KROHNE
measure the facts

Process instrumentation, Measurement solutions and Services

Overview

Contents

KROHNE – your global partner

KROHNE is your reliable partner for process instrumentation and automation. As our client, you benefit from our ability to solve your applications with matching measurement solutions; we offer a complete product portfolio, industry specific system solutions and complementary services for instrumentation projects of any size.

By having specialised in industrial process measurement since 1921, we have gained an enormous amount of application knowledge in various industries that is integrated into our products, solutions and services. We have truly mastered the physical principles our meters are based on: our ability to utilise physical effects and to find a matching measuring solution time after time are the reasons we are trusted by clients worldwide. The primary measured value is as accurate as possible to avoid consecutive faults that might affect your process control. It also enables our meters to measure reliably, even under changing or difficult process conditions. Both aspects are reflected by our claim **"Measure the facts"**.

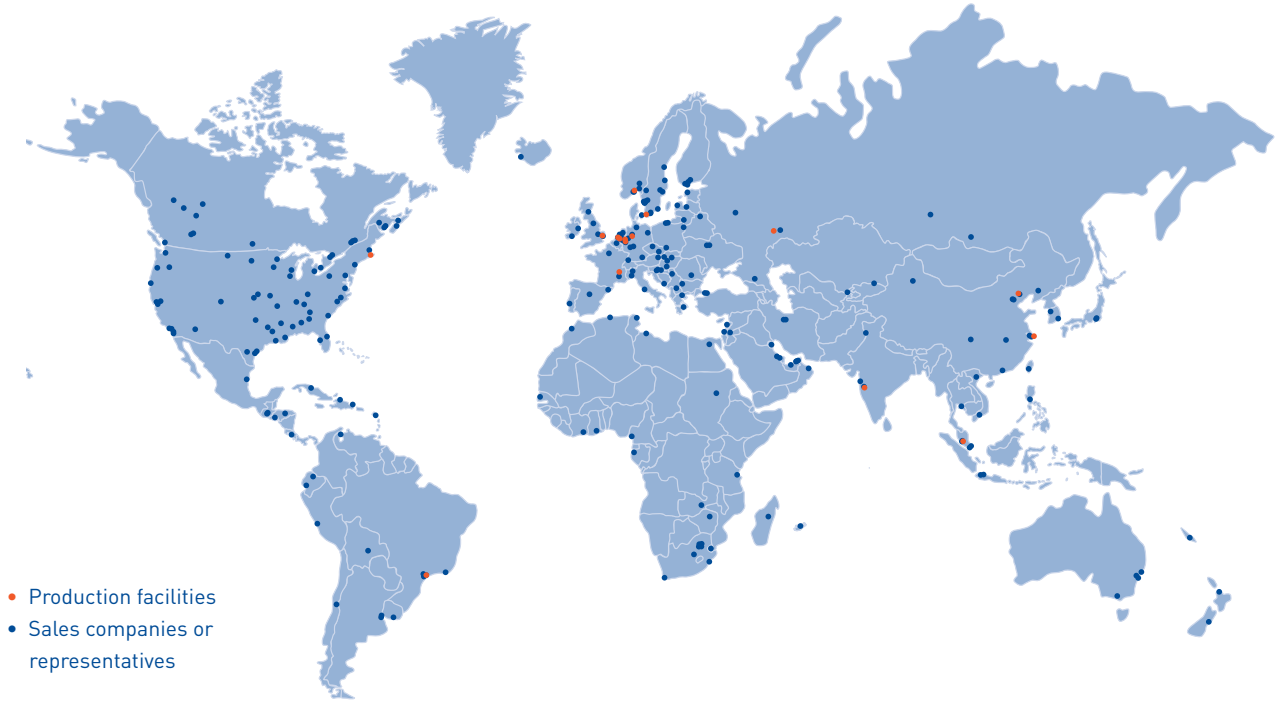
The innovative technologies we employ for your benefit are based on our extensive R&D activities: 10% of the >3700 KROHNE employees work in research and development. Next to sensor physics, their focus is on device communication and enabling technologies for the Internet of Things (IoT) in process industry, e.g. ethernet communication to transmit process and device diagnostic data for evaluation and process optimisation.

Our "Technology Icons" perfectly sum up the above mentioned advantages for you. You will find them highlighted within our complete portfolio in this brochure. If you don't find a matching solution for your measurement application, feel free to contact us, we look forward to solving it.

Global business, local partners

A network of local subsidiaries is the foundation of all global companies. From our experience we know that local subsidiaries prefer to work with local partners. For our clients, we have built a network of development and production sites, sales and service organisations on all continents. For every KROHNE subsidiary, we apply the same global quality standards for all offered Products, Solutions and Services.

Find your local contact at **www.krohne.com**



- Production facilities
- Sales companies or representatives

Industries

KROHNE has been a reliable partner for its clients from various industries for decades. Developing measuring solutions for industry-specific requirements and providing competitive advantages to our client as always been our main task. Next to Local Industry Managers, we employ Global Industry Divisions for various industries for a convenient contact.

The industries we serve include:

- Chemical
- Food & Beverage
- Water & Wastewater
- Oil & Gas
- Marine
- Power Generation
- Nuclear
- Metal & Mining
- Pulp & Paper
- Life Sciences

Manufacturing of converters in Duisburg, Germany

Development and production sites

Production of ultrasonic flowmeters in Dordrecht, the Netherlands

Headquartered in Duisburg, Germany, KROHNE has a large network of development and production sites who specialise in manufacturing different parts of our product range:

- Beverly, MA, USA (completion mid of 2018): electromagnetic, variable area and mass flowmeters, radar and guided radar level transmitters
- Breda, the Netherlands: oil & gas metering and proving systems, custody transfer products, leakage detection and localisation systems, flow computers, asset management systems
- Brevik, Norway: tank monitoring and alarm systems, fuel consumption and bunkering monitoring systems
- Bogota, Colombia (joint venture): metering systems
- Chengde, China (joint venture): variable area, vortex, DP, turbine flowmeters, flow controllers, level transmitters, temperature instruments
- Dordrecht, the Netherlands: electromagnetic, ultrasonic and multiphase flowmeters, oil & gas metering and proving systems
- Duisburg, Germany: variable area and vortex flowmeters, analysis sensors and systems
- Kuala Lumpur, Malaysia: oil & gas metering skids
- Malmö, Sweden: temperature assemblies, sensors and transmitters
- Minden, Germany: pressure and differential pressure devices
- Pune, India (joint venture): vortex, variable area and electromagnetic flowmeters, flow controllers and switches, mechanical level transmitters
- Romans-sur-Isère, France: radar and guided radar level transmitters, mechanical level transmitters, level switches, flow controllers and switches
- Samara, Russia: ultrasonic, vortex and electromagnetic flowmeters; radar, guided radar and mechanical level transmitters
- São Paolo, Brazil (joint venture): electromagnetic flowmeters
- Shanghai, China (joint venture): electromagnetic flowmeters
- Shanghai, China: electromagnetic and mass flowmeters, radar and guided radar level transmitters
- Wellingborough, United Kingdom: mass flowmeters

At KROHNE, we have a thorough quality and sustainable development policy applied and integrated into all levels of organisation. Available certifications and declarations include:

- Quality management: all KROHNE feeder factories are ISO 9001 certified
- Certified calibration standards (see chapter "Calibration")
- Welding certifications (ISO 3834)
- Certified environmental management system (ISO 14001)
- Industry-related certifications: ATEX, IECEx, FM, NEPSI, EHEDG, HART®, FOUNDATION™ fieldbus ITK, GOST, EAC, SIL, Achilles JQS, NSF, OHSAS etc.

For more information about quality management and certifications, please visit **www.krohne.com**

Flowmeters and flow controllers

Electromagnetic flowmeters · Mass flowmeters · Ultrasonic flowmeters ·
Variable area flowmeters · Differential pressure · Vortex flowmeters · Flow controllers

Move into the lead: Flowmeters and flow controllers

KROHNE offers a comprehensive range of world-class flowmeters:

- Every flowmeter is wet-calibrated
- We hold over 1,000 patents relating to flow products
- All flowmeters come with the relevant approvals

Our flowmeters are used in just about every type of plant and processes around the world. The expertise we have gained, spanning installation effects, different media and meter performance under real process conditions, adds value to every KROHNE meter you purchase.

We are more than capable of handling standard applications, as well as overcoming particularly tough challenges in enterprising ways.

Due to their repeatability and accuracy, our flowmeters are installed as reference meters on standard liquid flow calibration rigs of national metrology institutes such as PTB (Germany), EuroLoop (the Netherlands) and NMiJ (Japan).

Over 95 years' experience:

1921
Ludwig KROHNE starts manufacturing variable area flowmeters in Duisburg, Germany, to measure the flow of air, gases and liquids.

1952
The first electromagnetic flowmeter (EMF) for industrial measurement is launched.

1981
First EMF with measuring tube made of oxide ceramics and sintered platinum electrodes.

1994
First straight tube Coriolis meter.

1996
First ultrasonic meter for custody transfer of liquids in the world.

2006
First vortex flowmeter with integrated pressure and temperature compensation.

2008
ALTOSONIC V12, the first 12-chord ultrasonic gas flowmeter with compensating and diagnostic functions.

2010
WATERFLUX EMF with rectangular cross-section allows installation without straight inlets and outlets.

2014
First ultrasonic flowmeter for biogas applications with direct measurement of methane content.

2014
First Vortex flowmeter with integrated gross and net heat measurement for hot water (condensate) and steam.

2015
First multiphase flowmeter based on magnetic resonance technology

The modular product line

Converters

IFC 050
Basic applications
(Display/Blind)

IFC 100
Standard applications

IFC 300
Advanced applications

Flow sensors

OPTIFLUX 1000
Sandwich (wafer) device for compact installation

OPTIFLUX 2000
For water and wastewater applications

WATERFLUX 3000
For small and large flows without requiring inlets or outlets

OPTIFLUX 4000
For standard and advanced process and custody transfer applications

OPTIFLUX 5000
Ceramic measuring tube: maximum media and abrasion resistance and accuracy

OPTIFLUX 6000
For hygienic food and pharmaceutical applications

The specialists

WATERFLUX 3070 C
Battery-powered water meter for district metering and custody transfer

TIDALFLUX 2300 F
For partially filled pipes, Ex Zone 1

OPTIFLUX 7300 C flange
With non-wetted capacitive electrodes and ceramic liner

BATCHFLUX 5500
For volumetric filling systems in the beverage industry

POWERFLUX 4000
For nuclear applications

POWERFLUX 5000
For nuclear applications, with ceramic measuring tube

Accessories

OPTICHECK
Service tool for in-situ verification of field devices

Electromagnetic flowmeters

The measurement principle of electromagnetic flowmeters (EMF) is based on Faraday's law of induction. EMF can measure the volume flow of any electrically conductive liquid medium, even those with low conductivities.

Typical applications include:

- Water industry: revenue metering, district metering, water abstraction, leakage detection
- Wastewater industry: transport networks, sewage treatment plants, sludges
- Food & beverage industry: mixing, dosing and filling of drinks under hygienic conditions, filling systems applications
- Chemical industry: acids, alkalis, dosing applications, abrasive or corrosive media
- Pulp & paper industry: pulp, pastes, sludges and other caustic media, liquor, additives, bleaches, colourants
- Metal & mining industry: media with a high solid content, like ore or excavator mud

OPTIFLUX 4300 in the filtration system in city waterworks

Highlights:

- Minimal or no inlets/outlets
- All KROHNE EMF are wet-calibrated in a direct comparison of volumes
- Large choice of liner materials suitable for potable water, wastewater, chemicals, SIP/CIP
- Measurement independent of flow profile
- Custody transfer approvals
- Abrasion and corrosion resistant liners
- Ceramic measuring tubes and liners for flange and sandwich versions, also with non-wetted electrodes (capacitive flowmeter)
- Standard device for partially filled pipes
- 4-wire, 3 x 4...20 mA, HART®, Modbus, FF, PROFIBUS®-PA/DP, PROFINET etc.
- Virtual reference option: grounding electrodes and grounding rings can be left out
- Electrical conductivity of media can be used for detection of product change
- For high bubble content, high solids content and pulsating flow
- Secure handling of rapid media changes and pH jumps
- Zero-point stability regardless of changes in media properties
- Nominal sizes DN2.5...3000/ 1/10...120"
- 3x100% diagnostics (application and device diagnostic, out-of-spec test) exceeds NAMUR requirements

Highlights:

- Entrained Gas Management EGM: no loss of measurement with gas entrainments up to 100%
- Indication or configurable alarm to improve processes by identifying transient gas entrainments
- Not susceptible to installation effects: can be installed regardless of type of installation (no straight inlets/outlets) and external influences such as tube vibrations
- Only straight tube measuring devices for custody transfer applications in the highest OIML accuracy class of 0.3, approved to OIML R117/MID
- 4-wire, 3 x 4...20 mA, HART®, Modbus, FF, PROFIBUS®-PA/DP, PROFINET etc.
- Flow rates from 0.0003 to 4,600 t/h/ 0.01...169,000 lb/min
- Minimal pressure loss with straight tube measuring devices: reduced power consumption of pumps
- High density accuracy, not affected by medium and temperature changes
- Suitable for highly viscous media, inhomogeneous mixtures, media with solid content or gas inclusions
- Modular design for quick and easy replacement of electronics and/or flow sensors
- Self-draining and easy to clean
- OPTIMASS 7000 suitable for highly sensitive media as well as media requiring low flow velocity
- Variety of wetted materials (e.g. for corrosive media): titanium, stainless steel, HASTELLOY®, tantalum, duplex & super duplex
- Options for secondary containment up to 100 bar/1450 psi (OPTIMASS 2000 up to 150 bar/2176 psi)
- Turnkey solutions for the operation of batch plants

Mass flowmeters

The function of mass flowmeters is based on the Coriolis principle. They allow for a direct measurement of mass flow, density and temperature of liquids and gases as well as calculation of volume flow and mass or volume concentration with a single device.

