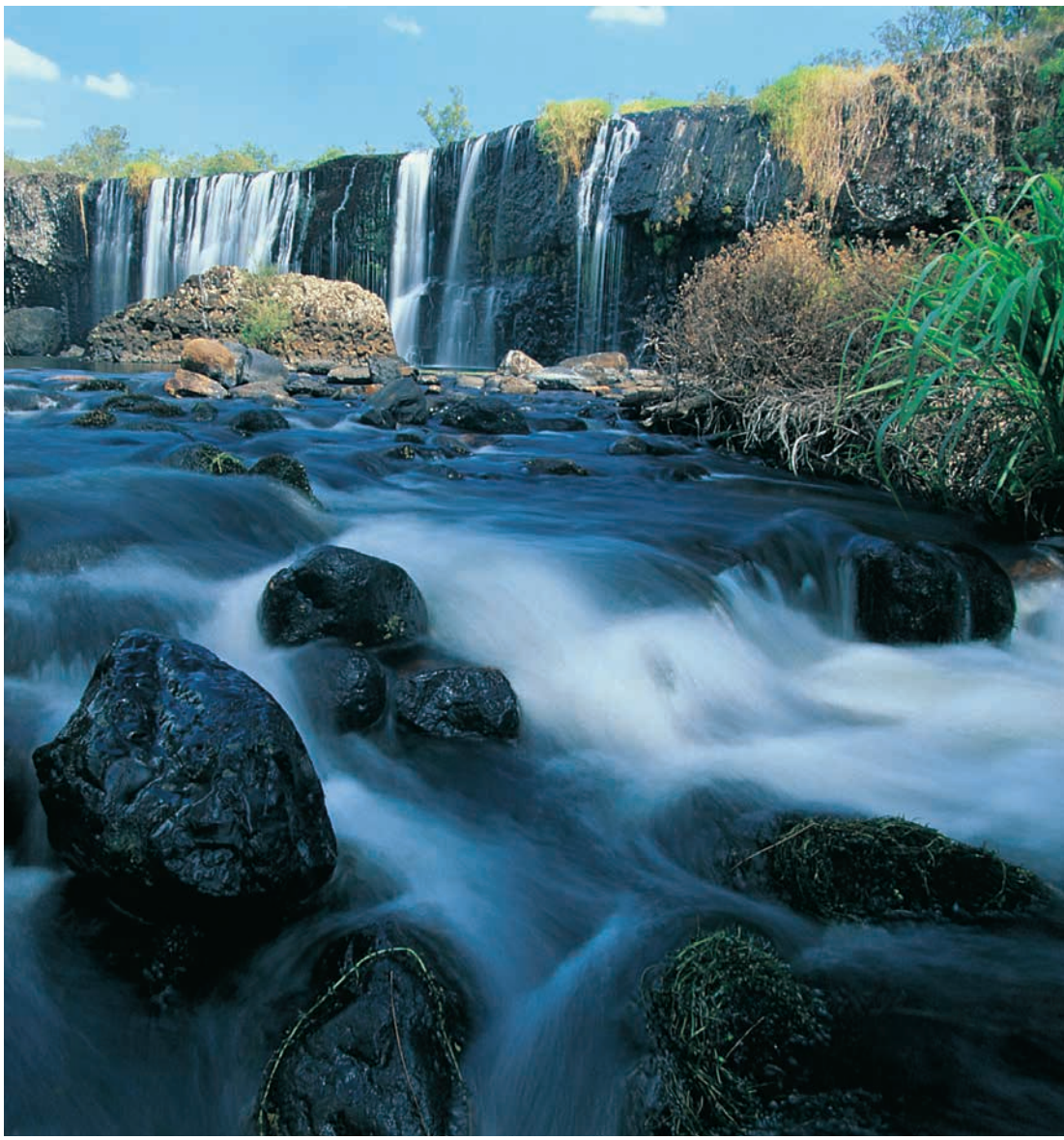
Flow measuring technology for liquids, gases and steam

Products and services at a glance



Endress+Hauser

People for Process Automation

Endress+Hauser – your partner

Endress+Hauser is a global leader in measurement instrumentation, services and solutions for industrial process engineering

With dedicated sales centers and a strong network of partners, Endress+Hauser guarantees competent worldwide support. Our product centers in twelve countries meet your needs and requirements quickly and effectively. The Group is managed and coordinated by a holding company in Reinach, Switzerland. As a successful family-owned business, Endress+Hauser is set to remain independent and self-reliant.

Endress+Hauser provides sensors, instruments, systems and services for level, flow, pressure and temperature measurement as well as analytics and data acquisition. The company supports you with automation engineering, logistics and IT services and solutions. Our products set standards in quality and technology.

We work closely with the chemical, petrochemical, food and beverage, oil and gas, water and wastewater, power and energy, life sciences, mining, minerals and metals, renewable energies, pulp and paper and shipbuilding industries. Endress+Hauser supports customers to optimize their processes in terms of reliability, safety, economic efficiency and environmental impact.

Flow measurement as competence
The Endress+Hauser Group is a global player. Within the Group, Endress+Hauser Flow ranks internationally as one of the leading producers of industrial flowmeters for liquids, gases and steam. As a competence center, we have achieved a top position in global markets for over 40 years. Endress+Hauser Flow currently employs a workforce of more than 2200 in Reinach (Switzerland), Cernay (France), Greenwood (USA), Aurangabad (India), Suzhou (China) and Itatiba (Brazil).

Reinach, Switzerland

Cernay, France

Greenwood, USA

Aurangabad, India

Suzhou, China

Itatiba, Brazil

To learn more about Endress+Hauser, visit:
www.endress.com

Measuring flow reliably

Consistent product quality, safety, process optimization and environmental protection – these are only a few reasons why industrial flow measurement is becoming more important all the time

Endress+Hauser supports you with proven, state-of-the-art flowmeters of high quality. From the communication-capable single measuring point to the complete solution for higher-level control systems: you can always rely on the fact that we customize our products to your process requirements. Together with automated process control and state-of-the-art communication interfaces (fieldbus systems), flow metering has advanced into more and more new fields of application in recent years.

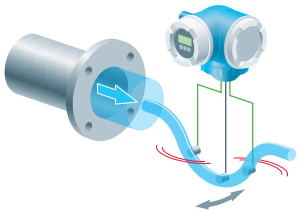
- Totalizing, displaying, recording
- Monitoring, controlling, balancing
- Dosing, filling and fueling
- Concentration measurement in two-phase fluids
- In-line viscosity measurement
- Condition monitoring and in-line verification

Index

From oxygen to honey

The ideal flowmeter for each fluid

Flow is one of the most frequently measured process variables in industry. Water, natural gas, steam, mineral oil, chemicals or wastewater are only some examples of fluids that have to be measured day in, day out. There is no single, across-the-board technology suitable for all these applications, so Endress+Hauser will be happy to advise you on the flowmeter best suited to your process needs.

Coriolis
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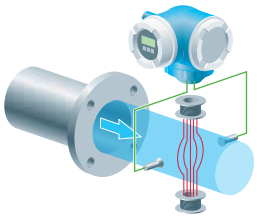


Electromagnetic
Page 40

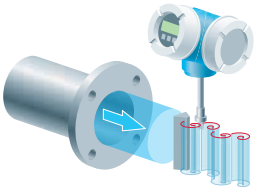
	Coriolis	Electromagnetic
Liquid applications		
Liquids in general (e.g. water)	✔✔	✔✔
Very low flow rates < 2 l/h (0.009 gal/min)	✔✔	✔✔
Very high flow rates 100 000 m^3/h (4.4 × 10^5 gal/min)	⊗	✔✔
Non-conductive liquids	✔✔	⊗
Viscous liquids (> 50 cP)	✔✔	✔✔
Cryogenic fluids (e.g. liquefied natural gas)	✔✔	⊗
Hygienic applications	✔✔	✔✔
Gas/steam applications		
Gas flow in general (e.g. natural gas, air)	✔✔	⊗
Wet/dirty gases (e.g. biogas)	⊗	⊗
Low flow rates (< 20 l/min)	✔✔	⊗
High flow rates	✔✔	⊗
Steam	✔	⊗
Special applications		
Slurries, suspended solids	✔	✔✔
Liquid/liquid mixtures (e.g. oil/water)	✔✔	✔
Liquid/gas mixtures (e.g. water/air)	✔	✔
Corrosive liquids (e.g. acids, alkalis)	✔✔	✔✔
Corrosive gas flows (e.g. HCl vapor)	✔✔	⊗
Applications in mining (e.g. ore slurry)	⊗	✔✔
Bidirectional metering (forward/reverse)	✔✔	✔✔
Measurement from outside (no process interruption)	⊗	⊗
Range of applications		
Nominal diameters	DN 1 to 400 (1/24 to 16")	DN 2 to 3000 (1/12 to 120")
Process pressure	max. 400 bar (5802 psi)	max. 160 bar (2321 psi)
Process temperature	–196 to +350 °C (–321 to +662 °F)	–40 to +180 °C (–40 to +356 °F)

✔✔ suitable; ✔ suitable with limitations (depending on the application, device design and material); ⊗ not suitable

The perfect flowmeter for any industry
Depending on the industry, the requirements for safety, hygiene, approvals, communication, operation, measuring ranges, or fluid properties are completely different. As a result, Endress+Hauser offers a vast array of tried and tested flowmeters, which are precisely matched to your requirements.

▸ Page 12–31

Applicator (select and size products)
For reliable planning and sizing of measuring points – proven in use for 30 years!
www.endress.com/applicator



Vortex
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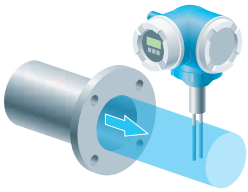

Thermal
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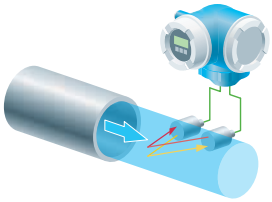


Ultrasonic
Page 52

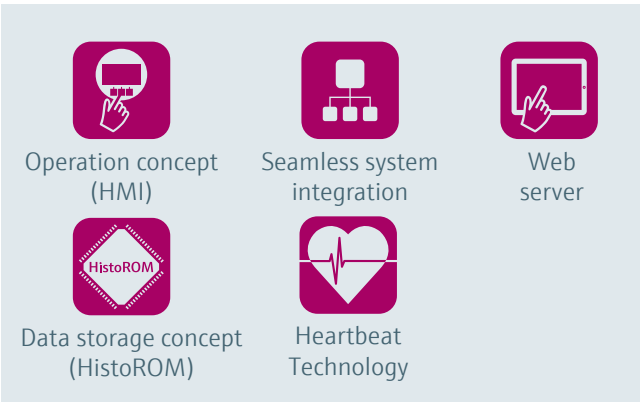
		Inline	Clamp on
✓✓	✓	✓✓	✓✓
⊗	⊗	⊗	⊗
⊗	⊗	✓✓	✓✓
✓✓	✓	✓✓	✓✓
✓	✓	✓	✓
✓✓	⊗	⊗	✓
⊗	✓	⊗	✓✓
✓✓	✓✓	✓✓	⊗
✓	✓	✓✓	⊗
⊗	✓✓	✓✓	⊗
✓✓	✓✓	✓✓	⊗
✓✓	⊗	⊗	⊗
✓	⊗	⊗	⊗
✓✓	✓	⊗	⊗
✓	✓	⊗	⊗
✓✓	✓	⊗	✓✓
✓	✓	⊗	⊗
⊗	⊗	⊗	⊗
⊗	✓	✓✓	✓✓
⊗	⊗	⊗	✓✓
DN 15 to 300 (½ to 12")	DN 15 to 1500 (½ to 60")	DN 15 to 4000 (½ to 160")	
max. 250 bar (3626 psi)	max. 40 bar (580 psi)	Depending on sensor	
–200 to +450 °C (–328 to +842 °F)	–40 to +180 °C (–40 to +356 °F)	–40 to +200 °C (–40 to +392 °F)	

Proline – simply clever

Proline stands for accurate and reliable flow measuring technology without compromise. For plant operators throughout the world, this means operational safety and top-level product quality.

