1.2 s undamped	
Damping time constant:	Selectable up to 5 min	
Process temperature:	-20°C...130°C (-4°F...266°F)	
Temperature compensation:	Automatic, by mathematical curve	
Ambient temperature:	Sensor: max. 45°C (113°F), min. -20°C (-4°F), Indicating transmitter: max. 50°C (122°F), min. 0°C (32°F)	
Process pressure:	max. 15 bar (200 psi) at 20°C (70°F)	
Recommended flow velocity:	Above 1.5 m/s (5 ft/s)	
Protected by the following US Patent:	Patent No. US6067151	
SENSOR:		
Wetted parts, standard:	AISI 316L stainless steel, prism gaskets teflon, prism spinel	
Wetted parts, option:	Hastelloy C/ASTM C276, Titanium/ASTM B348 GR2, Nickel 200, Tantalum, Zirconium/Zr702	
Sensor weight:	2 kg (4,4 lbs)	
Process connection:	Sandvik L clamp 76,1mm (2 1/2") or for smaller pipe sizes via -PFC Pipe Flowcell 25mm (1"), process connection ANSI 150 psi or DIN PN 25, material of construction AISI 316, Hastelloy C/ASTM C276 or Nickel 200	
Temperature measurement:	Built-in Pt-100	
Image detector:	1024 pixel CCD-element	
Light source:	Light emitting diode (LED)	
Sensor protection class:	IP67, Nema 4X	
Hazardous area classification:	Zone 2 IIC T4 (KEMA No. EX-00.Y.1153)	
Exproof:	Exproof by purging	
INDICATING TRANSMITTER:		
Transmitter protection class:	Enclosure IP66, Nema 4X	
Indicating Transmitter weight:	4,5 kg (10 lbs)	
Display:	256 x 128 pixels graphic liquid crystal (LCD)	
Keypad:	18 membrane keys	
Current output	4-20 mA/0-20 mA, max. load 1000 Ohm, galvanic isolation 1500 V DC or AC (peak) Built-in hold function during prism wash.	
Serial output:	RS485/RS232, galvanic isolation 500 V DC or AC (peak)	
Power:	100-115 V/220-240 V, 50/60 Hz, 15 VA	
Alarms:	Two built-in signal relays, max 24 V, 500 mA, DC/AC	
INTERCONNECTING CABLE:		
	Shielded cable, 2 twisted pairs with individual shields, 0.5 mm ² Digital transmission according to RS485	
Interconnecting cable length:	Standard 10 m (33 ft), max. 100 m (330 ft)	
OPTIONS:		
	Cable fittings to the indicating transmitter: European cable glands or US conduit hubs, External output unit 4-20 mA, Relay units for alarm, Stainless steel sensor cover	
ORDERING INFORMATION:	<ul style="list-style-type: none"> - Desired scale, properties of process solution - Process temperature and pressure range - Process flow range and pipe diameter 	<ul style="list-style-type: none"> - Length of interconnecting cable - Supply voltage and frequency - Options and accessories

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We reserve right to technical alterations.