Typical applications include:

- Chemical: measurement of concentration or density, bulk loading, batching to reactors, hydrocarbon cracking, aggressive, abrasive or viscous media or media of unknown composition
- Food & beverage: filling machine applications, measurement of degrees Brix, flow, density, specific gravity, additive components dosing
- Pharmaceutical: batching, dosing and filling, solvent extraction ultra-pure water measurement
- Water & wastewater: flocculent dosing, sludge flow and density measurement
- Pulp & paper: paper stock, pulp, additives, bleaches, colourants
- Oil & gas: metering skids, bypass density measurement, CNG/LPG dispensers, leak detection, custody transfer applications such as tanker loading, bunkering and pipeline transfer

OPTIMASS 2000 – Minimal installation footprint

The modular product line

Converters

MFC 400
General purpose

MFC 010
Modbus converter
for economical OEM
system integration

Flow sensors

OPTIMASS 1000
For universal applications
and process control

OPTIMASS 2000
Dual or four straight tube design for bulk
flows for custody transfer up to DN400/16"

OPTIMASS 3000
For low flow and
dosing applications

OPTIMASS 6000
The standard high-performance meter
for the process industry, up to DN300/12"

OPTIMASS 7000
For advanced applications, with single
straight measuring tube

The specialists

OPTIGAS 4010
Specially designed for CNG and
LPG in dispensing systems

OPTIBATCH 4011
Specially designed for linear
and rotating filling machines

Accessories

OPTICHECK
Service tool for in-situ verification
of field devices

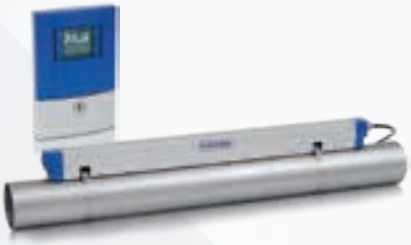
For liquids

OPTISONIC 3400
For process applications

OPTISONIC 3400 District Heating
For district heating applications

OPTISONIC 4400 HP
For high pressure liquids

OPTISONIC 4400 HT
For high temperature liquids



OPTISONIC 6300
Clamp-on flowmeter

OPTISONIC 6300 P
Portable clamp-on flowmeter

Custody transfer

ALTOSONIC III
For light liquid hydrocarbons

ALTOSONIC 5
For crudes, refined products, cryogenic media and chemicals

ALTOSONIC V
For liquid hydrocarbons, including Liquefied Natural Gas (LNG)

For gas and steam

OPTISONIC 7300
For natural gas, process gas and utility gas applications

OPTISONIC 7300 Biogas
For biogas, landfill and sewage gas applications

OPTISONIC 8300
For superheated steam and high temperature gases

Custody transfer

ALTOSONIC V12
For custody transfer measurement of natural gas

Process gas measurement
with OPTISONIC 7300

Ultrasonic flowmeters

Using the transit time method, ultrasonic flowmeters measure liquid and gaseous media.

Typical applications include:

- Power plants: cooling water and demineralised water, steam, thermal oil (HTF), molten salt
- Chemical industry: metering of liquid hydrocarbons and low-conductivity liquids, including feedstock, solvents, chemical addition in reactor control metering, demineralised water
- Petrochemical refineries: feedstock, cooker feed flow, cracking, desulphurisation, residues, blending of crude oil and refined product
- Petrochemical plants: feedstocks (e.g. naphtha and natural gas), (intermediate) products such as ethylene, propylene, solvents
- Oil & gas industry: measurement of crude oil and refined product, natural gas, liquefied natural gas (LNG) and biogas; standard and custody transfer applications in production, pipeline transfer and leak detection, loading and off-loading, storage and distribution
- Water/utilities: demineralised water, water purification, effluent, compressed air
- HVAC: metering of chilled water and hot water for (custody transfer) energy measurement

Highlights:

- Complete portfolio for liquid, gas and steam applications
- Accuracy and reproducibility regardless of medium properties such as viscosity, temperature, density and electrical conductivity
- Diagnostic and compensation functions for disturbed flow profiles and deposits, detection of gas entrainments in liquids, etc.
- No moving parts or components that protrude into the measuring tube
- Low operating and maintenance costs due to non-wearing parts
- Excellent long-term stability, no recalibration required
- High degree of reliability thanks to redundant measuring paths
- High-temperature versions available
- Large dynamic range
- Bi-directional flow measurement

Highlights:

- Local indication without the need for auxiliary power
- Use in hazardous areas
- Accurate measurement even at very low flow rates (<0.5 l/h)
- Extended turndown ratio up to 100:1
- Suitable for low operating pressures
- Can be used even with short or no straight inlets/outlets
- Modular display and measuring transducer concept: easy component replacement
- Hygienic stainless steel design without dead spaces and stagnation zones
- Flowmeters for nuclear power plants meet requirements of KTA 1401, RCC-E, RCC-M and ASME Section III and we are authorized to manufacture products with ASME N stamp and NPT stamp
- SIL2 certified
- Any meter orientation possible: vertical, horizontal or in fall pipes
- Optional limit switches, current output, totalizer, communication interfaces

Variable area flowmeters

Variable area flowmeters are suitable for measuring pure liquids and gases. They have an upright conical tube made of metal, glass or plastic, in which a float moves freely up and down. The flow through the tube causes the float to rise until the forces are in equilibrium.

Typical applications include:

- Measurement of additives such as catalysts, surfactants, foam and corrosion inhibitors, caustic soda, chlorine or sulphur substances, etc.
- Inerting of tanks or containers
- Measurement and dispensing of rinsing media (purge meters)
- Sample feed measurement for analyser systems
- Monitoring of lubricants and coolants for bearings and seals for process pumps and rotating machinery
- Hygienic applications in the food and pharmaceutical industries
- Measurement of gases and chemicals in laboratories and test facilities
- Gas/oil burner consumption measurement

Measuring the flow of CO_2 in the inlet lines of storage tanks at Eckes-Granini, Germany

Metal devices

H250 M40
For liquids and gases, modular design from mechanical to fieldbus

H250 M8
For liquids and gases, mechanical or with electronic bargraph indicator

DK32/34
For low liquid and gas flows, compact mechanical indicator, optional MIN/MAX switches and needle valve

DK37 M8
For advanced low liquid and gas flows, mechanical or with electronic indicator

Glass devices

DK46/47/48/800
For low flow gas or liquid applications and sample flow monitoring

VA40
For basic applications

VA45
For low pressure gas applications

K20
Plastic tube, for basic water applications

Pressure transmitters

OPTIBAR DP 7060
Differential pressure transmitter for flow applications, with integrated absolute pressure measurement

Primary flow elements

Orifice plates

OPTIBAR OP 1100/1110
Raised face (RF) or ring typ joined (RTJ) designs

OPTIBAR OP 3100/3200
With flat sealing face and corner taps

OPTIBAR OP 4100
With annular chamber and corner taps

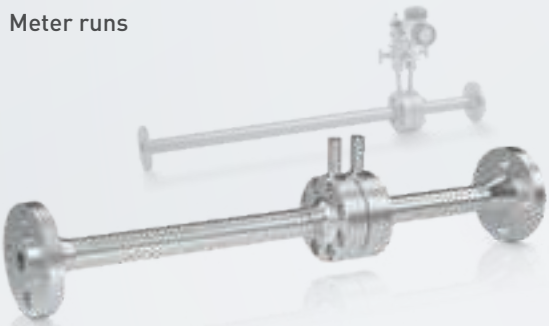
OPTIBAR OP 5100/5110
Assembly with measuring flanges (ASME 16.36)

Averaging pitot tubes

OPTIBAR PT 2000
With multiple impact-sensing ports

Other flow elements such as Venturis, nozzles, cone and wedge meters from SEIKO acc. to ISO or ASME standards available on request.

Meter runs



OPTIBAR MR 4300
Orifice meter run assembly with corner taps and annular chambers

OPTIBAR MR 6300
Cone meter run assembly with single taps

Accessories

Accessories for safe and easy installation of pressure transmitters in the process:

- Manometer and barstock valves, 3-/5-way valve manifolds, also for steam and high temperature applications
- Condensate pots for steam applications
- Fittings, seals, blind-plugs, oval flange adapter and gauge snubber

Differential pressure flow measurement

The principle of differential pressure (DP) is used to measure volume or mass flow of liquids, gases or steam.

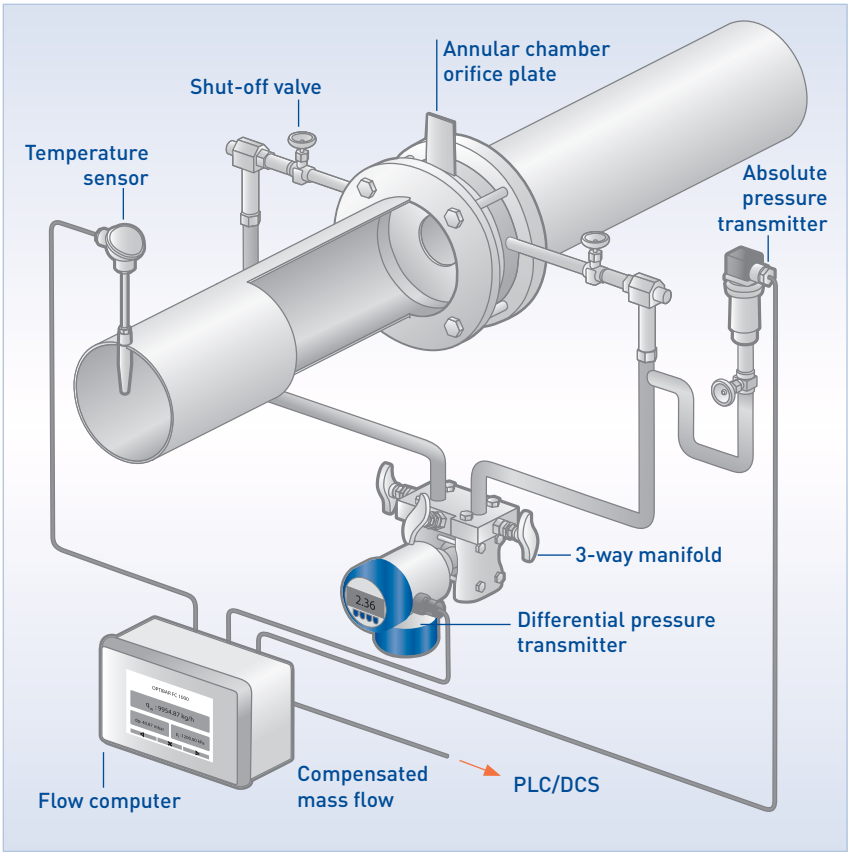
The pressure is measured at two points across a restriction in the line (e.g. a primary element). By using the Bernoulli equation, the difference in pressure between the two points is an indication for flow velocity and, as the pipe size is known, calculated to a volume flow rate.

The OPTIBAR modular product line ranges from DP pressure transmitters to complete DP flow measuring points from one source with matched, pre-configured components, (wet) calibrated and ready to install.

As an alternative to orifice plates, the pitot tube provides a simple, cost-efficient and long-term stable flow measurement solution for:

- Applications that require a low pressure loss
- Retrofit of existing pipes with a flow measurement
- Line sizes > DN300 / 12"
- Low pressure gases

Complete DP flow measuring point for compensated volume/mass flow



Highlights of DP flow measurement:

- Worldwide standardised flow measurement principle according to ISO 5167
- All measurement uncertainties under operational conditions are known and can be calculated
- Volume or mass flow measurement of liquids, gases or steam
- Primary elements manufactured by SEIKO Flowcontrol
- Medium temperatures -200...+1000°C / -328...1832°F
- Process pressure up to 400 bar / 5800 psi
- Line sizes from DN25...12000 / 1...470"
- Pressure and temperature compensation available as option
- Wet calibration up to DN3000 / 120", larger sizes on request
- Optimisation according to a given specification, e.g. short inlet/outlet, low pressure loss, small overall uncertainty, etc.
- Large choice of materials for corrosive and non-corrosive mediums

Vortex flowmeters

OPTISWIRL 4200
For utility applications and energy management systems

OPTISWIRL 4200 C 1R / 2R
With integrated nominal diameter reduction for space-saving and cost-saving installations

OPTISWIRL 4200 F
Remote version with field housing converter with connection cable up to 50 m/164 ft

Accessories

OPTICHECK
Service tool for in-situ verification of field devices

Mechanical flow controllers

DW 181
For clean liquids, G3/4...2, 3/4...2 NPT

DW 182
For clean liquids, DN15...65, 1/2...2 1/2" ASME

DW 183
For clean liquids, DN65...200, 3...8" ASME

DW 184
Insertion-type flow controller for pipe diameter ≥250 mm /10", process connection DN150, 6" ASME

Electromagnetic flow controllers

DWM 1000
With binary output

DWM 2000
With 4...20 mA output

Vortex flowmeters

Vortex flowmeters are based on the principle of the Kármán vortex street and are used in main as well as auxiliary and supply processes.

Capable of compensating for different temperature and pressure conditions, they measure the volume flow of both conducting and non-conducting liquids, industrial gases and steam.

Applications include measurement of:

- Saturated steam and superheated steam
- Gross and net heat for energy management systems
- Hot steam, also for CIP and SIP processes
- Liquefied gas, wet gas and flue gas
- Demineralised water and boiler feed water
- Solvents and heat transfer oil
- Steam boiler monitoring
- Compressor output
- Consumption in compressed air systems
- Free air delivery (FAD)
- Burner consumption

Highlights of vortex flowmeters:

- Integrated pressure and temperature compensation for fluctuating pressures and temperatures
- Temperature compensation for saturated steam included as standard
- Gross and net heat calculation to support advanced energy management
- Non-wearing, fully-welded stainless steel construction with high resistance to corrosion, pressure and temperature
- SIL2 certified
- Redundant Data Management: Easy exchange of electronics without loss of calibration and parametrisation data
- Use in hazardous areas

Mechanical flow controllers

Mechanical flow controllers work via a spring-mounted baffle that changes its position as flow increases. Adjustable switches generate alarms once switching points are reached.