For over 40 years, Endress+Hauser has been providing one of the most comprehensive product portfolios for measuring the flow of liquids, gases and steam. During this time, over 5 million flowmeters have successfully been installed in a wide range of industries.
A significant contribution to this success has been made by the Proline product family. Introduced in 1993, it is being improved based on a continuous experience exchange with our customers. The latest generation of Proline flowmeters – Proline 10, 100, 200, 300, 400, 500 and 800 – combines the sensors, which have proved themselves, with state-of-the-art transmitter technology. Thanks to numerous innovations, such as WLAN, web server, HistoROM, and Heartbeat Technology, this generation offers added value in every respect. This makes our new Proline reliable, already surpassing your future process automation requirements:

- **Proline exceeds** all industry-relevant regulations with regard to process safety (SIL), approvals, custody transfer, product quality, and system availability
- **Proline guarantees** significantly lower operating costs over the entire life cycle of field measuring devices



- **Proline is ready** for digital networking and its opportunities in process automation through the “Internet of Things”
- **Proline makes it easier** to fully access device and configuration data using all interfaces and therefore increases system availability
- **Proline offers more** than just flow measurement and, with Heartbeat Technology, also gives an insight into the process

Coriolis | Electromagnetic | Vortex | Thermal | Ultrasonic

Proline – added value in every respect

No compromises regarding accuracy, performance and conformity

Demands on process systems and measuring devices are constantly increasing: the highest possible process quality with low overall operating costs. The new Proline generation has been developed with precisely this in mind:

- Proline – innovative sensors and transmitters with latest technology
- Proline – recognized in all process industries all over the world
- Proline – tried and tested sensors
- Proline – available with industry-specific approvals

Heartbeat Technology – attested by TÜV SÜD

Heartbeat Technology is an integral part of Endress+Hauser's design concept for process instrumentation diagnostics. It aims to provide the user with an optimal balance of excellent measurement functionality, reliability, safety and ease of use:

- Comprehensive diagnostic functionality for highest process safety
- In-situ verification for maximal confidence in device functionality
- Legal compliance by IEC 61508 development and ISO 9001 traceable verification method
- Monitoring functionality for process optimization and predictive maintenance as well as maximal plant availability

Seamless integration

Particularly in large industrial plants is the availability of process, diagnostic, and measurement data of vital importance. Therefore, Proline flowmeters are equipped with the latest fieldbus technologies:

- Seamless integration into plants thanks to the variety of protocols: HART, PROFIBUS PA/DP, FOUNDATION Fieldbus, Modbus RS485, EtherNet/IP, PROFINET and OPC-UA
- Numerous, freely configurable signal inputs and outputs
- Easy data transfer via web server and WLAN
- HistoROM device memory: complete system integration compatibility through automatic restoration of the original firmware in service cases

Ready for digital networking – from the sensor to the office

Use of the latest information and communication technologies has become more widespread in industrial production. The new Proline generation is well-prepared for this:

- Optimum connection to information networks thanks to numerous communication protocols and signal outputs
- Improved production processes thanks to modern diagnostics, maintenance, and service functions
- Integrated web server technology to allow full data access on site via tablet and WLAN
- Simple and convenient remote data retrieval via Industrial Ethernet using integrated web servers and OPC-UA

Developed for outstanding safety in production facilities

Install and measure safely – Proline is based on years of experience in technical safety applications:

- Developed entirely in accordance with SIL guidelines (IEC 61508)
- Clear display of diagnostic/error messages according to NE107
- Safe and preventative maintenance thanks to Heartbeat Technology: non-invasive, traceable verification during operation

Flexible answers to individual needs

Simplify your product selection with our FLEX portfolio structure

Selecting the right products for your application can be a challenge for several reasons:
- The instrument has to fit the process
- Sensors with unnecessary functions make selection difficult and operations complex
- Time is usually essential, e.g. for searching the best product, and for installing and operating the device

FLEX: Fundamental – Lean – Extended – Xpert

The basic idea of the FLEX structure is that depending on the application, there are different goals to achieve and different challenges to overcome. Some processes you must just monitor, others you want to optimize. The FLEX structure separates our extensive portfolio into four distinct segments based on your needs.

Xpert Selection	Master your most challenging applications	▪ Specialized products ▪ Designed for demanding applications	F L E **X**
Extended Selection	Optimize your processes with innovative technologies	▪ High-end products ▪ Highly functional and convenient	F L **E** X
Lean Selection	Handle your core processes easily	▪ Standard products ▪ Reliable, robust and low-maintenance	F **L** E X
Fundamental Selection	Meet your basic measurement needs	▪ Simple products ▪ Easy to select, install and operate	**F** L E X

Fundamental: Easily find a simple device for measuring reliably in utilities without losing time with selection (few, relevant variants) or when installing and maintaining the device. Still, you may rely on Endress+Hauser quality and proven-in-use instruments.

Lean: Select from a range of very reliable instruments for core processes that reduce or neutralize the impact of process conditions on the measurement. Thanks to comprehensive diagnostic and self-monitoring capabilities, our devices can track their own functional integrity, indicate malfunctions as well as irregularities in the process and provide guidance on corrective actions. Additionally, you can depend on compliance with national and international regulations when it comes to hazardous areas, functional safety and hygiene, among other aspects.

Extended: Gain additional insight into processes by extracting, monitoring and using more data thanks to multivariable instruments providing measurements with superior reliability, even for fast-changing product and process conditions. Extended selection products feature the highest accuracy and fastest response times and help to optimize your production processes, either by reducing OPEX, increasing availability or improving product quality.

Xpert: Certain process analysis and control tasks, such as dealing with highly demanding ambient or process conditions, meeting ambitious productivity targets or complying with far-reaching regulations, require specialized instruments to maximize performance and productivity.

Proline transmitters

The new generation of transmitters

Proline 10
The transmitter for uncompromising simplicity
- Auto-rotatable, high-contrast LCD display
- SmartBlue app for wireless remote access
- Reliable commissioning thanks to wizard-guided menu
- Low total cost of ownership and minimal maintenance

Proline 100
The ultracompact transmitter
- Full functionality on the smallest footprint
- Space-saving installation (e.g. in skids)
- Integrated web server for time-saving local operation (via laptop and standard Ethernet cable)
- With/without display

Proline 200
The transmitter with genuine loop-powered technology
- Convenient device wiring thanks to separate connection compartment
- Safe operation – no need to open the device due to touch control
- Display module with data backup and data transfer function (e.g. to other measuring points)

Proline 300
The compact, easily accessible transmitter
- Multi-functional transmitter for the process industry
- Easy operation via the display, web server, WLAN, or fieldbuses
- HistoROM device memory: complete system integration compatibility through automatic restoration of the original firmware in service cases
- Reduced complexity thanks to freely configurable I/Os

Proline 400
The state-of-the-art transmitter for water and wastewater
- Corrosion-resistant housing made of polycarbonate
- Safe operation – no need to open the device due to display with touch control and background lighting
- Integrated web server for time-saving local operation (via laptop and standard Ethernet cable)

Proline 500
The remote transmitter version with up to 4 I/Os
- Remote installation with standard cable of up to 300 meters (984 ft) between sensor/transmitter
- Functionality, operation, and fieldbus interfaces as on Proline 300
- With up to 4 inputs and outputs

Proline 800
The battery-powered transmitter
- Secure data management: Worldwide, encrypted data transmission via cellular radio
- Intelligent during operation: Free choice of measuring intervals for a maximum battery life of up to 15 years
- Convenient commissioning: Operation via SmartBlue app

	Proline 10	Proline 100	Proline 200
			
	Utilities	Food / Life Sciences	Process industry
Display / Operation			
Local operation	✔	Display	✔
Web server	–	✔	–
WLAN (wireless)	–	–	–
Bluetooth (wireless)	✔	–	–
Cellular radio (wireless)	–	–	–
Materials / Protection			
Housing material	Alu, Poly	Alu, SS	Alu, CF3M
Degree of protection	IP66/67 (Type 4X) / Promag remote: IP68 (Type 6P)	IP66/67/69 (Type 4X)	IP66/67 (Type 4X)
Mounting			
Compact version	✔	✔	✔
Remote display/operation	–	–	✔
Remote version	Promag	–	Prowirl
System integration			
4–20 mA HART	✔	✔	✔
PROFINET-APL	–	–	Prowirl
PROFIBUS DP	–	✔	–
PROFIBUS PA	–	–	✔
FOUNDATION Fieldbus	–	–	✔
Modbus RS485	✔	✔	–
EtherNet/IP, PROFINET	–	✔	–
Pulse/frequency/status output	✔	✔	✔
Relay output	–	–	–
Configurable I/Os	–	–	–
Status input	–	–	–
Current input	–	–	Prowirl
Application packages (as standard or option)			
Heartbeat Technology	✔	✔	✔
Extended HistoROM	–	✔	✔
HistoROM device memory	✔	✔	–
Extended data logger	–	–	–
Concentration measurement	–	Promass	–
Conductivity measurement	Promag	Promag	–
Density measurement	Promass	Promass	Promass
Wet steam measurement	–	–	Prowirl F
Energy flow measurement	–	Prosonic Flow E	Prowirl F, R, O; Prosonic Flow B
Second Gas Group	–	–	–
Approvals / Certificates			
SIL	–	–	✔
Custody transfer	–	–	–
3-A, EHEDG (not for Prowirl)	Promass	✔	✔
CSA general purpose	✔	–	–
Ex Zone 2 / Class I Div. 2	Promass K; Promag P	✔	✔
Ex Zone 1 / Class I Div. 1	Promass K; Promag P	–	✔

✔ available; **Alu** Aluminum; **SS** Stainless steel 316L; **Poly** Polycarbonate; **CF3M** Stainless steel die-cast

Proline 300	Proline 400	Proline 500	Proline 800
			
Process industry	Water & Wastewater	Process industry	Water & Wastewater
✔	✔	✔	–
✔	✔	✔	–
✔	✔	✔	–
–	–	–	✔
–	–	–	✔
Alu, CF3M, SS	Alu, Poly	Alu, CF3M, Poly	Poly
IP66/67/69 (Type 4X)	IP66/67 (Type 4X)	IP66/67 (Type 4X)	IP66/67 (Type 4X) / IP68 (Type 6P)
✔	✔	–	✔
✔	–	–	–
–	✔	✔	✔
✔	✔	✔	–
Promass, Promag	–	Promass, Promag	–
✔	✔	✔	–
✔	–	✔	–
✔	–	✔	–
✔	✔	✔	✔
✔	(EtherNet/IP)	✔	–
✔	✔	✔	✔
✔	–	✔	–
✔	–	✔	–
✔	✔	✔	✔
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✔	✔	✔	✔
✔	✔	✔	–
✔	–	✔	✔
–	–	–	✔
Promass	–	Promass	–
Promag	Promag	Promag	–
Promass	–	Promass	–
–	–	–	–
t-mass F, I; Prosonic Flow G	–	–	–
t-mass F; t-mass I	–	t-mass F; t-mass I	–
✔	–	✔	–
✔	✔	✔	–
✔	–	✔	–
✔	–	–	✔
✔	✔	✔	–
✔	–	✔	–

Chemical: Competitive and safe

We help you boost your plant's safety and performance

Maximizing productivity and profitability whilst meeting toughening safety and sustainability standards is the greatest challenge facing the chemical industry today. Technological innovation brings opportunity, but reliability is vital. Plant modernization is expedient, yet project delivery complex. Our innovatory instrumentation with safety built-in, allied to expert safety and project consulting, enables Endress+Hauser to deliver solutions to safely and reliably attain peak plant performance.