Typical applications include:

- Local indication of flow without power supply – cooling systems, pump protection, lubrication control or cavitation alarm, for instance

Highlights of mechanical flow controllers:

- One limit switch (dry reed contact) as standard, second switch can be added
- For horizontal or vertical pipelines
- Available with screw-type, flange or mounting flange connectors
- Tropical version with Amphenol® sockets and a double coating of epoxy on device
- Additional amplifying relay for switching energies of up to 1200 VA

Electromagnetic flow controllers

Based on Faraday's law of induction, electromagnetic flow controllers monitor or measure the flow speed of electrically conductive liquids.

Typical applications include:

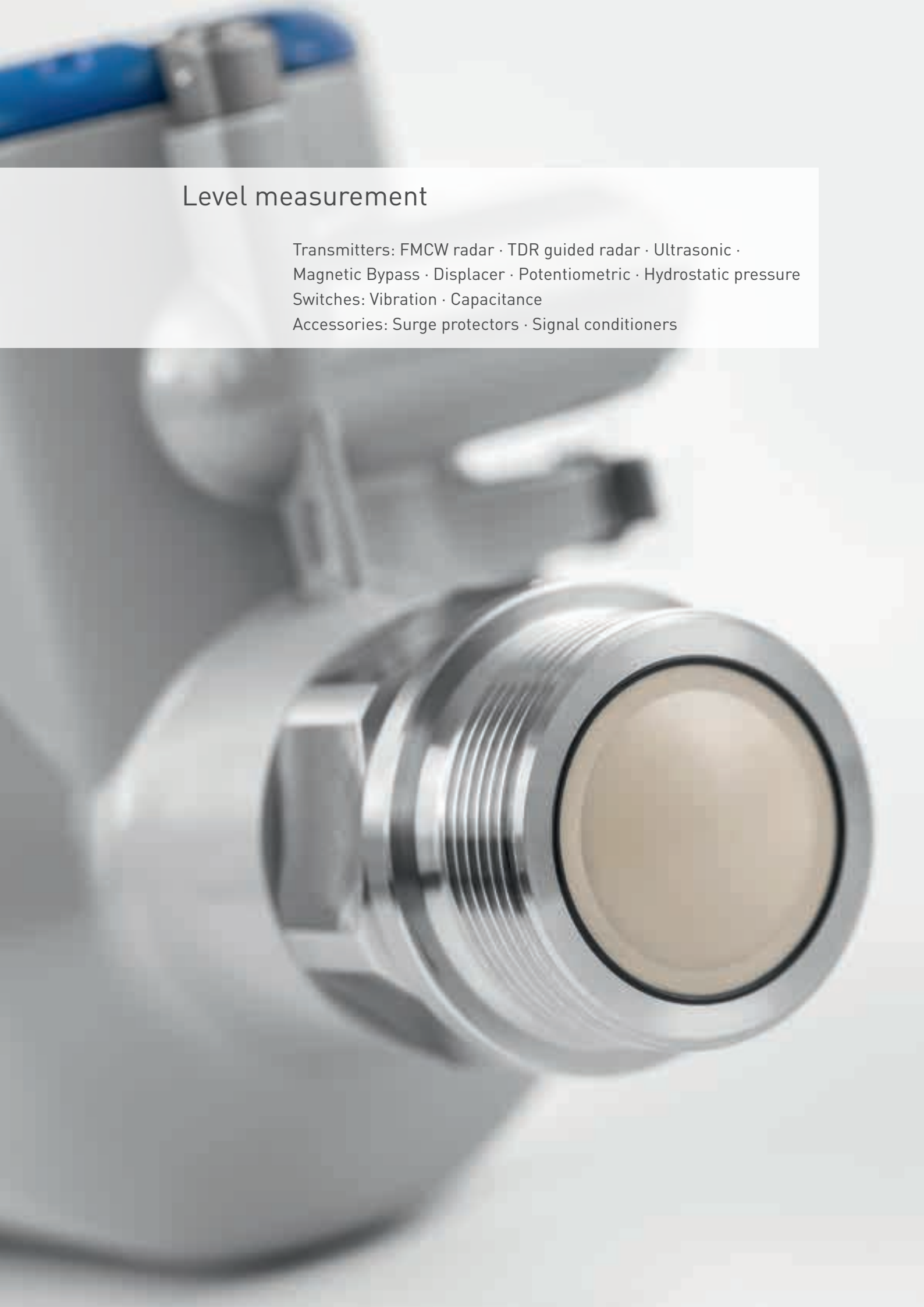
- Largely homogenous liquids, pastes. suspensions and sludges, even with solid content

Highlights of electromagn. flow controllers:

- Minimum conductivity 20 µS/cm
- Sturdy construction, no moving parts
- Parts in contact with medium made of stainless steel and ceramic
- For pipelines ≥DN25/1"

Level measurement

Transmitters: FMCW radar · TDR guided radar · Ultrasonic · Magnetic Bypass · Displacer · Potentiometric · Hydrostatic pressure
Switches: Vibration · Capacitance
Accessories: Surge protectors · Signal conditioners



For the highest level of quality: Level transmitters, switches, indicators and accessories

KROHNE offers a comprehensive range of level technologies for the accurate and reliable measurement, detection or indication of liquids and solids in any industry.

Our factory calibrated and field-proven level instruments ensure optimized performance and safety even in the most challenging applications like high temperature, high pressure, dusty atmosphere, liquid-liquid interface, agitated or corrosive liquids. The instruments are easy to use and comply with a broad spectrum of industry standards and approvals.

With over 60 years of experience in level measurement, KROHNE is also your partner for individually tailored solutions in terms of special materials or installations.

Over 60 years' experience:

1955
Production of mechanical level transmitters for measuring liquids in tanks and containers begins.

1989
KROHNE introduces the first FMCW radar transmitter for process tanks, pioneering the use of radar level measurement technology in process applications.

1995
KROHNE launches the first TDR guided radar transmitter.

2000
KROHNE develops the first 2-wire FMCW radar device.

2009
Introduction of the innovative Drop antenna for OPTIWAVE. Its ellipsoidal shape prevents product deposits in dusty or humid atmospheres.

2012
Modular housing concept with bayonet locking system for OPTIFLEX.

2013
Unique PP/PTFE Wave Horn antennas for OPTIWAVE in corrosive environments.

2017
New 24 and 80 GHz radars added to OPTIWAVE series, each designed for specific industry needs.

2018
New OPTIFLEX series of TDR guided radars designed for specific industry needs.

Frequency Modulated Continuous Wave (FMCW) radar

Highlights:

- Distance, level, volume and mass measurement
- Not affected by fixed or moving inserts/agitators
- Lens, Drop and Horn antennas to suit all process and installation conditions
- Drop antenna made of plain PP, PEEK or PTFE: its ellipsoidal shape and non-adhesive surface prevents product deposits in dusty or humid atmospheres
- Suitable for high and low process pressure/temperature applications
- Modular design from mechanics to converter
- Metaglas® dual process sealing system for dangerous products

FMCW radar continuously emits a linear, frequency-modulated microwave signal with a constant amplitude which is reflected from the product surface and received back. These transmitters allow for the continuous, contactless level measurement of liquids, pastes, granulates, powders and other solids in a wide variety of industries:

- Chemical & petrochemical: solvents, alcohols, chlorine, resins, fertilizers (urea), liquefied gas, hydrocarbons, plastics, asphalt (bitumen), acids, bases, butadiene, propylene, soap powder, molten sulphur, additives, foaming agent
- Energy: hydrocarbons, animal flour, dried sludge, coal, fly ash, biogas, cooling water, molten salt, lime milk, acids
- Agriculture, food & beverage: syrup, animal feed, juice, spirits, salt, sugar, sodium carbonate, flour, cereals, coffee, chocolate, milk powder, yeast, vegetable oil, molasses, starch
- Iron, steel & metal: molten steel, iron-disulphide, ore, coke
- Marine: cargo, ballasts
- Metals: molten steel, additives
- Minerals & mining : stone, gravel, sand, lime, cement, concrete, gypsum, calcium carbonate, clinker, coal, sludge, silica
- Oil & gas: hydrocarbons, condensates, liquefied gases
- Pharmaceutical: alcohol, high purity water, solvents, various raw materials
- Pulp & paper: binding agents, wood chips, saw dust, pulp moulding, titanium oxide
- Water & wastewater: potable, sea and river water, sewage, biological waste, dried sludge, flocculants, ferric chloride, lime, chlorine

Typical applications include:

- Reaction vessels
- Silos, bunkers and stockpiles for solids
- Stock monitoring for inventory
- Storage and production of toxic or corrosive liquids
- Storage of liquefied gases in high pressure/low temperature spheres
- Hygienic process applications
- Flow measurement in open channels with pre-shaped flumes and weirs
- Tank farms

For liquids

OPTIWAVE 1010 C
6 GHz FMCW radar
for liquids in bypass
chambers

OPTIWAVE 1400 C
24 GHz FMCW radar for
water and wastewater
applications

OPTIWAVE 3500 C
80 GHz FMCW radar
for liquids with hygienic
requirements

OPTIWAVE 5200 C/F
10 GHz FMCW radar for
liquids in storage and
process applications

OPTIWAVE 5400 C
24 GHz FMCW radar for liquids in
basic process applications

OPTIWAVE 7400 C
24 GHz FMCW radar for agitated
and corrosive liquids

OPTIWAVE 7500 C
80 GHz FMCW radar for
liquids in narrow tanks with
internal obstructions

OPTIWAVE 7400 C Marine
24 GHz FMCW radar for
marine applications

For solids

OPTIWAVE 6400 C
24 GHz FMCW radar for solids from
granulates to rocks

OPTIWAVE 6500 C
80 GHz FMCW radar for powders
and dusty atmospheres

Accessories

OPTICHECK
Service tool for in-situ verification
of field devices

OPTIFLEX 1100
For basic applications
with liquids

OPTIFLEX 3200
For liquids with hygienic
requirements

OPTIFLEX 6200
For solids from
granulates to powders

OPTIFLEX 7200
For liquids in storage and
process applications

OPTIFLEX 8200
For liquids at high
temperature and pressure

POWERFLEX 2200
For liquids in the
nuclear industry

TDR guided radar

TDR radar (Time Domain Reflectometry) emits electromagnetic pulses which are transmitted along a rigid or flexible conductor before being reflected from the product surface and received. It allows for continuous level measurement of liquids, pastes, granulates, powders and liquid interface in industries which include:

- Chemical & petrochemical: fertilizers (ammonia), solvents, carbon dioxide, hydrocarbons, liquefied gases, plastics, bitumen emulsion
- Power generation: hydrocarbons, coal powder, fly ash, boilers
- Food & beverage: animal feed, recycled cooking oil, coffee peel
- Iron, steel & metal: ore, cooling water, hydraulic oil
- Marine: cargo, ballasts
- Minerals & mining: mineral powders (cement, coal, alumina, talc, salt), sand, perlite
- Oil & gas: water/hydrocarbon interface, liquefied gases
- Pharmaceutical: solvents, alcohol and intermediate products
- Pulp & paper: binding agents, wood chips, saw dust
- Water & wastewater: potable, sea and river water

Typical applications include:

- Crude oil distillation in extraction vessels
- Storage of liquefied gases in high pressure/low temperature spheres
- Storage of raw materials and intermediates in bulk solid containers
- Separation of liquids
- Rag layer detection in impounding basins
- Condensation vessels for liquids and gases
- Storage of raw and finished products in tank farms of refineries
- Rock crushers, hoppers
- Water towers, basins and reservoirs
- Tide level, flood warning

Highlights:

- Distance, level, volume, mass and/or interface measurement
- Not affected by process conditions: dust, foam, vapour, agitated or boiling surfaces, changes in pressure, temperature and density
- SIL2/3-compliant according to IEC 61508 for safety-related systems
- 2 wire 4...20 mA (HART® 7) with second output current or switch
- Accuracy from ±2 mm; ±0.08"
- Measurement of interfaces starting at 50 mm/ 2" Large choice of probes to cover all applications
- Dual ceramic seal system for dangerous products
- Various converter and electronics versions to facilitate access to the device
- Reversed interface measurement
- FF/PA/HART® communication
- Specific algorithm for low reflective media
- CIP/SIP suitable hygienic design for level and interface measurement in small vessels

Ultrasonic

Highlights:

- Integrated temperature sensor for velocity compensation
- Unaffected by product properties
- Set-up without medium
- Gas and dust approvals for hazardous areas
- Highly resistant materials for acoustic signal transducers and process connections
- SIL2, FOUNDATION™ fieldbus, PROFIBUS® PA as options

This particular transmitter type emits ultrasonic pulses which are reflected from the product surface and received. It is suitable for continuous, non-contact level measurement of liquids and solids in the following industries:

- Chemical: acids, bases, plastics
- Water & wastewater: potable, sea and river water, sewage

Typical applications include:

- Non-contact flow measurement in open channels
- Level of solids in silos and storage tanks
- Slightly corrosive acids and lies
- Hazardous areas
- Sumps, water and wastewater basins

OPTISOUND 3010 C
2-/4-wire ultrasonic
level transmitter for
small vessels

OPTISOUND 3030 C
2-/4-wire ultrasonic
level transmitter for
medium-sized vessels

OPTISOUND 3020 C
2-/4-wire ultrasonic
level transmitter
for small and medium-
sized vessels

Magnetic bypass

BM26A-1000
MLI for basic liquid applications, optional with 6GHz radar

BM26A-3000
MLI for corrosive liquids

BM26A-5000
Bypass chamber for combination e.g. with radar or TDR transmitters

BM26A-6000
MLI for liquefied gas

BM26A-7000
MLI for liquids in storage and process applications

BM26A-8000
MLI for liquids at high temperature and pressure

Displacer

BW 25
Broadband displacer level transmitter for high pressures and temperatures

Potentiometric

BM 500
4-wire potentiometric level transmitter for hygienic applications

Magnetic bypass

Magnetic bypass level indicators (MLI) are based on the principle of communicating vessels and allow for a continuous level or interface measurement of liquids.

Typical applications include:

- Chemical industry: flammable, toxic and corrosive media, liquefied gases
- Oil & gas, petrochemical industries: hydrocarbons in refining applications, cold and cryogenic media
- Power generation: boilers

Highlights of MLI:

- Robust stainless steel design also for use in extreme process conditions
- Local level indication without power supply
- Hermetically sealed (IP68), easy to read local indication
- Variety of process connections, special materials, valves, insulation
- Analogue transmitters (FF/PA/HART®) with optional display
- Adjustable, clamp-on limit switches
- Local float failure indication
- Ex and PED-compliant

Displacer

Based on the Archimedes or displacer principle, these transmitters measure level and separating layers of liquids.

Typical applications include:

- Chemical & petrochemical industries: hydrocarbons, solvents, bases
- Energy, power generation: steam generator, water

Highlights of displacer transmitters:

- Suitable for use in extreme process conditions, e.g. high pressure/temperature liquids
- Reference vessel available for bypass installation
- Modular design, retrofitting under process conditions is possible
- Converter/indicator scale are mechanically sealed from the process

Potentiometric

Potentiometric transmitters measure the potential difference in voltage between a working and a reference electrode and enable level measurement independent of medium properties.

Applications in the food & beverage, pharmaceutical industries:

- Small tanks and hygienic applications
- Tough, pasty or strongly adhesive media

Highlights of potentiometric transmitters:

- Not sensitive to adhesives and foam
- Defined empty reporting function
- Quick response time
- Automatic position detection
- Resistant to high temperatures (CIP/SIP)
- Compact or remote version

Pressure transmitters

OPTIBAR P 2010
For hygienic applications, with flush metallic diaphragm

OPTIBAR PC 5060
For advanced applications, with corrosion and abrasion resistant ceramic diaphragm

OPTIBAR PM 5060
With fully welded metallic diaphragm for high pressure ranges and hygienic requirements

OPTIBAR DP 7060
Differential pressure transmitter for hydrostatic level measurement with integrated absolute pressure measurement

Diaphragm seals

OPTIBAR DSD 3100
Direct attachment to OPTIBAR DP 7060

OPTIBAR DSD 3110
Capillary tube attachment to OPTIBAR DP 7060

OPTIBAR DSD 3210
Direct and capillary tube attachment to OPTIBAR DP 7060

OPTIBAR DSD 3220
2x capillary tube attachment to OPTIBAR DP 7060

Submersible probes

OPTIBAR LC 1010
Submersible level probe with ceramic diaphragm 22 mm / 1" diameter

Accessories

Accessories for safe and easy installation of pressure transmitters in the process:

- Manometer and barstock valves, 3-/5-way valve manifolds, also for steam and high temperature applications
- Flange adapter according to DIN EN and ASME
- Condensate pots for steam applications
- Straight and curved connecting pipes, syphons in U- and circular shapes
- Fittings, seals, blind-plugs, oval flange adapter and gauge snubber

Hydrostatic pressure

Hydrostatic pressure is used to measure level or density of a liquid in a vessel. The OPTIBAR modular product line offers a complete portfolio for hydrostatic level measurement of corrosive and non-corrosive liquids and slurries.

For open vessels under atmospheric conditions, process pressure transmitters are used:

- OPTIBAR PM 5060 and OPTIBAR P 2010 with fully welded metallic diaphragm for aseptic / hygienic applications
- OPTIBAR PC 5060 with ceramic measuring cell also for abrasive or corrosive liquids, and small measuring ranges (H_2O: 0,25 m / 10")

For closed/pressurised vessels, differential pressure (DP) transmitters are used:

- OPTIBAR DP 7060 for precise level measurement for pressurised containers up to 420 bar / 6091 psi, with integrated head pressure measurement

If the level of a liquid is known, the DP transmitter can also be used to measure the density of the liquid, or the position of interface between two liquids of different density.

The pressure transmitters can be combined with diaphragm seals for high process temperatures up to +400°C / +752°F, corrosive media, and can also be equipped with different hygienic and pharmaceutical process connections.

To be used as a simple level measurement solution for wells or tanks, submersible probes are available, perfectly suited for water and wastewater applications.

Typical applications include:

- Level measurement of liquids in open and pressurised vessels
- Level measurement in vessels with agitators
- Hygienic level measurement applications
- Steam boiler monitoring
- Level or interface measurement in distillation columns
- Level measurement in water wells, rainwater retaining / overflow basins

Highlights of hydrostatic pressure products:

- Level, density or interface measurement of liquids in vessels
- Medium temperatures up to +400°C / +752°F
- Process pressure up to 420 bar / 6091 psi
- Not affected by fixed or moving inserts/agitators
- Not affected by process conditions: dust, foam, vapour, agitated or boiling surfaces, or pressure changes
- Large portfolio of process connections suitable for any industry application
- Different hygienic process connections for a hygienic, dead zone-free installation
- Differential pressure transmitter with integrated absolute pressure measurement to measure head pressure
- Measuring range starting at 10 mbar / 0.14 psi
- Interface measurement, also with emulsion layers
- Multiple functions for vessel linearisation integrated in converter
- NACE compliant materials
- Use in hazardous areas
- Smallest measuring span 10 mbar / 0.145 psi gauge
- 4...20 mA HART® 7 / HART® SIL2/3, FOUNDATION™ fieldbus, PROFIBUS® PA as communication options

Vibration

Highlights of vibration switches:

- Unaffected by process conditions
- Rugged oscillating fork, high abrasion resistance
- Reproducible switching point without adjustment
- Continuous self-monitoring of correct oscillating frequency, corrosion and cable breakage to the piezo drive
- Hygienic design with polished surface
- Recurring test acc. to WHG via test button (with SU 501)
- Functional safety: up to SIL2 in a single channel architecture and up to SIL3 in a multiple channel, redundant architecture

Vibration switches indicate the presence of liquid or solids when the medium comes in contact with their vibrating forks and dampens their oscillation.

Typical applications include:

- Applications with heavy dust build-up and mechanical stresses
- Light bulk goods
- Pump dry-run protection
- Limit and overfill detection
- Liquid detection in pipes
- Detecting solids in water

Capacitance

Highlights of capacitance switches:

- Measurement independent of media properties
- Not sensitive to adhesives and foam, condensate or build-up of deposits
- Hygienic installation by means of a hygienic process weld sleeve, nearly flush with the front
- Dry-run protection beyond a nominal width of DN15
- Not affected by vibration

A capacitance switch uses the phase shift that electromagnetic waves experience when emitted to a medium. It is suitable for level detection for liquids and pastes or as a dry-run protection. It can also detect liquid/liquid interfaces or identify the presence of a specific medium.

Applications in the food & beverage, pharmaceutical industries:

- Small tanks and hygienic applications
- Tough, pasty or strongly adhesive media

Accessories

Highlights of surge protectors:

- Direct screw connection
- Ingress protection IP67
- Zinc or stainless steel housing

Surge protectors

Surge protective devices for standard communication signals are directly attached to any measuring device via their connecting threads, eliminating the need for an additional connection box. They are also suited for rough industrial environments and hazardous areas.

Highlights of signal conditioners:

- Signal conditioning and power supply for connection with 4...20 mA devices
- Additional features, e.g. integrated relays for control of actuators
- Carrier rail, panel and surface mounting

Signal conditioners

Signal conditioners can power connected sensors and process their measurement signals. The measured variable is shown on the display and also outputted to the integrated current output for further processing. The measurement signal can thus be transferred to a remote indicator or a control system. They are also suited for rough industrial environments and hazardous areas..

Vibration

OPTISWITCH 3X00 C
Vibration level switches for solids

OPTISWITCH 4000 C
Vibration level switch for liquids for simple applications

OPTISWITCH 5X00 C
Vibration level switches for liquids for process and high temperature / high pressure applications

Capacitance

OPTISWITCH 6500
Capacitance level switch for advanced hygienic applications

OPTISWITCH 6600
Capacitance level switch for standard hygienic applications

Accessories

SURGEPROTECT SP-F / 1X2-24DC
Surge protection for measurement and control technology in current loops and non-hazardous areas

SURGEPROTECT SP-F / EX-24DC
Surge protection for measurement and control technology in acc. with protection types Ex d, Ex tD, Ex ia IIC

SU 501
For vibration level switches, also in hazardous areas and safety-related systems

SU 600
For 4...20 mA level transmitters, with integrated relays for control of pumps or other actuators

Pressure measurement

Process pressure · Differential pressure · Hydrostatic pressure

Always the right pressure.
Anytime. Any Process.

Pressure is one of the most commonly measured parameters in the process industry. Today, in over 40 % of all flow applications, differential pressure is still the first choice for metering liquids, gas or steam.

Almost 25 % of all liquid level measurement applications are hydrostatic pressure measurements – in case of pressurised vessels almost exclusively differential pressure level measurements.

With the release of the OPTIBAR series, KROHNE is extending its range of process instrumentation to include pressure measurement.

The OPTIBAR series includes a variety of pressure transmitters with ceramic or metal measuring cells, application specific diaphragm seals, primary elements and accessories to match a wide range of industrial process applications.

Milestones

2012
Introduction of OPTIBAR P 3050 C compact pressure transmitter

2014
Release of OPTIBAR DP 7060 differential pressure transmitter

2015
Complete OPTIBAR series of pressure transmitters, diaphragm seals, primary elements and accessories is released

2016
Multi-dimensional 3D linearisation for every OPTIBAR DP transmitter established as standard

Pressure transmitters

OPTIBAR P 1010
For basic applications, with recessed metallic diaphragm up to 600 bar / 8700 psi

OPTIBAR P 2010
For hygienic applications, with flush metallic diaphragm

OPTIBAR PM 3050
For standard applications, with recessed stainless steel diaphragm and optional display module

OPTIBAR PC 5060
For advanced applications, with corrosion and abrasion resistant ceramic diaphragm

OPTIBAR PM 5060
With fully welded metallic diaphragm for high pressure ranges and hygienic requirements

OPTIBAR DP 7060
Differential pressure transmitter for precise relative gauge pressure measurement with high overload resistance

Diaphragm seals

OPTIBAR DSD 3100
Direct attachment to OPTIBAR DP 7060

OPTIBAR DSD 3110
Capillary tube attachment to OPTIBAR DP 7060

OPTIBAR DSD 3210
Direct and capillary tube attachment to OPTIBAR DP 7060

OPTIBAR DSD 3220
2x capillary tube attachment to OPTIBAR DP 7060

Accessories

Accessories for safe and easy installation of pressure transmitters in the process

- Manometer and barstock valves, 3-/5-way valve manifolds, also for steam and high temperature applications
- Flange adapter according to DIN EN and ASME
- Condensate pots for steam applications
- Straight and curved connecting pipes, syphons in U- and circular shapes

Process pressure

Process pressure transmitters are used to measure pressure in pipes or vessels.

OPTIBAR PC, PM and DP transmitters feature a modular concept that meets various requirements of modern process applications:

- Intrinsically safe and explosion proof
- Optional display and adjustment module
- 4...20 mA HART® 7 / HART® SIL2/3, FOUNDATION™ fieldbus, PROFIBUS® PA
- Plastic, 316L, 316L hygienic, Aluminum

Measuring cells:

- Ceramic (OPTIBAR PC 5060)
- Metallic (OPTIBAR PM 5060)
- DP (OPTIBAR DP 7060)

Capacitive ceramic measuring cells (99.9% Al2O3) with high long-term stability, vacuum and overload resistance are used for all common process applications. The robust ceramic diaphragm with integrated diaphragm breakage detection, covers about 80 % of all pressure applications up to +100 bar / +1450 psi gauge.

Metallic measuring cells (strain gauge or piezoresistive) with fully welded process connection are used for high pressures up to +1000 bar / +14504 psi gauge, aseptic processes, and in combination with OPTIBAR DS diaphragm seals for high temperature or corrosive applications.

Typical applications include:

- Pump dry-run protection and compressor monitoring
- Flue gas ventilation control
- Monitoring processes from low pressure to absolute vacuum
- Overload resistant level and overpressure measurement in batch tanks
- Monitoring of supply pressure in pipelines

Differential pressure

For differential pressure (DP) flow measurement please refer to chapter “Flowmeters and flow controllers”, page 16.

Hydrostatic pressure

For level, density and interface measurement with hydrostatic pressure, please refer to chapter “Level transmitters and level switches”, page 30.

Highlights of process pressure products:

- Process pressures -1...+1000 bar / -14...+14504 psi gauge and 0...+600 bar / 0...+8702 psi gauge absolute
- Process temperatures up to +150°C / +302°F without diaphragm seal
- Ceramic or metallic measuring cells
- Quick step response times even with small measuring ranges
- Over 250 thread, flange and aseptic process connections available
- Duplex, HASTELLOY® C-276, PVDF as well as NACE compliant materials
- Use in hazardous areas

Temperature measurement

Temperature assemblies · Transmitters

A new degree of contact: Temperature measurement

KROHNE temperature assemblies and transmitters are as versatile as your requirements and specific applications need them to be.

Our OPTITEMP line covers a wide range of electrical temperature instruments for industrial temperature measurement. Alongside standard applications, they are also ideal for high temperatures, extreme pressures or high flow velocities.

KROHNE INOR, a fully-owned subsidiary of KROHNE, has been designing and producing temperature measurement equipment for over 75 years. Located in Malmö, Sweden, KROHNE INOR is today one of the world's leading manufacturers of temperature signal transmitters, specialised in industrial temperature measurement.

Building on this specialist knowledge and experience, KROHNE INOR is successfully expanding global production.

Over 75 years' experience:

1939
INOR is started as a family-owned company working with process instrumentation.

1965
Development of the first temperature transmitter.

1974
INOR presents world's first head-mounted transmitter.

2006
KROHNE acquires INOR.

2010
First temperature transmitter with dual sensor input in 4-wire connection.

2011
Temperature transmitter with SmartSense insulation resistance monitoring to detect cracks in the thermowell is developed.