Endress+Hauser helps you to improve your processes:
- With our field instruments that are designed with safety in mind
- With our worldwide industry application know-how
- With technologies and services for performance optimization

Advantages at a glance
- Safe operation: simplified access for maintenance work in hazardous areas thanks to the intrinsically safe design of the loop-powered devices (Proline 200)
- Worldwide recognized hazardous area approvals for all measuring devices
- Highest operational safety: devices developed entirely in accordance with IEC 61508 (SIL). Clear display of diagnostic and error messages according to NAMUR NE107
- Process safety is guaranteed at all times: integrated Heartbeat Technology for diagnostics, verification, and monitoring

Product highlights

Two-wire, loop-powered technology

F L **E** X

Promass F 200 (Coriolis)

With genuine loop-powered technology
Proven and robust flowmeter for gases and liquids with highest measuring performance in a wide range of applications. Rated sensor housing, purge connections and rupture disks. Wetted parts made of chemically resistant materials. No inlet/outlet runs.

F L **E** X

Promag P 200 (Electromagnetic)

Robust flowmeter
Genuine loop-powered device (4–20 mA) for corrosive liquids and high fluid temperatures. Wetted parts made of chemically resistant materials. Free pipe cross-section without pressure loss.

F L **E** X

Prowirl F 200 (Vortex)

The specialist for steam
Highest process safety thanks to the unique wet steam measurement and the dualsens version enabling redundant measurements. High resistance to vibrations, temperature shocks and water hammer. Lifetime calibration factor.

Four-wire technology

F L **E** X

Prosonic Flow G 300 (Ultrasonic)

Highly robust gas specialist
For a wide range of gas applications. Even with wet gas, gas mixtures and changing gas properties due to integrated temperature and pressure measurement. Unparalleled flexibility with advanced gas analysis functions (calorific value, Wobbe index, etc.)

F L E **X**

Promass Q 300 (Coriolis)

Specialist for quality control
Unmatched accuracy for mass flow, volume flow and density measurement even in very challenging applications. “Multi-Frequency Technology” (MFT) for an outstanding performance for liquids with entrained gas.

F L **E** X

Promag P 300 (Electromagnetic)

Robust, easily accessible flowmeter
For corrosive liquids and high fluid temperatures. Wetted parts made of chemically resistant materials. Free pipe cross-section without pressure loss.

Unbeatable: SIL and Heartbeat Technology

In the chemical industry, safety devices must be regularly tested to ensure their safety function (SIL). Such proof tests are often time-consuming and costly, particularly for continuously measuring systems.
Our new Proline flowmeter generation is equipped with Heartbeat Technology, allowing to extend proof-test intervals to three years, or more. The embedded self-monitoring functionality enables proof testing in maximal depth without interrupting operation:

- Lower probability of undetected failures thanks to highest diagnostic coverage
- In-situ verification can be carried out at any time during operation (minimizes the risk of dangerous systematic faults). No removal necessary.
- Electronically stored verification results in the flowmeter, uploaded to the asset management system
- Safe and seamless documentation in accordance with local standards
- Generation of verification reports according to IEC 61511-1

Efficient two-wire loop-powered technology

Round-the-clock operational safety and plant availability are particularly important in the chemical industry. In addition, the complexity for plant operators is constantly increasing due to the numerous measuring tasks.
Using our uniform two-wire concept (4–20 mA) for all measuring technologies, you are able to increase the operational reliability and reduce costs for planning, purchasing and operation:

- High operational safety and safe device access in hazardous areas due to intrinsically safe design (Ex ia)
- Reduced costs for installation and wiring
- Developed for SIL 2/3 applications according to IEC 61508 – suitable for use in safety instrumented systems
- Seamless system integration into existing infrastructures
- Common installation practice
- Uniform operation, components, data management, etc.

Water & Wastewater: Water is our life

Increase your efficiency and ensure compliance with an experienced and trusted partner

Today more than ever the water and wastewater industry must balance the opposing pressures of improving water safety and shrinking budgets. Whether treating for consumption or discharge, process complexity is rising. Endress+Hauser combines a wide portfolio of smart measuring instruments with industry-experienced consulting and expert services to flexibly and efficiently ensure water safety with verifiable regulatory compliance.

Endress+Hauser helps you to improve your processes:
- With a comprehensive portfolio of measuring instruments and tailor-made services
- With reliable industry application expertise
- With optimized maintenance routines through instruments with self-diagnostic functionalities

Advantages at a glance
- Industry-optimized device portfolio for measuring raw water (river and seawater), potable water, process water, or wastewater
- Worldwide recognized drinking water approvals
- Fully welded sensors with certified corrosion protection (EN ISO 12944) for permanent installation under water or underground
- Integrated web server for time-saving local operation without additional software and hardware
- Device check with Heartbeat Verification during operation and without removal

Product highlights

F L **E** X

Promag W 400 (Electromagnetic)

The specialist with corrosion protection
For demanding raw water or wastewater. Robust, completely welded sensor for operation under water or underground due to IP68 (Type 6P) and certified corrosion protection (EN ISO 12944). Custody transfer. Drinking water approvals. Up to DN 3000 (120").

F **L** E X

Promag W 800 (Electromagnetic)

For regions without power supply
Battery-powered flowmeter for drinking and process water. Encrypted data transfer via mobile network. Robust, well-proven sensor for installation under water or underground. Battery life up to 15 years.

F **L** E X

Promag W/D 10 (Electromagnetic)

For basic applications
For water and wastewater. Easy-to-use operation concept. Drinking water approvals. Promag W: Flanged device (DN ≤ 3000/120") with 0 x DN inlet run and without pressure loss.

F L **E** X

Promag W 300/500 (Electromagnetic)

The specialist for hazardous areas
With up to four signal outputs (I/Os). Completely welded sensor with certified corrosion protection (EN ISO 12944). Drinking water approvals. WLAN communication for a time-saving commissioning.

F L E **X**

Prosonic Flow B 200 (Ultrasonic)

The specialist for wet biogas
Accurate measurement of digester gas and biogas also with low process pressure, low flow rates or fluctuating gas composition. Integrated real-time methane fraction analysis. With diagnostic functions. Energy balancing by calculating corrected volume, calorific value or Wobbe index. With hazardous area approvals.

F L **E** X

t-mass F/I 300/500 (Thermal)

For controlling aeration air
Reliable gas flowmeter, e.g. for aeration control in activated sludge basins. High performance, large turndown. Robust, drift-free sensor and IP68 (Type 6P) for harsh ambient conditions. No moving parts. Up to DN 1500 (60").

Verification made easy with Heartbeat Technology

The smallest measuring inaccuracies can cause shortfalls in the end-of-year accounting for providers or consumers. In the water industry's 24-hour operation, removing flowmeters for test measurements or recalibration is simply not realistic. The questions asked by a plant operator are therefore always the same:

- How can I prove that my flowmeter measures within the specified accuracy?
- How can flow measuring points for custody transfer be inspected and verified in accordance with the law?
- Is it possible to extend the calibration intervals specified by law?

Answers to all of these questions are provided by the unique "Heartbeat Technology." This function, integrated into the measuring electronics, allows to monitor Proline flowmeters constantly and verify their performance at any time – guaranteeing high measurement quality:

- Audited and attested self-monitoring and verification (attested by TÜV SÜD)
- Verification possible at any time using any device interface – no presence in the field required
- No process interruption required
- Metrologically traceable verification
- Documentation in accordance with ISO 9001
- Guided and time-saving device programming

Food & Beverage: Trust in quality

We help you to improve quality while reducing operational costs

Constant demand for consistency in product quality and taste makes Food & Beverage a demanding industry. Complexity increases as ever more stringent hygiene regulations for food safety add cost pressures. Endress+Hauser's industry leading portfolio of reliable instrumentation, expert global consulting and accredited calibration services all combine to enable greater plant availability, resource conservation and high repeatability in processing with traceable compliance.

Endress+Hauser helps you to improve your processes:
- With a hygienic, robust product portfolio that meets international standards
- With access to traceable, reliable and real-time data
- With a network of industry application experts that help you ensure greater plant availability throughout the product life cycle

Advantages at a glance
- Proline 100: industry-optimized flowmeters with an ultracompact design and full functionality on the smallest footprint (with or without display)
- All measuring devices feature a hygienic design (3-A, EHEDG)
- Fewer measuring points thanks to multivariable measurement of mass flow, density, temperature (Coriolis) and volume flow, temperature, conductivity (electromagnetic)
- Integrated web server for time-saving local operation without additional software and hardware
- Extended calibration intervals thanks to Heartbeat Technology

Product highlights

F L **E** X

Promag H 100 (Electromagnetic)

The proven specialist for food
Ideally suited for demanding hygienic applications as well as for modular, skid-mounted process facilities. Numerous hygienic process connections. Highest degree of protection (IP69). Easy to clean (CIP/SIP) and piggable.

F L E **X**

Promass S 100 (Coriolis)

The hygienic single-tube system
With optimal cleanability and self-drainability. Single-tube system with gentle fluid treatment (no shear forces). Immediate availability after CIP/SIP cleaning. Numerous hygienic process connections. Highest degree of protection (IP69). No inlet/outlet runs.

F L **E** X

Promass F 100 (Coriolis)

For premium accuracy and robustness
Highest flow and density measuring accuracy for liquids and gases under varying, demanding process conditions. Immediate availability after CIP/SIP cleaning. Highest degree of protection (IP69). No inlet/outlet runs.

F L **E** X

Promass E 100 (Coriolis)

For cost-effective liquid measurement
For non-conductive liquids in basic applications. Ideally suited for modular, skid-mounted process facilities. With a clearly lower total cost of ownership than conventional volumetric flowmeters. Immediate availability after CIP/SIP cleaning. Highest degree of protection (IP69). No inlet/outlet runs.