2018
NFC and Bluetooth®communication for temperature transmitters.

Temperature assemblies

KROHNE has a wide portfolio of standard pre-fitted temperature assemblies for solid, liquid, gaseous and steaming media. We can also provide you with systems that are custom-made for your specific requirements.

Typical applications include:

- Chemical industry: measurement of liquids, gases and solids, acids and alkalis, abrasive or corrosive media in pipes, vessels and reactors
- Iron & steel industry: measurement in production and during the thermal treatment of steels, gas and ovens, as well as cooling media temperatures
- Power generation: steam and flue gas, as well as measurements of cooling media and bearing temperatures
- Hygienic applications: production and cleaning processes according to the stringent requirements of GMP, FDA, EHEDG and others

Depending on process conditions – temperature, pressure, flow velocity and media properties – we will recommend an appropriate temperature assembly and materials to be used. We will then support you when it comes to choosing the right combination of thermowell and sensors/measuring inserts for your application – resistance (RTD) or thermocouple (TC).

Used in combination with the correct insert, head and neck pipe, our range of thermowells will ensure maximum process certainty.

Highlights of temperature assemblies:

- Various process connections: insert, screw-in/threaded, flanged, weld-in, compression fittings, coatings and covers, gas-tight threaded sleeves, sliding flange
- Standardised and customer-specific temperature assemblies
- Replaceable spring-loaded measuring inserts made from mineral isolated cable, durable, with low drift and high resistivity against any mechanical load
- Connection heads for a wide variety of requirements
- Extensive range of accessories

Highlights of thermowells:

- Reduced and tapered tips for faster response
- Wide range of materials
- Additional PTFE or tantalum coating for use in conditions like exposure to a high level of chemicals
- Corrosion and abrasion-resistant versions
- Individual stress calculations
- Various test and examination certificates available, including pressure test, PMI test, X-ray test, ultrasonic test, dye penetration test

Temperature assemblies (with RTD or TC measuring insert)

Flange

OPTITEMP TRA-F/TF and TCA-F/TF
For standard applications up to higher flow velocities and pressures

Plug-in

OPTITEMP TRA-P and TCA-P
For standard up to high temperature applications

Hygienic fitting

OPTITEMP TRA-H
For hygienic applications

Screw-in

OPTITEMP TRA-S and TCA-S
For standard applications, lower temperatures, use in existing thermowells or machinery, or with higher flow velocities and pressures

Weld-in

OPTITEMP TRA-T/TW and TCA-T/TW
For higher flow velocities and pressures

Clamp-on

OPTITEMP TRA-G
For surface temperature measurement in industrial applications

Temperature sensors and measuring inserts

RTD compact sensors

OPTITEMP TRA-C/V
For industrial process, OEM, HVAC or hygienic applications with limited space

RTD cable sensors

OPTITEMP TRA-G/W
For surface and underground measurement or bearing and plastic moulding machinery applications

TC cable sensors

OPTITEMP TCA-M
For machinery and high temperature applications

Measuring inserts

OPTITEMP TR or TC
RTD (Pt100) or thermocouple (K or J) for temperature assemblies

Highlights:

- Analogue temperature transmitters for basic applications
- Digital, universally programmable state-of-the-art transmitters for demanding applications
- Fits any B-connection head and on DIN rail
- Excellent measurement accuracy with high precision, long-term stability and low temperature drift
- HART® 6 compatible transmitters
- PROFIBUS® interface available
- Diagnostic functions for high process safety: monitoring of isolation resistance (SmartSense), sensor drift, sensor breakage and short circuit
- Dual sensor input TC and RTD, 2-, 3- and 4-wire (4-wire on OPTITEMP TT 51 R only) with automatic back-up in case of sensor failure (redundancy)
- High galvanic isolation
- NAMUR compliance: NE 21/NE 43/ NE 53/NE 89/NE 107
- 10-g vibration resistance
- 50-point individual sensor linearisation
- Communication options: PC, FC375/475, AMS, PDM, EDD, DTM
- Ex-approval acc. to ATEX Ex i and Ex n (non-incendive) approvals
- SIL2 (acc. to IEC 61508)
- Configuration via PC without external power supply

Temperature transmitters

In 1974, INOR launched the world's first temperature transmitter which could be built into the connection head of a temperature assembly to convert the sensitive thermometer signal into a stable, noise-immune signal directly at the measuring point.

KROHNE INOR has an extensive programme, based on years of experience developing transmitters, covering low to high-performance accuracy, fail-safe measuring that fits into all kinds of applications in the process industries.

Typical industries include:

- Machine-building industry
- HVAC applications
- Energy & power generation
- Petrochemical
- Oil & gas

Head- and rail-mounted temperature transmitters

OPTITEMP TT 10
With RTD or TC inputs

OPTITEMP TT 11
With RTD input

OPTITEMP TT 22
With RTD input, PC programmable

OPTITEMP TT 30
With universal inputs and galvanic isolation, PC programmable

OPTITEMP TT 31
With universal inputs, dual channel and high galvanic isolation

OPTITEMP TT 32
With universal inputs and high galvanic isolation

OPTITEMP TT 33
With universal inputs and galvanic isolation

OPTITEMP TT 40
With universal inputs and galvanic isolation, accuracy ±0.05%

OPTITEMP TT 51
With universal dual input, galvanic isolation, HART® and SIL

OPTITEMP TT 53
With universal input, galvanic isolation, HART® 7, NFC and Bluetooth® communication

Accessories

OPTITEMP TT-CON
Transmitter configuration kit for PC configuration of OPTITEMP transmitters

Process analytics

Sensors · Systems · Assemblies · Transmitters and operating units · Accessories

From analysis to the solution: Process analytics

KROHNE is your partner for all aspects of analytical instrumentation, from pH measurement in hazardous areas to sludge level and sedimentation measurement on wastewater treatment plants.

We offer a comprehensive portfolio of liquid analytical sensors with and without integrated transmitter, complete measuring systems as well as installation equipment, transmitters and accessories to match the requirements of various industries.

Our main goals are attaining sturdiness, reliability and quality in the various application areas. We will gladly assist you in the search for the optimum solution to your measurement task. Should it be necessary to specifically design a measuring system according to your requirements, we are able to modify our systems in line with your needs and include additional components.

Milestones:

2005
First presentation of analysis instruments for the water industry.

2008
Launch of complete portfolio with digital analysis sensors for wastewater treatment plants featuring integrated sensor spray cleaning with air or water.

2008
Launch of turbidity measuring system with unique cuvette calibration and ultrasonic cleaning for easy calibration and low maintenance costs.

2010
KROHNE is the first manufacturer to offer a standardised operating and service concept for both flow-meters and analysis instruments.

2012
OPTISENS range of sensors is expanded with sensors specially suited for food & beverage processes.

2013
KROHNE introduces SMARTPAT: the first digital sensor portfolio with integrated transmitter technology and direct connection to control system via 4...20 mA/ HART®.

pH measurement in a dairy with insertion assembly

Sensors

Based on different physical, electrochemical and optical effects, liquid analysis sensors measure values such as pH, ORP, conductivity, TSS, turbidity, oxygen, and various others.

KROHNE offers an extensive portfolio of analytic sensors: each sensor is specifically designed for its area of application; the respective approvals, certificates and process connections range from hazardous (zone 0) to hygienic areas.

Potentiometric pH sensors

SMARTPAT PH 8320*
For water and wastewater applications

SMARTPAT PH 8530
For pure water and low conductivity media (>2 µS/cm)

SMARTPAT PH 8570*
For food, beverage and pharmaceutical applications

SMARTPAT PH 8150*
For chemicals and industrial wastewater applications

*also available with Ex approval

SMARTPAT PH 1590
For potable, process or treated water applications

SMARTPAT PH 2390
For municipal and industrial wastewater applications

OPTISENS PH 8300
For wastewater, surface and process water applications

OPTISENS PH 8500
For potable water applications

OPTISENS PH 9100
For lower conductivity water applications (>20 µS/cm)

OPTISENS PH 8100
For pure water and low conductivity media (>2 µS/cm)

OPTISENS PH 8390
For wastewater applications

OPTISENS PH 8590
For municipal and industrial wastewater applications

OPTISENS PH 9500
For lower conductivity water applications (>20 µS/cm)

Inductive conductivity sensors

OPTISENS IND 7000
For food and beverage applications

OPTISENS IND 1000
For water, wastewater and chemical applications

Total suspended solids (TSS) sensors

OPTISENS TSS 3000
For wastewater applications

OPTISENS TSS 7000
For food & beverage applications

Next to the OPTISENS series for "traditional"use with an external transmitter, KROHNE offers the SMARTPAT series with integrated transmitter. Introduced in 2013, SMARTPAT is the first sensor series with built-in fieldbus communication and current output: any SMARTPAT sensor can be connected directly to the process control system via 4...20 mA/HART® 7. For offline calibration, the sensor can be connected to a PC running PACTware™ (FDT/DTM).

Highlights analytical sensors:

- With or without integrated transmitter technology
- Wide range of sensor designs, materials, diaphragms and standard process connections
- For any industrial requirements – from hygienic to Ex applications
- Configuration and offline sensor calibration via PACTware™ with dedicated DTM

Potentiometric ORP sensors

SMARTPAT ORP 8150*
For chemicals and industrial wastewater applications

SMARTPAT ORP 8510
For water and wastewater applications, process connection PG 13.5

SMARTPAT ORP 1590
For water and wastewater applications, process connection 3/4 NPT (male)

OPTISENS ORP 8590
For water and wastewater applications, process connection 3/4 NPT (male)

OPTISENS ORP 8500
For water and wastewater applications, process connection PG 13.5

Conductive conductivity sensors

SMARTPAT COND 1200
For water and wastewater applications

SMARTPAT COND 3200
For condensate, process, boiler feed or (ultra)pure water

SMARTPAT COND 5200*
For chemicals and industrial wastewater applications

SMARTPAT COND 7200
For food, beverage and pharmaceutical applications

OPTISENS COND 1200
For water, wastewater, process water or pure water

OPTISENS COND 7200
For food, beverage and pharmaceutical applications

Oxygen sensors

OPTISENS ADO 2000
Amperometric sensor for water and wastewater applications

OPTISENS ODO 2000
Optical sensor for water and wastewater applications

Disinfectant sensors

OPTISENS CL 1100
Potentiostatic amperometric sensor for water and wastewater

Turbidity sensors

OPTISENS TUR 2000
Optical sensor for water and wastewater applications

Highlights of analytical measuring systems:

- Completely mounted sets with configured outputs
- Pre-installed and tested
- Bypass or inline installation
- Ready to use set-up with valves, holders or assemblies
- Additional sensors as option, e.g. pH sensor for chlorine measuring system

Systems

Liquid analytical measuring systems are preconfigured combinations of sensor(s), transmitter, mounting assembly or process connections, specially designed for a certain area of application.

From potable water disinfection, sludge monitoring in wastewater treatment, to quality control in dairies, breweries or beverage production – KROHNE offers a wide range of analytical measuring systems for:

- Chlorine and turbidity analysis
- Hygienic conductivity and total suspended solids measurements
- Monitoring of sludge blanket level and sedimentation

Sludge blanket measurement in secondary clarifier of wastewater treatment plant, Krefeld, Germany

Inductive conductivity systems

OPTISYS IND 7100
For food and beverage applications, process connection conical nozzle (DIN 11851) DN50

OPTISYS IND 8100
For food and beverage applications, process connection G1 (hygienic, male) with hygienic adapters

Disinfectant measuring systems

OPTISYS CL 1100
Potentiostatic amperometric measuring system for water and wastewater

Turbidity measuring systems

OPTISYS TUR 1050
Optical measuring system for potable water applications

Sludge level measuring systems

OPTISYS SLM 2100
Optical measuring system for sedimentation profile measurement and continuous tracking of sludge blanket

Total suspended solids (TSS) measuring systems

OPTISYS TSS 1050/3050
For hygienic applications, process connection G1/2

OPTISYS TSS 2050/4050
For hygienic applications, process connection PG 13.5 for use in retractable assemblies

Manual retractable assembly for a pH sensor in a chemical plant

Assemblies

Highlights of assemblies:

- Retractable, immersion or insertion housings
- Flow-through process adaptions and weld-in sockets

KROHNE offers a large variety of installation equipment for analytical sensors for use in harsh environments, hazardous areas, hygienic or other applications.

Transmitters and operating units

Highlights of transmitters and operating units:

- Display of readings and alarms
- Loop-powered equipment
- Operating units for on-site calibration and configuration of SMARTPAT sensors
- Transmitters for on-site calibration and configuration of OPTISENS sensors

Transmitters and operating units for liquid analytical sensors provide a convenient on-site access to sensor readings and parameterisation.

Accessories

Highlights of accessories:

- Loop powered indicators
- Convenient offline calibration
- PC-based evaluation of calibration data

A large range of accessories allows for convenient use and handling of liquid analytical sensors in the plant.

Assemblies

Manual retractable assemblies

SENSOFIT RET 5000
For harsh chemical and water treatment applications, length up to 700 mm / 27,6"

SENSOFIT RET 5810
For harsh chemical and water treatment applications, length 107 mm / 4.21"

SENSOFIT RET 5830
For hygienic applications in the food, beverage and pharmaceutical industry

Automatic retractable assemblies

SENSOFIT RAM 5810
For harsh chemical and water treatment applications

SENSOFIT RAM 5830
For hygienic applications in the food, beverage and pharmaceutical industry

Flow-through assemblies

SENSOFIT FLOW 1000 Y/T
For chemical and water treatment applications, G1 (female) or socket weld

SENSOFIT FLOW 2000 Y/T
For water and wastewater applications, for OPTISENS ADO or ODO sensors

Insertion assemblies

SENSOFIT INS 1310
For all-purpose applications in various industries

SENSOFIT INS 7311
For hygienic applications, process connection Tri-Clamp

SENSOFIT INS 7312
For hygienic applications, process connection VARIVENT® N

Mounting assemblies

SENSOFIT MOUNT 1000
For applications in various industries

Immersion assemblies

SENSOFIT IMM 2920
For chemical and wastewater treatment applications

SENSOFIT IMM 1000
For general water and wastewater treatment applications

SENSOFIT IMM 2000
For general water and wastewater treatment applications, telescopic rod holder mounted to handrail

Transmitters and operating units

MAC 100
Analytical transmitter for OPTISENS sensors

MAC 300
Analytical transmitter for OPTISENS TSS, pH/ORP and COND sensors

SMARTMAC 200*
Operating unit for on-site calibration and configuration of SMARTPAT sensors

Accessories

SD 200*
Multiparameter indicator for analytical and other parameters

OPTIBRIDGE*
USB interface cable for offline calibration and configuration of SMARTPAT sensors

SMARTBASE
Database for all SMARTPAT PH sensors

*also available with Ex approval

Communication technology

Drivers · Protocols · Configuration · Diagnostics

Open for the future

KROHNE is committed to making communication convenient. Which is why our field devices communicate reliably with controllers, control systems and PCs, and can also be used for a variety of control and regulating tasks.

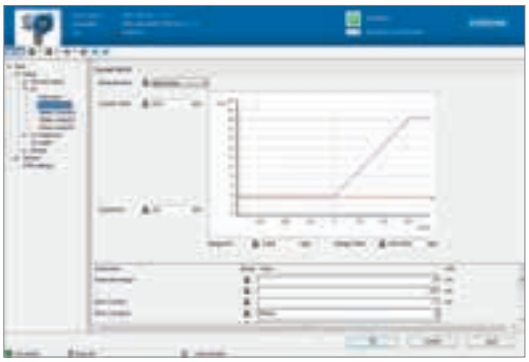
Protocols and interfaces
We support proven and established protocols as well as new ones for certain industries, e.g. EtherNet/IP™ for the food and beverage industries, or PROFINET® for the water and wastewater sector.

Device integration
KROHNE meets all of the prerequisites for integration into modern plant asset management systems, based on integration technologies such as DD/EDD and FDT/DTM.

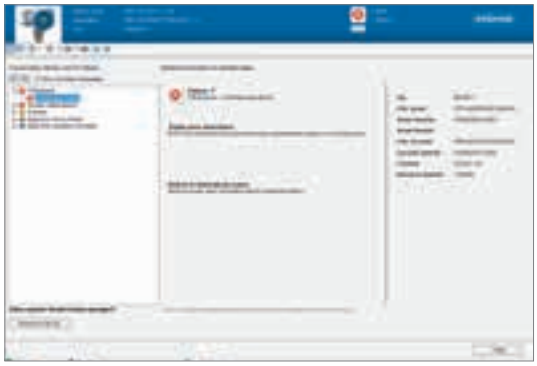
We are a longstanding member of PACTware™ and the FDT Group®. Since 2003, we provide DTMs and EDDs for our field devices with HART®, PROFIBUS® or FOUNDATION™ fieldbus interfaces.

Configuration and diagnostics via DTMs

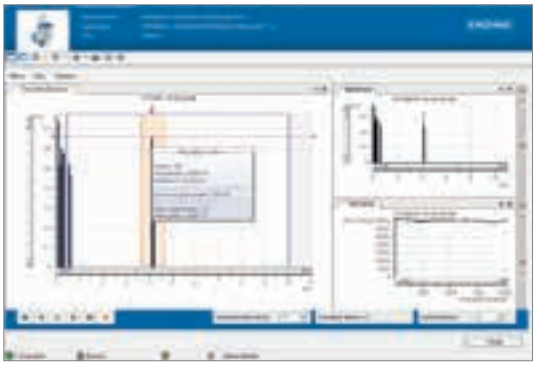
Easy navigation, device status available anytime



Simple parameterisation supported by graphic elements

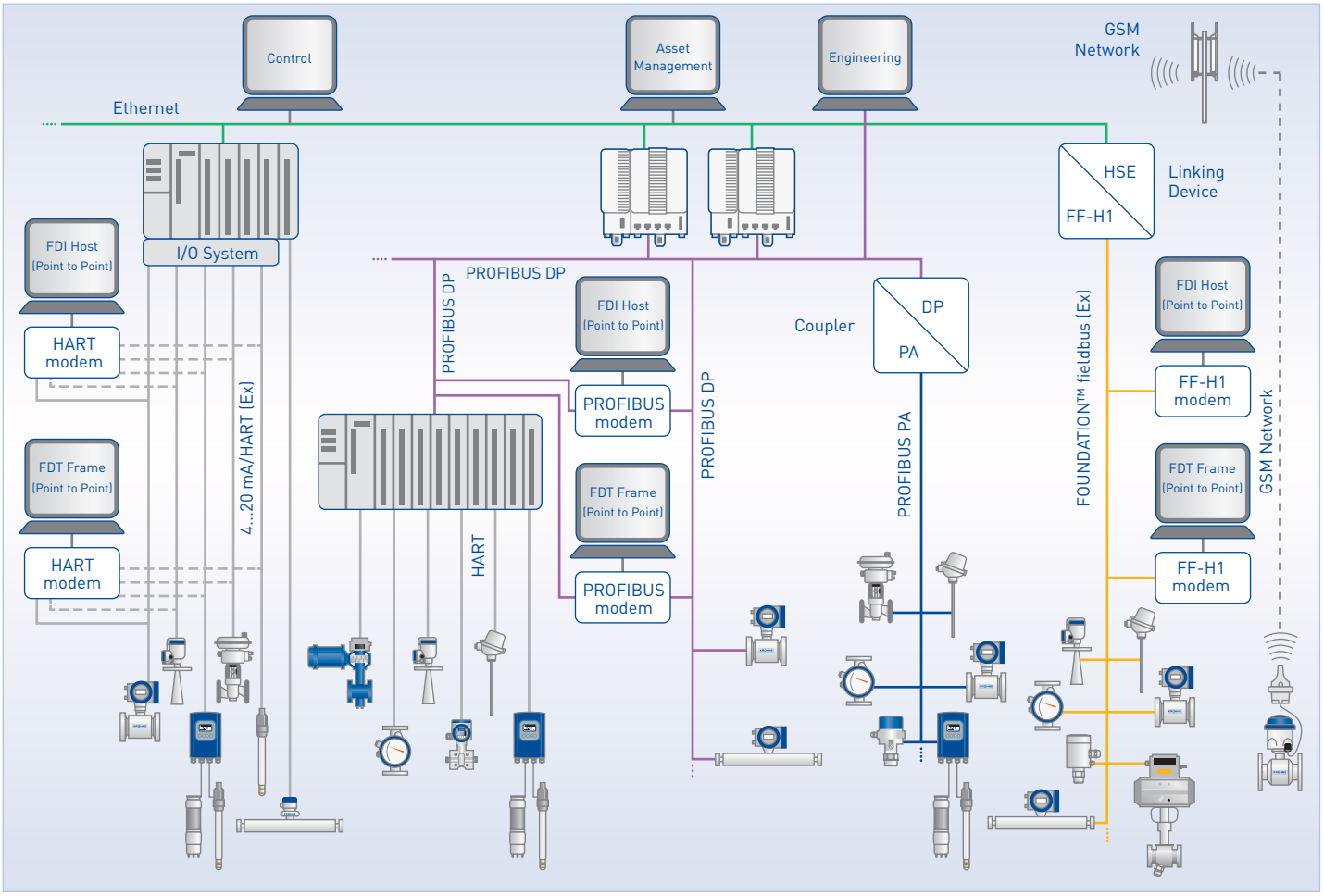


Detailed diagnostics overview with recommendations to resolve actual events



Advanced monitoring functions with optional recording of events

Fast and convenient access to process and device data from any level



Technology Icons

To deliver reliable values even under difficult conditions, KROHNE products and solutions use a number of high-end technologies.

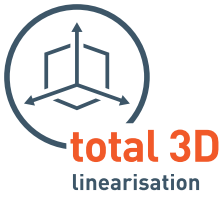
These are highlighted by the technology icons, each representing a unique and characteristic feature that also generates additional benefit for users:

Ceramic durability

By implementing oxide ceramic sensors into OPTIFLUX and BATCHFLUX electromagnetic flowmeters as well as ceramic diaphragms into OPTIBAR pressure devices, KROHNE is using a superior material that is permanently resistant to corrosive and abrasive media and also immune to temperature shocks.

EGM™ Entrained Gas Management

EGM™ was developed for the OPTIMASS Coriolis mass flowmeters to overcome problems caused by air or gas entrainments in a liquid. Powerful control algorithms maintain measurement, even during a complete transition from a pure liquid phase to a gas phase and back. Mass flow and density measurements remain stable and continuous, which has been demonstrated in batch / loading / empty-full-empty applications.

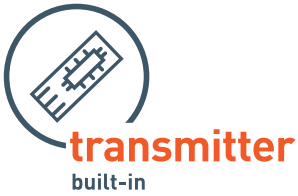


Total 3D linearisation

For a robust and accurate differential pressure measurement, even under changing process conditions, each OPTIBAR DP 7060 differential pressure transmitter is linearised in 3 dimensions during calibration: differential pressure, ambient temperature and static pressure are taken into account in combination. Since the full specified operating range is covered, an outmost stable and accurate measurement under all process conditions is guaranteed.

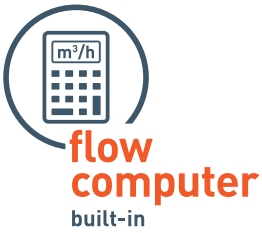
SmartSense insulation monitoring

Temperature assemblies with Pt100 or thermocouple sensors can produce erroneous measurements due to humidity in the measuring insert, e.g. caused by wear, corrosion or cracks. OPTITEMP temperature transmitters with SmartSense monitor the temperature sensor and warn for isolation errors.



Transmitter built-in

The SMARTPAT series of analysis sensors significantly eases the handling of analytical sensors: formerly an external device, the transmitter has now been miniaturised and built into the sensor head, enabling direct 4...20 mA/HART® 7 communication. This reduces the costs of ownership, eases installation and maintenance, and allows for usage in Ex applications (zone 0).



Flow computer built-in

Many KROHNE flowmeters have a built-in flow computer that compensates for the effects of pressure and temperature on the flow measurement or to convert to standard volume. The OPTISONIC 7300/8300 have analogue input for P & T sensors, the OPTISWIRL 4200 has both integrated. This saves both cost and installation efforts for an external flow computer.

80 GHz radar level measurement

The 80 GHz technology used in the OPTIWAVE series is the most recent and versatile radar technology for level measurement of liquids and solids. Over an identical distance, it presents a highly focused beam with a smaller diameter compared to lower frequency radars, ideal for dusty atmospheres or low reflective media. The small dead zone and narrow beam angle allow for use in both small and tall vessels.

Multiphase measurement

Multiphase measurement allows for the simultaneous measurement of flow rates of oil, water and gas in multiphase mixtures, without the need of separation. This saves time, costs, space and installation efforts compared to conventional test separators. Our magnetic resonance based multiphase flowmeter M-PHASE 5000 offers a full bore, non-radioactive solution for measuring multiphase flow.

E-RTTM pipeline leak detection

E-RTTM is a leading mathematical model for continuous internal monitoring of pipelines. Integrated in our PipePatrol system, it compares measurement data from the actual pipeline with those of a simulated "virtual pipeline" in real time. If the model detects a discrepancy, a leak signature analysis using leak pattern recognition determines whether it is a leak or safe, with outstanding accuracy.

Water & Wastewater

Products · Solutions · Services

KROHNE
Water & Wastewater

From generation of tender documents to remote monitoring of measurement points

The provision of reliable water supply and sustainable wastewater treatment are essential for the development of entire regions. At the same time, operators focus on efficiency while not neglecting process safety and availability.

Here, our dedicated industry division contributes the essence of over 50 years of experience and application know-how we have gained in the water and wastewater industry. We provide highly sophisticated, market oriented and competitively priced measuring devices, matched and fully equipped solutions up to integration into the control system, complemented by extended services and support.

Our team comprises consultant engineers and specialists who assist you from early planning stages to commissioning. Together with automation partners PhoenixContact, Danfoss Drives, hawle, wilo, VAG, mall umweltsysteme, WAVIN or VIDEC we offer trainings and (in-house) seminars.

Level measurement
in waterworks

Products

In 1961, KROHNE introduced the worlds first electromagnetic flowmeter (EMF) for water, wastewater, additives and sludge. Since then, we have developed a large and dedicated portfolio with approvals from potable water to Ex:

- (Battery powered) electromagnetic water meters up to DN3000/120", with extended functionality e.g. to gain additional parameters or for use in leakage detection
- Dedicated flowmeters for partially filled pipes, biogas, etc.
- Level transmitters for open or closed vessels of any size
- Analytical sensors and systems for process monitoring and quality control

Flow measurement of wastewater in partially filled pipes

Solutions

We have developed numerous system solutions for typical applications that have their very own requirements, e.g.:

- Bulk water metering with remote data communication
- Sludge level measurement on scraper bridges with remote data communication
- Level measurement on tanks with remote data communication
- Chlorine/disinfectant measurement in outlets of waterworks with remote data communication

Battery-powered IP68 metering point with GSM/GPRS communication

Services

We offer a variety of services to assist you in all stages of your water or wastewater project:

- Internet-based Planningtool: easy creation of precise tender documents (Word, Excel or GAEB) for flow, level, analysis, pressure and temperature instrumentation, combined with comfortable configuration of the devices. Find the free tool at **http://planningtool.krohne.com/**
- Periodic re-calibration of water meters and metrological services
- In-house trainings or free KROHNE Academy seminars on automation topics such as energy efficiency in water&wastewater plants, metrological requirements, dimensioning of devices, and many more. Send us your request: **seminare.wasser@krohne.com**

Planningtool for generation of tender documents

Chemical

Products · Solutions · Services

KROHNE
Chemical

Highly concentrated know-how for your process

The chemical and petrochemical industries form the foundation of the manufacturing industry. KROHNE has actively supported these industries for almost a century: we have implemented industry-specific standards and requirements regarding Ex proof, resistance against chemical attack, corrosion and abrasion resistance, or plant safety.