F L E **X**

Promass Q 300 (Coriolis)

Specialist for challenging applications
With unmatched accuracy for mass flow and density measurement even in applications with highest demanding requirements. "Multi-Frequency Technology" (MFT) for an outstanding performance for liquids with entrained gas. Immediate availability after CIP/SIP cleaning. Highest degree of protection (IP69). No inlet/outlet runs.

Process control made easy

The trend toward more efficient processes and higher quality requirements in the food industry demands for measurement of more parameters beyond flow.

Density functions (Promass)

The fluid density constantly measured by Promass can be used to calculate further density parameters that are available for optimal process control:

- Temperature-compensated density values
- Concentrations, mass (%) and volume (%) and also of solid contents, e.g. in two-phase fluids
- Industry-specific density units, e.g. standard density, °Brix (sugar content), °Plato (wort, beer) or the alcohol content (%)

Viscosity measurement (Promass I)

Promass I is the world's first Coriolis flowmeter that also measures the viscosity of a fluid directly in the piping – without additional devices. As with the density, this characteristic value can be used to constantly monitor and immediately adjust the process.

Conductivity measurement (Promag H)

Promag H 100 monitors the product quality by measuring temperature and temperature-compensated conductivity of the fluid.

In-line measurement of fluid properties
▸ page 32 to 35

Life Sciences: The pulse of life sciences

Trust a reliable partner who helps you achieve operational excellence

Today's thriving biopharmaceutical industry demands high productivity and efficiency balanced with meticulous alignment to GMP standards. From our innovatory ASME-BPE compliant product portfolio enabling standardized production automation, reliable monitoring and predictive maintenance, to our expert consulting in process scale-up and operations optimization, Endress+Hauser offers the full solution. We speed time to market, sustain operational excellence, enhance productivity, and reduce risk.

Endress+Hauser helps you to improve your processes:

- With the largest range of innovative and compliant measuring instruments, integrated calibration solutions and the latest instrument diagnostics
- With standardized project engineering and project management as well as a service portfolio that focuses on higher productivity

Advantages at a glance

- Proline 100: ultracompact flowmeter with full functionality on the smallest footprint – ideally suited for modular, skid-mounted process facilities
- Fewer measuring points thanks to multivariable measurement of mass flow, density, temperature (Coriolis) and volume flow, temperature, conductivity (electromagnetic)
- Simple and simultaneous access to extended device and process data thanks to digital signal transmission (Quality by Design)
- Less calibration effort and higher operational safety thanks to Heartbeat Technology

Product highlights

F L E **X**

Promass P 100 (Coriolis)

The specialist for sterile processes
For biotech applications requiring highest compliance. Fully self-drainable even in horizontal installations. Audit safety thanks to industry-compliant design (ASME BPE, etc.), comprehensive documentation and all required approvals. Stainless steel wetted parts with electropolished surface finish. No inlet/outlet runs.

F L **E** X

Promass F 100 (Coriolis)

For premium accuracy and robustness
Highest mass flow and density accuracy in regard to chemical API manufacturing under demanding process conditions. Immune to fluctuating processes and harsh environments. Immediate availability after CIP/SIP cleaning. No inlet/outlet runs.

F L **E** X

Promass E 100 (Coriolis)

Cost-effective metering of non-conductive liquids
Especially suited for mass flow measurement with basic requirements. Multipurpose device as an alternative to conventional volumetric flowmeters. Immediate availability after CIP/SIP cleaning. Easy installation thanks to a compact dual-tube sensor design. No inlet/outlet runs.

F L **E** X

Promag H 100 (Electromagnetic)

Cost-effective volumetric measurement of conductive liquids
For a broad range of less demanding applications. Flexible installation thanks to numerous hygienic process connections. Multivariable measurement of volume flow, temperature and conductivity. Fulfills internal and external regulatory requirements: FDA compatibility (USP Class VI). No pressure loss.

F L **E** X

Promag H 300 (Electromagnetic)

Cost-effective volumetric flowmeter
For a broad range of less demanding applications. High flexibility in regard to system integration: 3 freely configurable I/Os as well as various fieldbuses. Fulfills internal and external regulatory requirements: FDA compatibility (USP Class VI). Flexible installation due to numerous hygienic process connections. No pressure loss.

Extended calibration intervals thanks to Heartbeat Technology

Product quality, measuring accuracy and reproducibility are all critical in the highly regulated life sciences industry. Full GMP compliance (Good Manufacturing Practice) is therefore a basic requirement to achieve operational excellence and reduce operational costs. This is especially important when dosing, mixing or filling very expensive active ingredients.
Plant operators are therefore obligated to have process-critical measuring devices periodically checked in a traceable way and to document the results for regulatory audits. Traditional calibration, for example, is not only expensive and time-consuming, but also causes process interruptions and increases the risk of cross contamination due to the opening of sterile process loops.
With Heartbeat Technology, calibration intervals can be significantly extended:

- Compliant verification without interrupting the process. Can be carried out via all device interfaces at any time.
- Verification results are stored in a data record or in PDF format — available for electronic reporting and quality auditing.
- Complete metrological traceability, thus ensuring that the flowmeter works within specification.
- Minimized residual risk of failure due to total test coverage of 95% – allowing for extended calibration intervals of up to 5 years.

Oil & Gas: Fuel for thought

We reduce complexities to help you perform, comply and thrive in the oil and gas sector

Maximizing plant availability, safety and the efficiency of operations are the key challenges for today's oil and gas industry. Complexity increases in the face of volatile market forces, strict international regulations and your ever-tightening resources. Close, accurate monitoring of key process parameters is critical. Our broad, reliable portfolio of instrumentation, deep industry experience, and our services and solutions make Endress+Hauser the ideal partner for optimal plant performance.

Endress+Hauser helps you to improve your processes:
- With the largest portfolio of safety instruments that comply with international regulations
- With applied technologies and people who have extensive industry application know-how
- With access to accurate and traceable information

Advantages at a glance
- Globally unique Heartbeat Technology: for the highest level of system safety and measurement integrity. Best-in-class diagnostic coverage, developed in accordance with IEC 61508.
- Simple and quick commissioning/maintenance thanks to wireless data transfer via WLAN (web server).
- Worldwide recognized custody transfer approvals.
- Certified bunker fuel metering system in accordance with MID (MI-005). Approved for commercial use by the Maritime and Port Authority of Singapore (MPA).

Product highlights

F L **E** X

Promass F 300 (Coriolis)

For premium accuracy and robustness
Highest measuring performance for hydrocarbons under varying, demanding process conditions. Highest safety (SIL 2/3): rated sensor housing, purge connections and rupture disks.

F L E **X**

Promass Q 300 (Coriolis)

Specialist for challenging applications
With unmatched accuracy in custody transfer and for mass flow, volume flow and density measurement even in very demanding applications. "Multi-Frequency Technology" (MFT) for an outstanding performance for liquids with entrained gas.

F L E **X**

Promass O 300 (Coriolis)

Robust high-pressure flowmeter
Premium accuracy also at highest process pressures up to PN 250 (Class 1500). Maximum safety (SIL 2/3): highest resistance to stress corrosion cracking and hydrogen sulfide (H_2S). Measuring tubes made of Super Duplex.

F L **E** X

Prosonic Flow G 300 (Ultrasonic)

For process gas measurement
High-tech gas flowmeter for dry or wet gases. Integrated pressure/temperature sensors for real-time compensation. Unparalleled flexibility with gas analysis functions for pure gases or user-defined gas mixtures with up to 8 selectable components.

F L **E** X

Prosonic Flow P 500 (Ultrasonic)

Maximum performance in confined spaces
Non-intrusive measurement for various pipe types. Ideally suited for challenging applications (corrosive, abrasive, toxic). Independent of high pressures and temperatures. Specified accuracy even for very short inlet runs (≥2 × DN).

F L **E** X

Prowirl F/O 200 (Vortex)

The all-rounder with integrated natural gas calculation (AGA)
Robust vortex flowmeter for natural gas, liquids and steam. Dualsens version with two sensors and transmitters for redundant measurements and maximum safety (SIL 3). Lifetime calibration factor. With unique wet steam detection. Prowirl O 200 for high-pressure applications up to PN 250 (Class 1500).

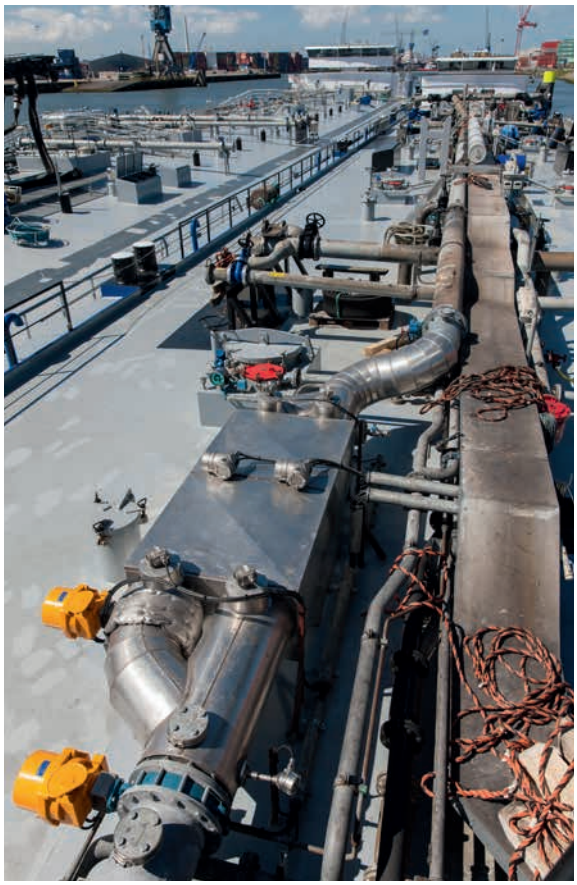
Certified bunker fuel metering systems

Day after day, vast quantities of bunker oil are pumped into the fuel tanks of passenger ships, container ships, tankers and bulk carriers. Even the slightest measurement inaccuracies during this bunkering process cause "cash register" shortages and time-consuming disputes.

As well known, the traditional quantity measurement via tank gauging can, for example, be associated with a great amount of uncertainty due to error prone volume to mass calculation as well as not considered air content caused by tank stripping and the "cappuccino effect."

Our solution according to MID (MI-005) prevents measuring inaccuracies during the bunkering process, no matter how small:

- Improved profitability – accurate billing thanks to high accuracy (±0.5% with areated fuels)
- Maximum transparency – simultaneous monitoring of mass flow, bunker fuel quantity, density, pressure, temperature and air index
- Sustainable efficiency – time savings of up to 3 hours for each bunkering operation
- Guaranteed system integrity – components are sealed by independent agencies
- Simple operation – separate control panel with intuitive user interface



Power & Energy: Power up your plant

Power plants play a vital role, we help maximize uptime while delivering safety and productivity

Today's Power & Energy industry must strike a complex balance: meeting spiraling demand for affordable and reliable energy while increasing cleaner and renewable sources in the energy mix. As cost and regulatory pressures grow, modernization is essential for efficient, safe resource use. As renewables advance, so does the need for energy storage. With best-fit instrumentation, deep power application expertise, services and solutions, Endress+Hauser brings efficient, reliable productivity.

Endress+Hauser helps you to improve your processes:
- With innovative installation concepts executed during operation to minimize downtime
- With experts to advise you from concept to commissioning
- With measurement technologies, accessories and mechanical pre-assembled components to minimize outages

Advantages at a glance
- Fewer downtimes thanks to first-class, robust measuring instruments for every application: flow, level, temperature, pressure, analysis, etc.
- Maximum operational safety and energy efficiency: vortex flowmeter with permanent steam quality measurement (dryness fraction)
- Maximum system availability thanks to Heartbeat Technology – traceable device verification during operation
- Decades of experience in engineering and project management

Product highlights

F L **E** X

Prowirl F 200 (Vortex)

Standard device for demineralized water, steam and gas
Multivariable loop-powered two-wire device (4–20 mA). With temperature/pressure measurement and a flow computer to calculate mass and energy flow. With worldwide unique in-line wet steam measurement. Lifetime calibration factor (K-factor).

F L **E** X

Promass F 500 (Coriolis)

Highly accurate mass flow and density measurement for flue gas desulfurization
Reliable measurement of abrasive and chemically aggressive gypsum suspension. Optimum process control thanks to a minimum measured error (±0.0005 g/cm³). No inlet/outlet runs.

F L **E** X

Promag W 400 (Electromagnetic)

For the accurate metering of raw and cooling water
Measuring principle is independent of pressure, density and temperature. With an integrated electrode cleaning function (ECC) to prevent conductive magnetite deposits. 0 x DN full-bore version available, without inlet and outlet runs. Optional measurement of conductivity.

F L E **X**

Promass I 300 (Coriolis)

For cost-optimized combustion processes
Simultaneous measurement of mass, volume, density and temperature. With unique in-line viscosity measurement for adjusting the optimum burning of fuels, e.g. with auxiliary burners. No inlet/outlet runs.

F L **E** X

t-mass F/I 300/500 (Thermal)

For hydrogen, natural gas and compressed air
Direct output of gas mass and corrected volume. Negligible pressure drop, very high turndown and lowest flow rates measurable. Insertion version for large line sizes (DN ≤1500/60"). For bidirectional flow. Short inlet runs with integrated flow conditioner. Optionally with SIL approval.

Multivariable measurement for more transparency

You can use Proline flowmeters – without additional sensors – to measure multiple variables simultaneously and thereby control your processes optimally while saving money.

Cost-reduced combustion (Promass I 300)

Promass I 300 is the world's only flowmeter that also measures fluid viscosity directly in the piping. This makes it possible to adjust the best possible, viscosity-dependent burning temperature during combustion of fuel oil.

Efficient flue gas desulfurization (Promass F 500)

During flue gas desulfurization, flue gases are sprayed with a limestone suspension and plaster is produced by blowing in air. For this process to run correctly, Promass F 500 not only measures the amount of plaster suspension, but also measures its density simultaneously with the greatest accuracy (±0.0005 g/cm³).

Comprehensive energy management (Prowirl F 200)

For energy management Prowirl F 200 offers "everything" in a single device: a flow computer for calculating important characteristic values, the option of reading in temperature and pressure values, a temperature sensor and the globally unique wet steam measurement for increased safety and energy efficiency.

Mining, Minerals & Metals: Extracting more from less

In a world of lower ore grades, skill gaps and excavation challenges we can help you hit your target

Never more so than today has the mining, minerals and metals industry had to manage such tension between soaring demand, increased scarcity, lower ore grades, fluctuating prices, and toughening safety and sustainability criteria. Combining our innovative product portfolio with our deep application and industry knowledge enables Endress+Hauser customers to optimize processes, boost productivity, and ensure safety and environmental compliance.

Endress+Hauser helps you to improve your processes:
- With process experts who recommend the best-fit products, services and solutions according to industry requirements
- With solutions that mitigate risk and reduce your environmental impact
- With access to the right data at the right time

Advantages at a glance
- Maximum system availability even in extreme process conditions – Promag 55S with chemical-resistant and abrasion-resistant linings and electrode materials
- Maximum productivity – Prowirl 200 with integrated wet steam measurement for the highest possible energy efficiency in steam utilities
- Environmental compliance – reliable and accurate measurement of industrial wastewater with industry-optimized flowmeters (e.g. Promag W 400 for permanent measurement under water or underground)
- Maximum system availability thanks to Heartbeat Technology – traceable device verification during operation
- Ready for IIoT – Proline instruments offer a well-suited range of measuring parameters that can be checked independent of location and with high integration flexibility

Product highlights

F L E **X**

Promag 55S (Electromagnetic)

For inhomogeneous or abrasive fluids
For slurries with high solids content, fine to rocky size. High resistance to abrasion thanks to industry-optimized linings. Excellent accuracy and repeatability. Calculation of mass flow and solids content.

F L **E** X

Promag P 300/500 (Electromagnetic)

For demanding industrial applications
Robust device, e.g. for mineral processing, steel works, highest safety and chemically aggressive fluids at high temperatures. Corrosion-resistant PTFE or PFA lining (180 °C/356 °F). Hazardous area approvals. Also available as remote version (Promag 500).

F L **E** X

Promag W 400 (Electromagnetic)

For industrial water and wastewater
Corrosion-resistant polycarbonate transmitter housing. Constant accuracy with 0 x DN inlet run and no pressure loss. With completely welded sensor in IP68 (Type 6P) and with certified corrosion protection (EN ISO 12944) for reliable long-term operation.

F **L** E X

Promag W 800 (Electromagnetic)

Battery-powered for remote applications
Reliable battery-powered flow measurement of process water. Encrypted data transfer via mobile network. Robust, well-proven sensor for installation under water or underground. Battery life up to 15 years.

F L **E** X

Prowirl F 200 (Vortex)

The specialist for gas and steam
Multivariable loop-powered two-wire device (4–20 mA). With pressure/temperature measurement and a flow computer for the calculation of mass and energy flow. Unique wet steam measurement for highest safety. Lifetime calibration factor.

F L E **X**

Promass I 100 (Coriolis)

For fuel measurement
Simultaneous measurement of mass, volume, density and temperature. With unique in-line viscosity measurement to adjust for optimal burning temperatures, e.g. in kilns. No inlet/outlet runs. No pressure loss due to straight single-tube design.

Measuring flows with solids reliably

Plant operators who pump slurries – for example in mining – frequently need to register the total density of the fluid or the quantity of solids transported as part of their "quality information":

- Density measurement of extracted raw materials in water mixtures
- Determination of solid content in concentrators and in settling and clarifying pools
- Density determination of slurries for disposal

With the Promag 55 flowmeter and the Gammapilot FMG50 densimeter, Endress+Hauser offers a unique product solution package for computation of solid content flow.

Promag 55S (flow)

- Integrated computation function for solid flow without the need for an external computer (software can be uploaded via F-CHIP optionally at any time)
- Density values (from any density meter) can be directly read in via the current input
- Solids readings output in mass, volume or percentage fractions via the frequency or current output

Gammapilot FMG50 (density)

- Radiometric density measurement for extremely abrasive, stone-laden fluids (regardless of grain size)
- Installation/retrofitting without process interruption
- Robust, compact transmitter

Saving energy and costs – together

Generating and distributing air, steam, gas, cooling or heating water requires a considerable amount of cost and energy. We help you to run these utilities as efficiently as possible.

The first step companies take to increase plant efficiency and consequently their competitiveness is to save energy and thus reduce operating costs. In utility networks, for example, there are so many potential areas to save energy. It is therefore important to increase transparency regarding energy flows. Comprehensive energy monitoring can typically cut energy consumption by 5 to 15%.

You can fully count on Endress+Hauser in regard to energy and cost savings:
- Customized solutions for your energy applications
- Planning, commissioning and maintenance
- Engineering, project management of simple solutions, for example, for boiler houses right through to complete system solutions
- Expert advice from qualified specialists

Advantages at a glance
- All costs kept under control – energy consumption is charged efficiently to internal cost centers
- Maximum supply reliability and transparency – extensive monitoring of all fluid and energy flows around the clock
- Maximum system availability thanks to Heartbeat Technology – integrated and traceable device verification during operation
- Guaranteed compliance with legal requirements and guidelines – many years of experience in the planning and installation of energy (ISO 50001) and environmental management systems (ISO 14001)

Product highlights

F L **E** X

Prowirl F 200 (Vortex)

All-rounder for steam, gas and air
Multivariable loop-powered two-wire device (4–20 mA). With pressure/temperature measurement and a flow computer for the calculation of mass and energy flow. With worldwide unique in-line wet steam measurement. Lifetime calibration factor.

F L **E** X

Promag W 400 (Electromagnetic)

For process, cooling and wastewater
Measurement is independent of pressure, density and temperature. No pressure loss. Combinable with flow computers and temperature sensors for deltaheat applications (energy).

Prosonic Flow 93T (Ultrasonic)

For temporary consumption measurement of water
Portable ultrasound measuring system for flexible monitoring, testing and verifying metering points. With integrated data logger. Data transmission via USB memory stick.

F L **E** X

t-mass A/B 150 (Thermal)
t-mass F/I 300/500 (Thermal)

Cost-effective metering of utility gases
For leakage detection in gas networks and/or in-house consumption accountancy of compressed air, CO_2, nitrogen or argon. Multivariable measurement of mass flow, corrected volume flow, FAD volume flow and temperature. Inline (A, F) and insertion versions (B, I) for pipes and rectangular ducts. t-mass F/I for almost all gas mixtures and utility gases, e.g. natural gas or oxygen.

F L E X

Picomag (Electromagnetic)

Flow metering in a pocket-sized format
For cost-effective measurement of conductive liquids in numerous industries. Space-saving device where space is at a minimum. Integrated temperature measurement. Operation and commissioning using Bluetooth and the SmartBlue app.

F **L** E X

Promass K 10 (Coriolis)

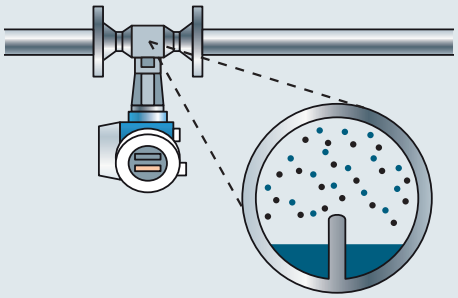
For utilities
Alternative for conventional volumetric and variable area flowmeters. Direct mass flow measurement in WFI water purification skids. Fast installation and commissioning. Auto-rotating display with touch screen and guided menus. No inlet/outlet runs.

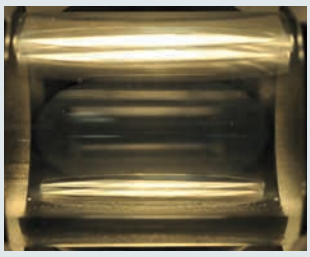
Don't give wet steam a chance

Time and time again, insufficient insulation, defective condensate drains as well as pressure and temperature fluctuations lead to dangerous wet steam. Moreover, the transfer of heat energy via wet steam is not energy-efficient. This is now a thing of the past! As the world's first vortex flowmeter, Prowirl F 200 is capable of permanently measuring the steam quality in the piping.