Our specialised team brings their experience and extensive knowledge to the table: we have continuously contributed ingenious and reliable measuring technology, making processes more efficient, more reliable and more economical.

We provide an extensive range of products and solutions, complemented by consultancy offerings and other services for your process.

Inertisation with purge meters

Products

As a main instrumentation vendor and preferred supplier for many international chemical and petrochemical producers, we have developed a large product portfolio:

- Broad application range, e.g. cryogenic & high temperature applications -200...+400 °C /-328...+752 °F with a standard device
- EMF with oxide ceramics measuring tube for aggressive and abrasive products, capacitive pickup option
- Coriolis meters with straight and bent tube designs, secondary containment, tantalum option
- Wide range of devices for safety-related applications: FM, CSA, ATEX, IECEx, NEPSI, cFMus, NAMUR compliant, SIL2/3, etc.

Solutions

Based on application know-how gained over decades, we offer a number of measuring solutions for challenges in process automation, for example:

- Entrained Gas Management EGM™ for Coriolis meters: considerable improvements with plant start-up and shut-down, full-empty-full applications, reliable indication of gas entrainments, uninterrupted output signal, etc.
- Pipeline leak detection and localisation system for liquid and gas pipelines, continuous and robust monitoring during all operating conditions, new or retrofit, multiproduct
- Metering systems for liquids and gases, mobile or stationary, e.g. tanker loading, custody transfer, batching/blending

Services

Chemical and petrochemical facilities and processes are becoming increasingly complex and extensive: this is why our service does not start at the time of the first maintenance or repair call, but right from the initial contact, through the entire life cycle of the plant:

- Project management, commissioning, training and documentation
- Metrological accreditation of custody transfer applications according to Measurement Instruments Directive, OIML
- Customer inspections (FAT, SAT, TPI), pre-manufacturing (PMM) and pre-inspection meetings (PIM), quality audit support
- On-site calibration verification and documentation, calibration of devices, temporary measurements
- Seminars, trainings and workshops on relevant topics: Functional Safety, virtual grounding, diagnostics, etc.

Gas measurement in a plastics plant

Butanol level measurement on bypass chamber

Virtual reference for EMFs: grounding rings made redundant

Straight tube coriolis meters in a safety application

Food & Beverage

Products · Solutions · Services

KROHNE
Food & Beverage

Optimisation in hygienic processes through key technologies

The food and beverage industry is a key industry for KROHNE: our dedicated division comprises a global team of industry specialists and account managers to take care of your needs. Being an instrumentation supplier for the food and beverage industry for over 20 years, we have gained industry- and application-specific know-how that we implemented into our devices and measuring solutions.

Temporary flow measurement with clamp-on flowmeter in a dairy

Level measurement on a milk tank

Products

We offer a complete portfolio for flow, level, pressure and temperature measurement as well as inline analysis for hygienic and auxiliary applications. The hygienic instruments feature conformity to EC 1935/2004 and FDA and are EHEDG and 3A approved.

- Flowmeters for low conductive liquids and liquids with gas entrainments
- Mass or volume flowmeters for filling machines
- Non-contact level measurement of liquids and solids, also in dusty atmospheres without air purge
- DN2.5...150/0.1...6", wide range of hygienic connections
- Best-in-class inline density measurement: 0.2 g/cm³
- Wide flow ranges: smaller meter size possible where competition can only offer larger and more expensive sizes

Solutions

Contact us to learn more about the optimisation potentials we offer.
Here are some impulses:

For process applications:
- Entrained Gas Management EGM™ for our OPTIMASS series: immune to gas entrainments/two phase flows, it allows for
  - Converting applications from batch to inline/continuous, e.g. by replacing loading cells with mass flowmeters, even with aerated products
  - reliable measurement of mass, density, and concentration of air-containing products without process interruption, e.g. with raw milk, ice cream, dough, syrup, tomato concentrate, spinach, meat, margarine, mayonnaise
- In-line analysis of compositions, e.g. fat content in milk
- Avoid overdosing of cryogenic cooling, e.g. on meat, through dosing based on continuous temperature measurement

Examples auxiliary applications:
- Monitoring of CIP/SIP plants
- Measurement of steam, hot water, compressed air, natural gas, (thermal) oil or cooling fluids
- Gross and net heat measurement for hot water and steam with direct energy output
- Monitoring air compressor efficiency (FAD) or gas burner consumption
- MID MI-004 heat metering, supporting ISO 50001 energy management systems

Services

Our industry division team provides technical consulting, maintenance and service concepts for any plant size. We can also support you with:

- On-site verification (calibration verification and documentation),
- Calibration and metrological services
- Useful online configuration tools (see chapter "Services")

Case study: Ice-cream production with Entrained Gas Management EGM™

Consistent product quality and overrun measurement:

- Immunity to entrained air allows in-line density measurement after the freezer
- Maximize ice cream output based on continuous mass flow measurement and simultaneous control of air addition
- Increase product quality, eliminate sample taking, reduce freezer start-up time

OPTIMASS straight tube mass flowmeter for shear sensitive products

Oil & Gas

Products · Solutions · Services

KROHNE
Oil & Gas

From well-head to refinery

For all inquiries, please contact:

KROHNE Oil & Gas
Minervum 7441
4817 ZG Breda
The Netherlands
Tel.: +31 76 711 200 0
oilandgas@krohne.com
www.krohne.com/oilandgas

Headquartered in Breda, the Netherlands, our Global Industry Division Oil & Gas is dedicated to servicing customers in the Oil & Gas industry.

Our offering extends from elementary process instrumentation up to fully engineered custody transfer metering systems, and from engineering consultancy during design phase up to on-site commissioning and training.

With local presence in around 100 countries, local support is usually available from just around the corner. Please contact us to learn more about our capabilities and the experience we can offer to tackle your metering challenges.

M-PHASE 5000
Magnetic resonance multiphase flowmeter for simultaneous measurement of oil, gas and water

SUMMIT 8800
Flow computer for custody transfer measurement

WGS 1000/2000/3000
Wet gas measurement systems

Products

We offer a large instrumentation portfolio, including:

- Process instrumentation for the entire oil & gas value chain, including flow, level, pressure and temperature measurement
- Custody transfer ultrasonic and coriolis flowmeters for crude oil, refined products , natural gas and LNG
- Multiphase and wet gas flowmeters for reservoir measurement and well testing
- Flow computers with full custody transfer approvals

Solutions

In house consultancy, design and manufacturing of measurement solutions:

- Custody transfer metering systems
- Mobile master meters, ball provers and calibration systems
- Analyser houses and shelters
- Metering control systems including flow computer cabinets
- SCADA/HMI software and AMADAS analyser management
- Pipeline management and leak detection systems

Services

Our service offering covers all aspects of measurement and includes:

- Expert consultation during design phase
- On site commissioning and training
- Service level agreements
- Periodical inspection and validation
- Metrological accreditation according to local legal requirements
- In-house seminars and workshops on a wide range of topics

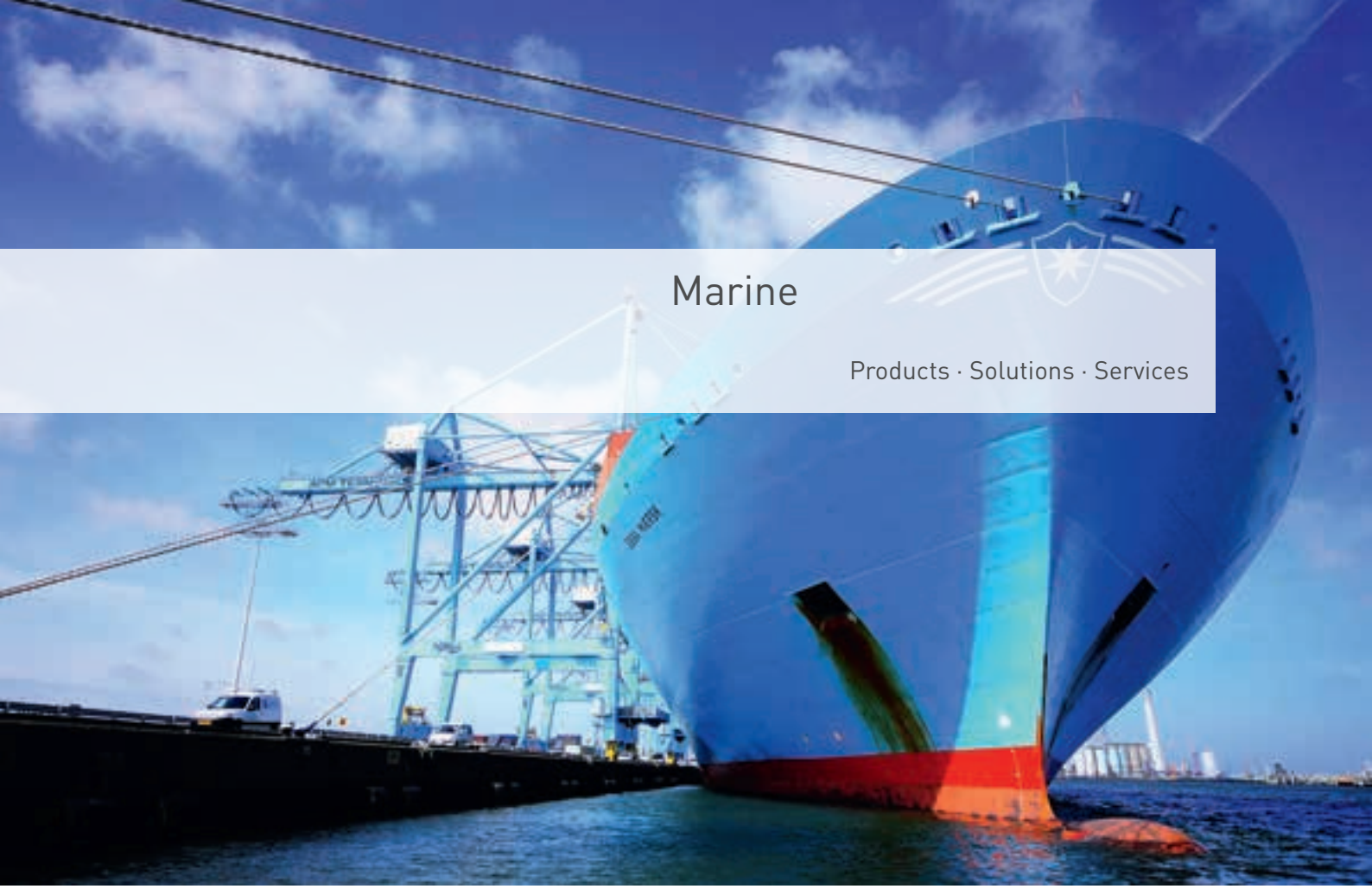
Mobile master metering system

Skid mounted metering system with integrated ball prover

Analyser house for liquid metering system

Case study: Natural gas and LNG metering systems

- For a large LNG liquefaction plant in Australia, KROHNE supplied over 20 custody transfer metering systems for natural gas and cryogenic LNG.
- With system integration and instrumentation from one company, KROHNE provided a cost effective, impeccable project execution, well within customers planning.



Marine

Products · Solutions · Services

KROHNE
Marine

Safe monitoring of liquids onboard all kinds of ships

For all inquiries,
please contact:

KROHNE Marine
Stromtangveien 21
NO-3950 Brevik
Norway
Tel.: +47 35 561 220
marine@krohne.com
www.krohne-marine.com

Based in Norway, the Marine team holds over 60 years of experience in equipping seagoing vessels, from small product tankers to complex chemical tankers and large VLCCs. KROHNE Marine has its own network of sales representatives and service agents and is present in all the main global shipping hubs and shipbuilding countries. Contact us for all marine specific applications!

Case study: Fuel balance calculation for Maersk Line

- Task: transfers between onboard tanks, consumption of main engine, auxiliary engines and burners/water boilers for a vessel fuel balance calculation (marine diesel oil, heavy fuel oil and mixtures of both)
- For a proof of concept (POC) testing, KROHNE Marine delivered a complete measuring and monitoring solution, including system engineering, piping, mechanical and electrical installation
- Key points were overall accuracy achieved, response time during pilot stage, fulfilment of timelines and availability to clients inquiries
- After successful POC phase, Maersk Line decided to equip 84 vessels (provisionally) of different sizes with the KROHNE Marine solution

Products

We offer a large range of flow, level, temperature and pressure instruments specially designed for onboard use, e.g. with heavy-duty stainless steel housing:

- Bunkering flowmeters
- Ballast water flowmeters
- FMCW radar level transmitters

OPTIWAVE-M 7400 C
For marine applications

Solutions

- EcoMATE software for monitoring and reporting of fuel consumption for ship owners and operators:
  - Onboard monitoring and reporting of fuel consumption and key emission data
  - MRV ready: compliant and verified according to EU regulation 2015/757
  - Automatic calculation reporting of emission (e.g. CO_2) and efficiency data
  - Optimized for use with OPTIMASS mass flowmeters

- CARGOMASTER system for onboard tank monitoring and alarming:
  - Readings from all tanks and lines onboard available via application-specific software on standard marine computers, optional integration into other systems
  - All vessel sizes
  - Instrumentation and software, full scope of supply: engineering, drawings, documentation and commissioning

- Onboard valve & pump management and control system:
  - Can be combined with CARGOMASTER for an integrated solution for liquid cargo control of tankers
  - Remote control and service tanks gauging system for all kinds of merchant ships

EcoMATE for monitoring and reporting of fuel consumption

CARGOMASTER tank monitoring and alarming system

Services

We are glad to assist you with our offering including dedicated research and development, engineering and system design, project management, commissioning and service.

Suction flow monitoring on dredgers

Power generation & Nuclear

Products · Solutions · Services

For a safe and efficient operation

KROHNE Power Generation

KROHNE Nuclear

In power plants, process instrumentation has a very important role: the functional safety and accuracy of the measurements is essential for plant availability and safe and efficient operation.