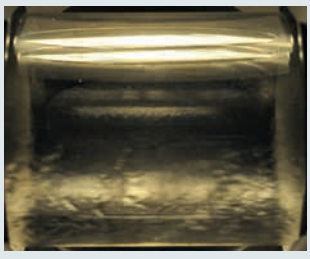
Wet steam occurs through the condensation of steam. First, the condensate flows at the bottom of the pipe and then smears up the wall, which affects the measuring signal of Prowirl F 200. This effect can be used to determine the steam quality, which can be outputted as measured variables:

- Measurement of the dryness fraction between 80 and 100% – and thus the determination of the steam type (wet, saturated or superheated steam)
- Exact mass measurement of the steam and/or condensate quantity (e.g. in kg/h)

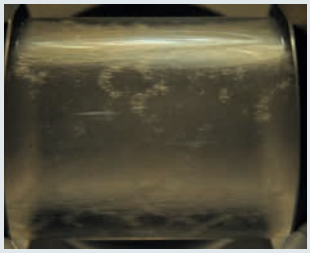




100% dryness fraction (saturated steam, $\chi = 1$)



90% dryness fraction ($\chi = 0.9$)
10% condensate (with wavy flow)



80% dryness fraction ($\chi = 0.8$)
20% condensate (with annular flow)
Alarm ⚠

Flow measurement for filling

Dosimass und Dosimag – Filling and dosing in a cycle of mere seconds with the highest possible accuracy: these requirements are fulfilled by the two flow specialists from Endress+Hauser without any compromise

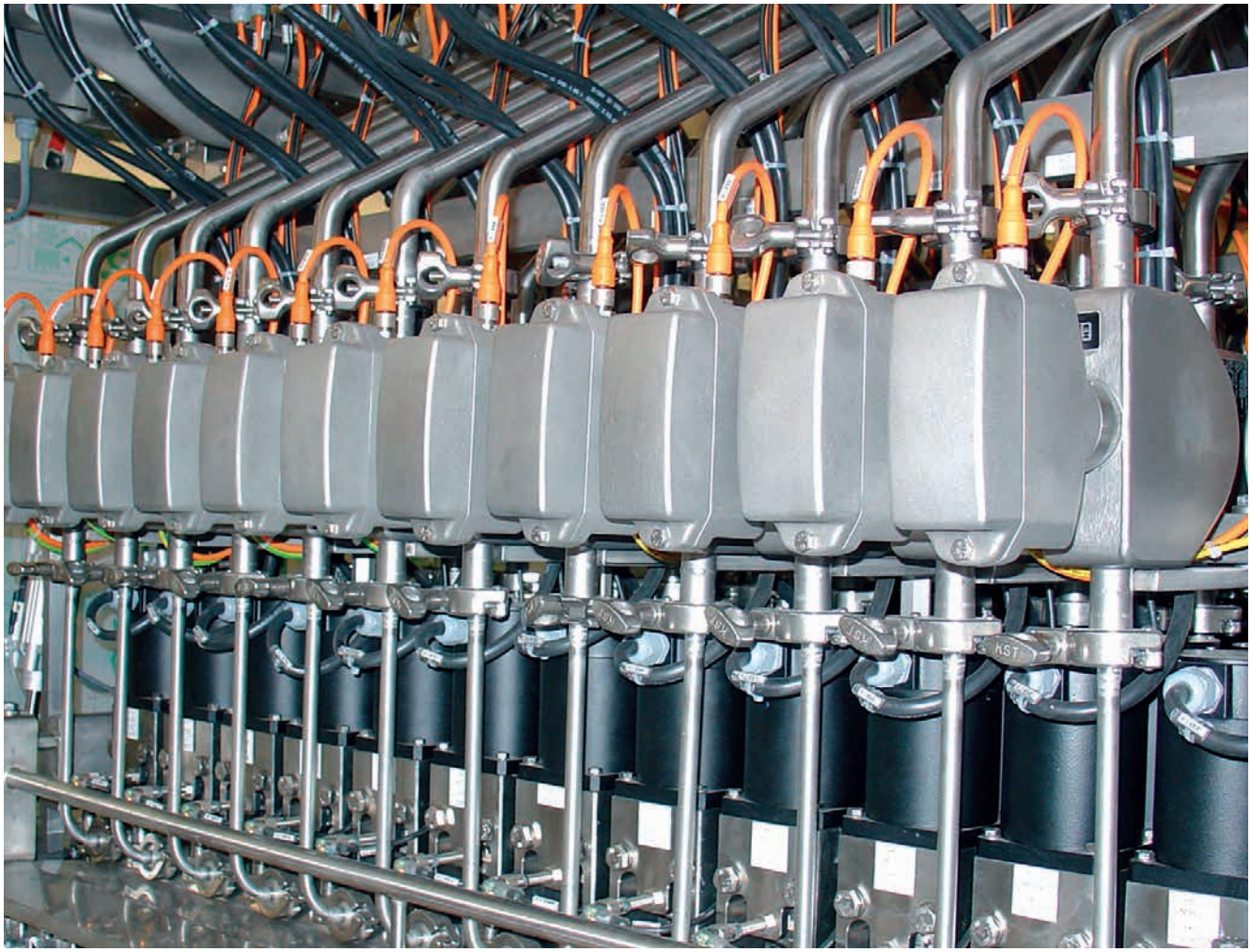
For years now, state-of-the-art flowmeters have been used increasingly for filling applications, since previously used technologies – e.g. piston-type fillers – are no longer adequate for remaining competitive. Endress+Hauser's Dosimass and Dosimag are two measuring devices that not only measure flow reliably, but also exceed all common requirements for hygiene, cleaning and process control.

Designed for industrial requirements
Dosimass and Dosimag are high-precision, maintenance-free filling meters. Reliability in operation and a high level of performance, even under demanding requirements, are characteristic of both flowmeters. They are an ideal replacement for conventional filling technology:

- Compact, space-saving design of the device
- Optimal integration into existing systems with numerous process connections
- 3-A approval and EHEDG certified
- Measuring technology for shorter and faster cleaning cycles
- For non-continuous filling processes
- High repeatability
- Smallest volumes can be metered within the shortest filling cycles thanks to the "batching function" which can directly control up to two closing valves

Cost-effectiveness in metering
In real-world terms, cost-effective means no unnecessary downtime caused by maintenance or repair. This is exactly where Dosimass and Dosimag support operators with an ideal device concept:

- Functions for self-monitoring and diagnosis
- Maintenance-free, no moving parts in the measuring tube
- CIP and SIP cleanable (up to 150 °C / 302 °F for 60 minutes)
- Self-emptying measuring tubes (open cross-section)
- Practical replacement concept for process seals








Dosimag

Cost-effective filling of conductive liquids

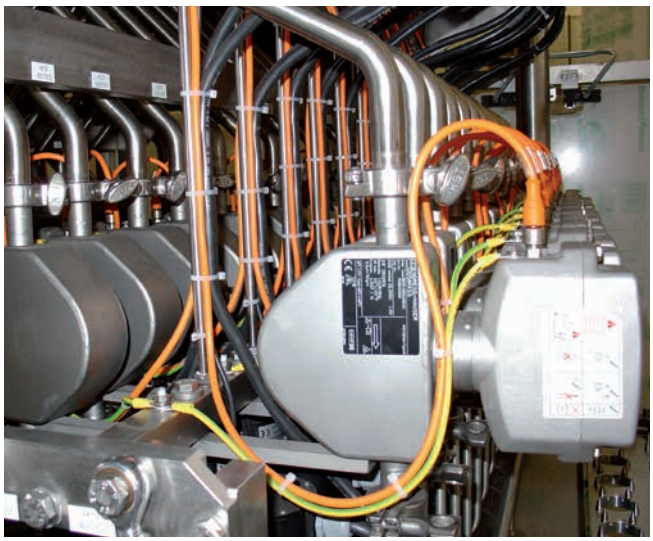
- Electromagnetic flowmeter
- Measured variable: Volume flow of liquids (≥5 µS/cm)
- Flow rate up to 5 l/s (1.33 gal/s)
- Applicable up to 130 °C (266 °F) and 16 bar (232 psi)
- DN 4 to 25 (5/32 to 1")

Dosimass

Direct and highly accurate mass measurement

- Coriolis flowmeter
- Measured variable: Mass/volume flow
- Independent of the physical fluid properties
- Applicable up to 125 °C (257 °F) and 40 bar (580 psi)
- Especially for handling different fluids
- DN 8 to 25 (3/8 to 1")

F L E X

Gas filling and refueling

CNGmass, LPGmass und LNGmass – The number of refueling stations and dispensers for compressed natural gas (CNG), liquefied gas (LPG) and liquefied natural gas (LNG) is increasing around the world. Our unparalleled selection of flowmeters guarantees maximum accuracy for billing and on-site fueling.

Outstanding performance is the norm for these three Coriolis flowmeters, as safety and reliability in operation is always of foremost importance for gas fueling.

- Assured measuring accuracy – since every device is certified on accredited calibration rigs (ISO/IEC 17025)
- Measuring principle independent of physical fluid properties
- Worldwide recognized hazardous area approvals (e.g. ATEX, FM or CSA)
- Numerous custody transfer approvals (e.g. PTB, NTEP, MC and MID)
- Time-saving operation and commissioning using FieldCare software
- Optimal process control with Modbus RS485
- High customer acceptance thanks to longtime industry experience

For compressed natural gas (CNG)

CNGmass (Ex d/Ex i)

- For dispensers
- DN 8 to 25 (⅜ to 1")
- Direct mass flow measurement
- Max. 150 kg/min (330 lb/min)
- Max. 350 bar (5076 psi)
- −50 to +125 °C (−58 to +257 °F)
- Process connection: Internal thread
- Modbus RS485, pulse/ frequency/switch output
- High vibration resistance
- With UL approval (Underwriters Laboratories)
- Ex i version: CNGmass (D8CB) in a compact design, only with Modbus RS485, no custody transfer approval

Ex d

Ex i

CNGmass DCI (Ex d)

- Same basic technical data as for CNGmass (Ex d)
- Four-line, backlit display with push buttons or touch control (operation from outside)
- −50 to +150 °C (−58 to +302 °F)
- HART, relay output

Ex d

Your benefits

- Compact, space-saving design – fits into every dispenser
- Broad range of different instrument versions
- Wide measuring range fulfills the operating requirements of all common refueling station types

For liquefied petroleum gas (LPG)

LPGmass (Ex d/Ex i)

- For dispensers or tank trucks
- DN 8 to 50 (⅜ to 2")
- Direct mass or volume flow metering
- Max. 1167 kg/min (2570 lb/min)
- Max. 40 bar (580 psi)
- −40 to +125 °C (−40 to +257 °F)
- Process connections:
  Flanges EN (DIN), ANSI, JIS;
  VCO threaded connections, etc.
- Modbus RS485, pulse/
  frequency/switch output
- High vibration resistance

Your benefits

Direct calculation of temperature-compensated volumes on site without additional measuring instruments:

- Integrated temperature measurement in accordance with MI-005 – can be used for corrected volume flow
- API table integrated as standard

For liquefied natural gas (LNG)

LNGmass (Ex i)

- For dispensers
- DN 8 to 25 (⅜ to 1")
- Direct mass flow measurement
- Max. 300 kg/min (660 lb/min)
- Max. 40 bar (580 psi)
- −196 to +125 °C (−321 to +257 °F)
- Process connections:
  Flanges EN (DIN), ASME
- Modbus RS485
- High vibration resistance

Your benefits

- Smallest flowmeter for LNG dispensers worldwide – fits into every dispenser
- Highest accuracy and security when refueling even at lowest temperatures
- MID-005/OIML R117 certified for liquid and boil-off gas (BOG)

In-line measurement of fluid properties

Conductivity, density, viscosity, concentration, build-up and gas analysis. Improve your product quality and process stability.