With over 40 years of experience in the field of instrumentation for the power generation sector, our team can cope with the increasing requirements of today's highly efficient and flexible plants. Please contact us to learn how you can benefit from our knowledge!

Ultrasonic flow measurement of superheated steam

Products

For liquid and gaseous media:

- Large range of flow, level, temperature, pressure instrumentation and process analytics
- Flow measurement with temperatures up to +600°C / 1112°F, pressures up to 490 bar / 7107 psi, higher on request
- Custody transfer flowmeters
- High accuracy flow meters for feed water applications
- Dedicated products for resistance to radiation and/or seismic

Solutions

Our scope includes design and manufacturing of measuring solutions for:

- Nuclear: nuclear island systems, steam/water cycle systems, cooling systems, emergency power generation systems, auxiliary systems
- Hard coal/ lignite: storage/preparation, steam/water cycle, condensate-system, external cooling, flue gas cleaning, ash handling
- Gas/ oil: gas turbine, HRSG HP/IP/LP steam system, condensate & cooling water system, flue gas treatment
- District heating: heating network, large users
- Industrial power generation
- Waste incineration: fuel preparation, steam/water cycle, external cooling, flue gas cleaning
- Biogas: methane content, power & heat production/ efficiency monitoring, biomethane injection
- Biomass: steam, power & heat production, biomass storage, flue gas cleaning
- Solar thermal: HTF circuit, liquid salt, water/ steam circuit
- Power-2-gas: electrolysis, methanation, injection

Services

Our services offerings include:

- Project management
- Design and calculations
- Qualification and tests
- Documentation

Mass flow measurement of heavy fuel oil

TDR level transmitter as overfill protection in water pit

Nuclear projects

- Dedicated team of engineers and technicians for nuclear projects
- Flow, level, temperature and pressure range for safety-related and non-safety-related applications
- New designs or re-engineered solutions on request
- All relevant approvals and certifications for design, manufacturing and testing of instrumentation for nuclear power plants (e.g. ASME Section III, RCC-M)
- Qualifications and test reports according to IEEE 323, IEEE 344, and RCC-E for safety-related applications
- High level of safety consideration in all project procedures

TDR level measurement of condensates in irradiating environment

Services

Project services · Online tools · Maintenance services · Metrological services · Seminars · In-situ verification · Calibration

Beyond the highest requirements

From engineering and planning to commissioning, training and documentation: our services cover all project stages, and can be offered for all enterprise sizes:

- Complete project management for instrumentation projects
- Engineering
- Commissioning
- On-site start-up
- Product training (on-site)
- Calibration, (in-situ) verification and documentation
- Maintenance services
- Seminars and trainings on various topics

Please see right page for more details on selected services.

Commissioning of flowmeters

Online tools:

PiCK
up your information

PiCK
Enter the serial number and get device specific documents, e.g. manuals, handbooks, calibration certificates, etc.:
pick.krohnegroup.com

Configure It

Configure It
Configure flow and level devices and get free 2D/3D CAD data:
www.krohne-direct.com

Maintenance services

Choose from maintenance and service contracts tailored to suit all business sizes and needs:

- Spare parts and consumables
- Field service and on-site repair
- Returns
- Workshop repair
- Helpdesk

Large team of field service engineers and technicians

Metrological accreditation of custody transfer applications

We offer special services for metrological accreditation of measuring and loading systems for liquids and gases, according to local fiscal regulations:

- Project management from planning to commissioning, training and documentation
- For mobile and stationary measuring systems

MID MI-005 tanker filling system for liquefied gas

Seminars: KROHNE Academy & KROHNE Academy online

KROHNE Academy is a series of seminars in collaboration with leading automation companies. Taking place in various countries, it addresses key operating issues, from plant safety to ways of increasing efficiency and controlling costs, and shows possible solutions. Should your interest be more towards working "hands-on" with our devices , then our service academy is what you are looking for. Learn more about KROHNE Academy at **www.krohne.com**

KROHNE Academy online is an online eLearning platform, focusing on industrial process instrumentation. It comprises electronic learning content with full audio, explaining measuring technology without relation to specific manufacturers. Register now for free and start your training at **academy-online.krohne.com**

Functional safety seminar at KROHNE headquarters, Duisburg, Germany

In-situ verification

OPTICHECK is the essential tool to assure that your process measuring devices are performing according to specification. When connected to an installed meter (in-situ), it gathers data to ensure that the meter is performing within 1 % of the factory calibration.

- Printed individual verification certificate
- Preventive maintenance and service features
- Storage of verification data
- Download factory calibration settings from KROHNE manufacturing database

Calibration from KROHNE: Certainty you can count on

Calibration of high pressure/high flow gas and liquid meters

For oil&gas flow metering systems, our partner EuroLoop in Rotterdam, The Netherlands, offers testing and calibration according to European MID, EN or IEC standards or OIML recommendations.

With their large closed loop facilities, single meters or complete skids can be calibrated with:

- Natural gas: 20...30,000 m3/h for sizes 6...36" up to ANSI 900 with best overall uncertainty (CMC) of 0.17%
- Liquid hydrocarbons: sizes 4...30" up to 5,000 m³/h, large range of Reynolds numbers, viscosities 1...400 mm²/s (cSt), with best overall uncertainties 0.02% for volume and 0.04% for mass

Calibration is one of KROHNE's core areas of expertise. If you buy a KROHNE product, you will get a measuring device that performs most accurate with low uncertainty under real process conditions.

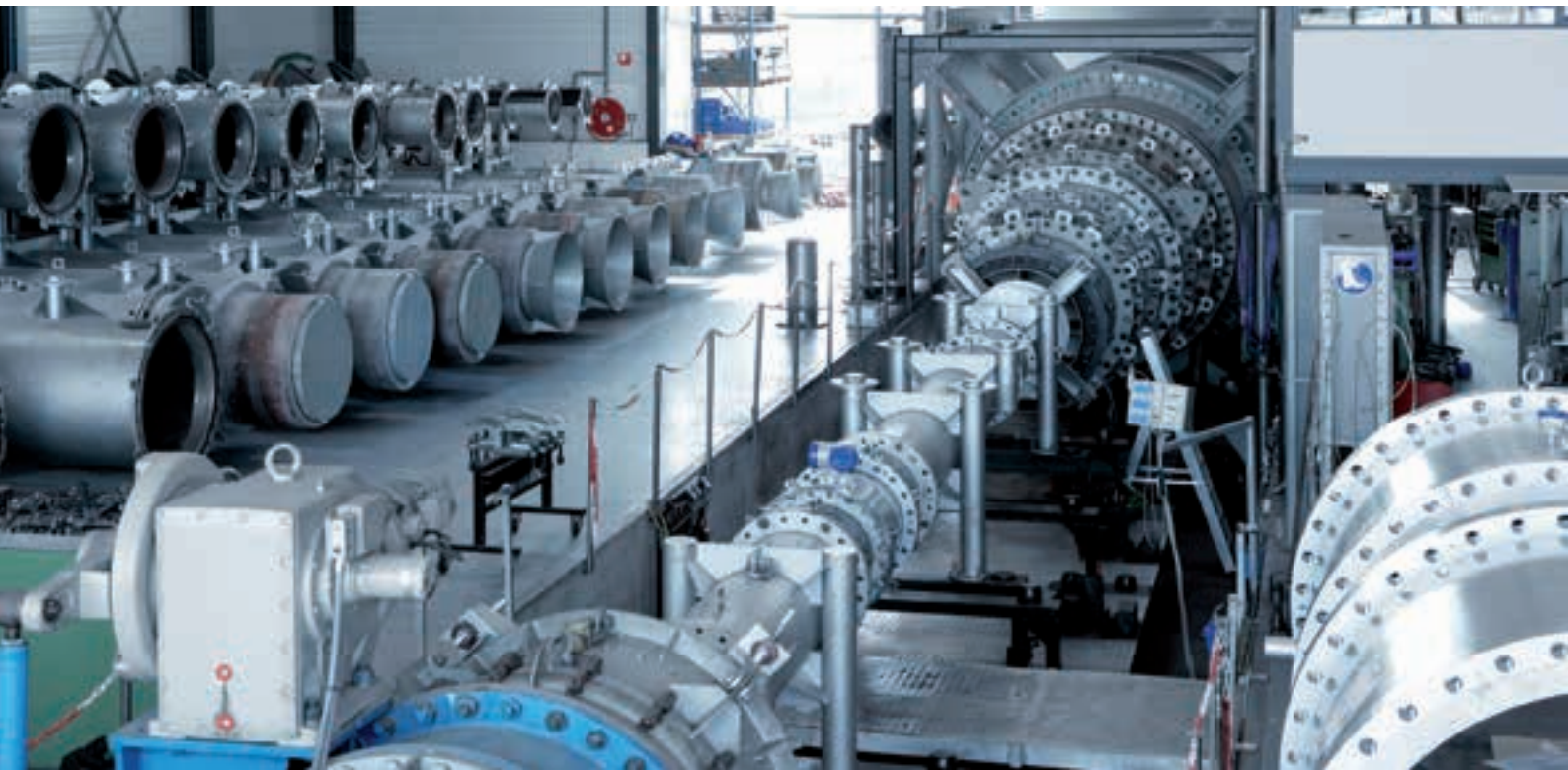
To achieve this, we operate more than 140 calibration facilities for volume flow, mass flow, level, temperature, density and pressure to (wet-)calibrate any device we manufacture. For example, every flowmeter is wet-calibrated using water or air as standard before leaving our facilities.

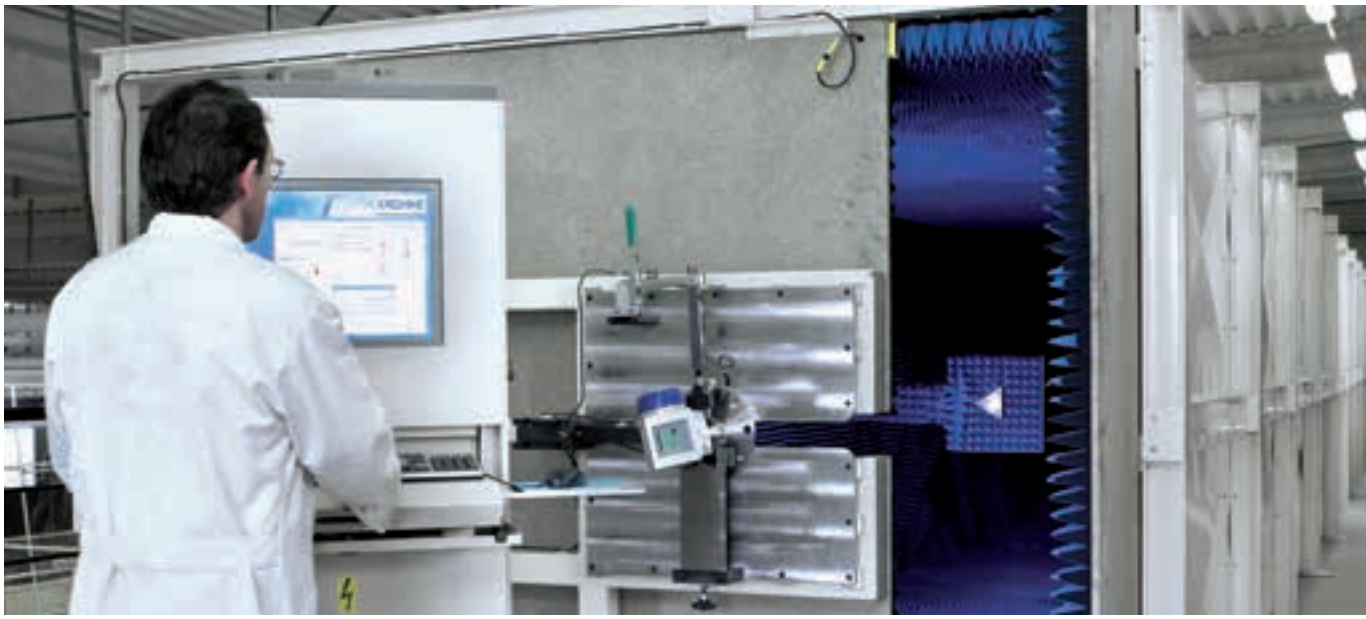
We can also provide customer specific calibration such as:

- Carry out multipoint calibrations
- Vary different parameters such as temperatures, viscosities, pressures etc.
- Use the actual medium or similar
- Build or emulate customer-specific flow geometries
- Use piping provided by the customer

For calibration we only use direct comparison of measurands (e.g. we calibrate our Coriolis mass flowmeters with a gravimetric weighing system). Our calibration rigs are the most accurate used in measuring device production worldwide: the accuracy of the reference is usually 5 to 10 times better than that of the meter under test.

The world's most precise volumetric calibration rig for flowmeters up to DN3000/120"





Stretch for calibration of FMCW level transmitters

This goes for small as well as for very large sizes: KROHNE operates the world's most precise volumetric calibration rig for flowmeters up to DN3000/120" with a certified accuracy of 0.013 %. The reference vessel is a 44 m/144 ft high tank containing almost 0.5 million litres/132,000 gal (US) of water which allows for a maximum flow rate of 30,000 m³/h/7,925,000 gal (US)/h.

Certified technology for fiscal & custody transfer applications

Our meters can be calibrated and certified according to various standards such as OIML, API, Measuring Instruments Directive (MI-001, 002, 004, 005), GOST, etc. The standards we use for calibration are ISO/IEC 17025 accredited and traceable to international or national standards. Regular inspections by national metrology institutes, round robin tests and alignments with national and international metrological standards according to ISO 9000 and EN 45000 guarantee the quality and comparability of our calibration rigs. Staff performing the calibrations are trained and given regular re-trainings to ensure quality and continuity.

Volumetric piston prover

KROHNE – Products, Solutions and Services

- Complete product portfolio: flow, level, temperature, pressure, process analytics
- Application-specific system solutions for various industries
- Services for instrumentation projects

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