Product quality has several aspects: On the one hand, the product must comply with national and international standards; on the other hand, it needs to live up to the consumers' expectations. Our measuring devices support the production processes with accurate measurements of not only flow quantity, but also of several additional parameters that indicate product quality and process stability, e.g. conductivity, density, viscosity, concentration, build-up and gas properties.

Conductivity measurement with Proline Promag

Conductivity is a reliable additional measurement parameter available with our Proline Promag electromagnetic flowmeters.
It is relevant for most industries and is used to improve process efficiency. For example, it allows to monitor CIP processes and to optimize cleaning cycles and dosage of detergents. This helps to save time and detergent usage.

Another application example is to optimize intake and discharge volume of ballast water to reduce vessel fuel consumption by monitoring the salinity.
Conductivity also serves as an indicator for product quality by detecting process impurities, e.g. due to leakages, and thus improves output quality and prevents unexpected downtime.

More about Proline Promag ▸ page 40

Superior density measuring performance with Promass Q

Density is a commonly used parameter in laboratory and process settings to characterize or identify fluids in many different applications, such as, water cut in crude oil or sugar content in syrup. Laboratory analysis of grab samples is not easy. It is time consuming and does not provide continuous monitoring of product quality.

Promass Q masters the typical influences in a process environment like changes in fluid and ambient temperature, pressure and viscosity while keeping its high-performance promise.

Promass Q with the Premium Density option achieves an accuracy of ±0.1 kg/m³ (±0.0001 g/cm³) making it an outstanding density meter if real-time, in-line density measurement with the performance quality of a lab device is required.

More about Proline Promass Q ▸ page 38

Viscosity measurement with Proline Promass I

Viscosity is an important fluid property. It varies with product composition and correlates with the texture of the product, which makes it an important parameter, e.g. in the food industry. In-line measurement of viscosity helps manufacturers to monitor product quality continuously and without the time delay of a typical grab sample analysis.

The multivariable Promass I sensor offers several parameters with one device: flow, density, temperature and viscosity. This extended process insight enables you to adjust the process immediately if needed and makes your production more efficient.

More about Proline Promass I ▸ page 38

Concentration measurement with Teqwave and Promass

Consistent product quality and flavor are crucial for beverage production. Key measuring values are concentration of sugar in beverages like soft drinks and fruit juices or alcohol in distilled beverages.

Correct concentration is also essential in the chemical industry or in cleaning and disinfection processes, e.g. to ensure efficient cleaning or to check the rinse water for cleaning agent residues. Other applications are cleaners or solutions in surface treatment.

Depending on the application you may favor a density or speed of sound-based concentration measurement. Promass offers concentration measurement based on density for binary liquids with its easy-to-use concentration package. Teqwave measures the concentration of ternary mixtures precisely using ultrasound. Additionally, preinstalled data sets enable plug-and-play measurements.

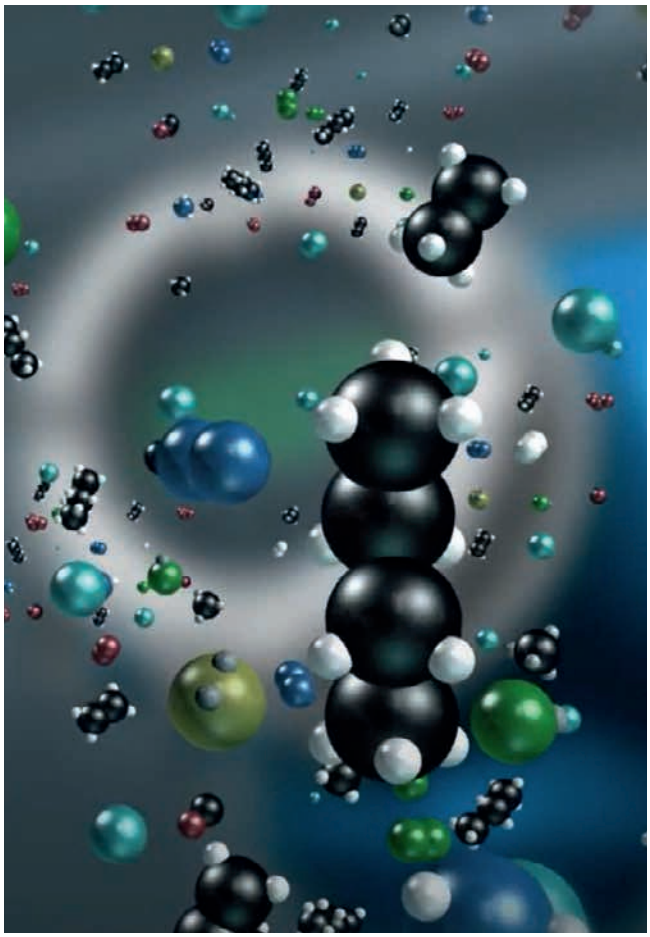
More about Teqwave ▸ page 56

Build-up index with Proline Promag

Operators of water treatment plants often face unexpected downtime due to build-up clogging their pipes. The patented build-up index integrated into Heartbeat Technology offers permanent monitoring of build-up for trend analysis, thereby enabling condition-based maintenance.

With this information, customers are able to optimize their cleaning cycles to save costs and to reduce the risk of unexpected downtime. Thus, customers benefit from a higher plant availability and reliability in their processes.

More about Proline Promag ▸ page 40



Advanced gas analysis with Proline Prosonic Flow G

The advanced gas analysis of Prosonic Flow G is unique worldwide. It gives users powerful process control with functions for pure gases or user-defined gas mixtures with up to 8 components using several gas compensation models. Based on these models, the advanced gas analysis calculates additional process variables:

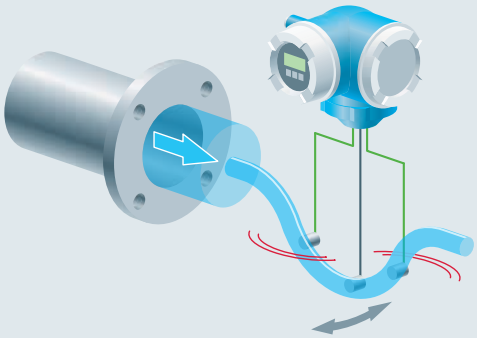
- Volume flow, corrected volume flow and mass flow
- Energy flow
- Calorific value, Wobbe index
- Molar mass
- Methane content, e.g. in biogas
- Density and viscosity

Additionally, Prosonic Flow G ensures optimal process monitoring thanks to the simultaneous measurement and evaluation of directly measured variables, such as, flow velocity, sound velocity, pressure and temperature.

More about Proline Prosonic Flow G ▸ page 52

Coriolis mass flowmeters

Proline Promass – Multivariable sensors and highest accuracy: just two of the many reasons why the Coriolis measuring principle is being used more and more frequently to measure gases and liquids



Measuring principle

Each Coriolis flowmeter has one or more measuring tubes which an exciter causes to oscillate artificially. As soon as the fluid starts to flow in the measuring tube, additional twisting is imposed on this oscillation due to the fluid's inertia.
Two sensors detect this change of the tube oscillation in time and space as phase difference. This difference is a direct measure of the mass flow. In addition, the fluid density can be determined from the oscillation frequency of the measuring tubes.
The temperature of the measuring tube is also registered to compensate thermal influences. The process temperature derived from this is available as an additional output signal.

Advantages at a glance

- Universal measuring principle for liquids and gases
- Multivariable – simultaneous measuring of mass flow, density, temperature and viscosity
- High measuring accuracy:
  – typically: ±0.1% o.r.
  – optionally: ±0.05% o.r. (PremiumCal)
- Measuring principle independent of the physical fluid properties and the flow profile
- No inlet/outlet runs necessary

Measuring principle movie:
www.eh.digital/3jr2hUv

Simultaneous measurement of mass flow, density and temperature opens up entirely new perspectives for process control, quality assurance and plant safety. Additional important characteristic values can also be calculated from the primary variables measured:

- Volume flow and standard volume flow
- Solid content and concentration of binary mixtures: e.g., °Brix, °Plato, %mass/vol
- Characteristic variables in the petroleum industry: e.g. net oil, water cut, °API, weighted averages

The Coriolis measuring principle is used in a wide range of various industrial branches, such as the life sciences, chemicals, petrochemicals, oil and gas, food and – no less importantly – in custody transfer applications. Virtually all fluids can be measured: cleaning agents, solvents, fuels, crude oil, vegetable oils, animal fats, latex, silicon oils, alcohol, fruit solutions, toothpaste, vinegar, ketchup, mayonnaise, gases or liquefied gases.

Over 1 million Endress+Hauser Coriolis flowmeters have been successfully installed since 1986.

Promass sensors

Promass F
For universal use

- Tube material: stainless steel, Alloy C22
- Up to –196 °C (–321 °F)/ +350 °C (+662 °F)
- For custody transfer (MI-005, cryogenic fluids, MI-002)
- DN 8 to 250 (⅜ to 10")

F L **E** X

Promass A
For low flows

- Tube material: stainless steel, Alloy C22
- Self-drainable single-tube design
- DN 1 to 4 (1/24 to 5/32") (up to 430.9 bar/6250 psi)

F L **E** X

Promass Q
The top specialist

- Highest performance in density and custody transfer applications
- Unmatched accuracy in foaming liquids with "Multi-Frequency Technology"
- DN 25 to 250 (1 to 10")

F L E **X**

Promass P
Life sciences industry

- Hygienic single-tube system
- Complies with ASME BPE, ISPE, FDA, EHEDG and 3-A
- Tube material: stainless steel
- DN 8 to 50 (⅜ to 2")

F L E **X**

Promass E
For basic applications

- Cost-effective sensor
- Tube material: stainless steel
- DN 8 to 80 (⅜ to 3")

F L **E** X

Cubemass C
For low flows

- Space-saving, multivariable measuring system
- Tube material: stainless steel
- DN 1 to 6 (1/24 to ¼")

F L **E** X

Promass G
Compact, high pressures

- Ultracompact design with threaded connections
- Up to 350 bar (5076 psi)
- Tube material: stainless steel
- DN 8 to 25 (⅜ to 1")

F L E **X**

Promass H
For aggressive fluids

- Single-tube system
- Tube material: zirconium, tantalum
- Highest corrosion resistance
- DN 8 to 50 (⅜ to 2")

F L E **X**

Promass X
Maximum flow rates

- For oil and gas
- Highly accurate four-tube measuring technology
- Tubes and housing: stainless steel
- For custody transfer
- DN 300 to 400 (12 to 16") (up to 4100 t/h)

F L E **X**

Promass K
For utilities

- Cost-effective general-purpose device
- Minimized total cost of ownership
- Optimum usability via SmartBlue app or touch screen
- DN 8 to 80 (⅜ to 3")

F **L** E X

Promass I
Straight single-tube

- Easy-to-clean single-tube system
- Tube material: titanium
- Optionally with viscosity measurement
- DN 8 to 80 (⅜ to 3")

F L E **X**

Promass S
Food industry

- Hygienic single-tube system
- Standard approvals: 3-A, EHEDG and FDA
- Tube material: stainless steel
- DN 8 to 50 (⅜ to 2")

F L E **X**

Promass O
For highest pressures

- For oil and gas
- Corrosion resistant measuring tubes made of Super Duplex
- Stainless steel housing
- For custody transfer
- DN 80 to 150 (3 to 6") (PN 250)

F L E **X**

Proline transmitters

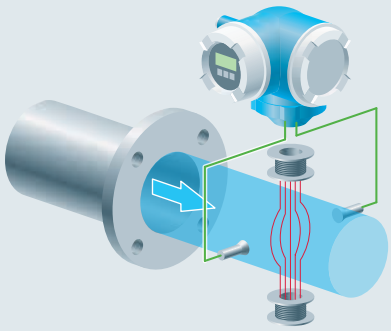
Proline – the perfect transmitter for every application
Whether applied in the life sciences, water, or food industry, the new generation of Proline transmitters can be freely combined with many of our sensors, all tried and tested for decades – while maintaining full backwards compatibility. This means a high level of added value and maximum flexibility matching your industry and application demands.

Detailed description of all Proline transmitters ▸ page 9 to 11

Promass sensors	Proline transmitters				
	10 	100 	200 	300 	500 
Promass F	–	✔	✔	✔	✔
Promass E	–	✔	✔	✔	✔
Promass K	✔	–	–	–	–
Promass A	–	✔	✔	✔	✔
Cubemass C	–	✔	–	✔	✔
Promass I	–	✔	–	✔	✔
Promass Q	–	–	–	✔	✔
Promass G	–	✔	–	–	–
Promass S	–	✔	–	✔	✔
Promass P	–	✔	–	✔	✔
Promass H	–	✔	–	✔	✔
Promass O	–	✔	–	✔	✔
Promass X	–	–	–	✔	✔

Electromagnetic flowmeters

Proline Promag – Universally applicable in all industries and in pipes from 2 millimeters to 3 meters. Since 1977, Endress+Hauser has delivered over 3 million devices.



Measuring principle

Faraday's law of induction states that a metal rod moving in a magnetic field induces electrical voltage. This dynamo principle also governs the way electromagnetic flowmeters work.
As soon as the electrically charged particles in a fluid cross the artificial magnetic field generated by two field coils, an electric voltage is induced. This voltage, tapped by two measuring electrodes, is directly proportional to the velocity of flow and thus to the flow volume. The magnetic field is generated by a pulsed direct current with alternating polarity. This ensures a stable zero point and makes the flow measurement insensitive to multiphase or inhomogeneous liquids, as well as low conductivity.

Advantages at a glance

- The measuring principle is virtually independent of pressure, density, temperature and viscosity
- Even fluids with entrained solids can be metered, e.g. ore slurry or cellulose pulp
- Wide range of nominal diameters: DN 2 to 3000 (1/12 to 120")
- Free pipe cross-section: CIP/SIP cleanable, piggable
- No moving parts
- Minimum outlay for maintenance and upkeep
- No pressure losses
- Very high turndown up to 1000:1
- High degree of measuring reproducibility and long-term stability

Measuring principle movie:
www.eh.digital/3E92q6K

The popularity of magmeters across innumerable sectors of industry continues to be unabated, further proof of the worldwide success that this measuring principle has been enjoying for more than 60 years. Magmeters can be used to measure all electrically conductive liquids above 5 µS/cm with or without solids, e.g. water, wastewater, sludge, slurries, pastes, acids, alkalis, juices or fruit mashes.

The rule of thumb for magmeters is: anything that can be pumped can also be measured – a highly valued trait in measurement technology. Typical tasks include measuring and monitoring continuous flow rates, filling and dosing as well as applications in custody transfer.

In the industrial environment, magmeters are primarily used in water management and in the processing, life sciences and food industries. In tunnel construction and mining, robust magmeters are often the only option for measuring highly abrasive ore slurries with entrained solids, sand-water mixtures, filler materials or bulk solids with the required accuracy.

FROST & SULLIVAN

2017 BEST PRACTICES AWARD

GLOBAL MAGNETIC FLOWMETERS MARKET LEADERSHIP AWARD

Promag sensors

Promag H
Food industry

- For food industries, life sciences, chemicals and process industry
- Robust stainless steel housing (3-A, EHEDG)
- CIP/SIP cleanable
- PFA liner: –20 to +150 °C (–4 to +302 °F)
- Flexible connection concept
- DN 2 to 150 (1/12 to 6")

F **L** E X

F L **E** X

Promag S
For demanding fluids

- For inhomogeneous or abrasive fluids (ore slurry, cement, paper pulp, etc.)
- Industry-optimized measuring electrodes
- Linings: PTFE, PFA, polyurethane or natural rubber
- High-temperature version up to 180 °C (356 °F)
- DN 15 to 600 (½ to 24")

F L E **X**

Promag P
Chemical and process industry

- For high fluid temperatures
- With all common hazardous area approvals
- For custody transfer
- PTFE: –40 to +130 °C (–40 to +266 °F) PFA: –20 to +180 °C (–4 to +356 °F)
- DN 15 to 600 (½ to 24")

F **L** E X

F L **E** X

Promag E
Chemical and process industry

- For the economical and cost-efficient flow measurement in basic applications
- PTFE lining: –10 to +110 °C (14 to 230 °F)
- DN 15 to 600 (½ to 24")

F L **E** X

Promag W
Water & wastewater

- For hazardous areas
- Drinking water approvals
- IP68 (Type 6P) for underground or underwater applications
- For custody transfer
- Linings: Hard rubber: 0 to 80 °C (32 to 176 °F), Polyurethane: –20 to +50 °C (–4 to +122 °F) PTFE: –20 to +90 °C (–4 to +194 °F)
- DN 25 to 3000 (1 to 120"), without inlet run

F **L** E X

F L **E** X

Promag D
Water & wastewater

- Wafer device with shorter installation length and less weight
- Drinking water approvals
- Lining: Polyamide: 0 to 60 °C (32 to 140 °F)
- DN 25 to 100 (1 to 4")

F **L** E X

Magphant
Limit switch

- For cost-effective flow monitoring
- For steel or plastic pipes
- DN 15 to 2000 (½ to 80")

Another highlight with Endress+Hauser magmeters is the flexible installation independent of flow profile and without pressure loss, e.g. directly after bends.

Find out more in this animation:
www.eh.digital/3FgnTeB

Proline transmitters

Proline – the perfect transmitter for every application
Whether applied in the food, water, chemical, mining or other process industries, the new generation of Proline transmitters can be freely combined with many of our sensors, all tried and tested for decades – while maintaining full backwards compatibility. This means a high level of added value and maximum flexibility matching your industry and application demands.

Detailed description of all Proline transmitters ▸ page 9 to 11

Promass sensors	Proline transmitters							
	10	100	200	300	400	500		800*
								
Promag H	✔	✔	✔	✔	–	✔	✔	–
Promag P	✔	✔	✔	✔	–	✔	✔	–
Promag E	–	✔	–	–	–	–	–	–
Promag W	✔	–	–	✔	✔	✔	✔	✔
Promag D	✔	–	–	–	–	–	–	–

* battery-powered

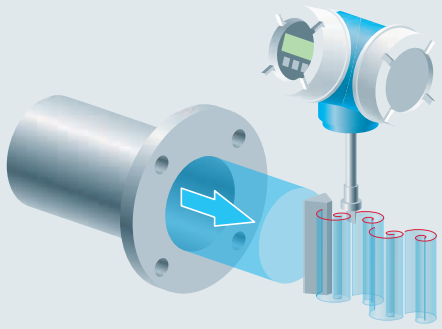
reddot design award
winner 2018

Picomag
Flow metering in a pocket-sized format

- Reliable measuring and monitoring of industrial water, cooling water or warm water
- Simultaneous measurement of flow, temperature and conductivity
- Flexible integration into all fieldbus systems using IO-Link
- Intuitive commissioning and operation using Bluetooth and the SmartBlue app
- Cost-effective measuring device for the use where space is at a minimum

Vortex flowmeters

Proline Prowirl – Robust and universally applicable. For measuring the volume and mass flow of liquids, gases and steam up to 250 bar (3626 psi) and 450 °C (842 °F) reliably.



Measuring principle

This measuring principle is based on the fact that turbulence forms downstream of obstacles in the flow, such as a bridge pier.
Inside each vortex flowmeter, a bluff body is located in the middle of the pipe. As soon as the flow velocity reaches a certain value, vortices form behind this bluff body are detached from the flow and transported downstream. The frequency of vortex shedding is directly proportional to the mean flow velocity and thus to the volume flow.
The detached vortices on both sides of the bluff body generate alternately a local positive or negative pressure that is detected by the capacitive sensor and fed to the electronics as a primary digital, linear signal.

Advantages at a glance

- Universally suitable for measuring liquids, gases and steam
- Largely unaffected by changes in pressure, density, temperature and viscosity
- High long-term stability: no zero-point drift, lifetime K-factor
- No moving parts
- Little pressure loss
- Easy installation and commissioning
- Large turndown of typically 10:1 to 30:1 for gas/steam, or up to 40:1 for liquids
- Wide temperature range: –200 to +400 °C (–328 to +752 °F) (450 °C / 842 °F on demand)

Measuring principle movie:
www.eh.digital/2XzvvJ1

In chemicals, petrochemicals, power engineering and heat supply, a wide variety of fluids can be measured using vortex flowmeters, e.g. saturated steam, superheated steam, compressed air, nitrogen, liquefied gases, flue gases, carbon dioxide, fully demineralized water, solvents, heat-transfer oils, boiler feedwater or condensate. Vortex flowmeters are also in widespread use for measuring mass flow. Therefore, modern vortex meters such as the multivariable Prowirl 200 are built for more than merely measuring volume flow, and come complete with pressure and temperature sensors as well as a flow computer.

Whenever gas mass flow has to be measured, external pressure values can be read in digitally and with high accuracy via HART, PROFIBUS or FOUNDATION Fieldbus. Prowirl 200 is also available with reduced line sizes, which permits measurements even at very low flow velocities – with the same installation length and accuracy.

Prowirl 200 is the world's first vortex flowmeter with the option of monitoring the steam quality and immediately generating an alarm message in case of wet steam. Prowirl can also be used for flow monitoring systems up to SIL 2 and SIL 3 and is independently evaluated and certified by TÜV Rheinland in accordance with IEC 61508.

Prowirl sensors

Prowirl D
Compact wafer device

- With centering rings for high fitting accuracy
- Worldwide standardized installation length (65 mm) enables one-to-one replacement of orifice plates
- Sensor made of stainless steel (CF3M)
- PN 10 to 40 (Class 150 to 300), 10 to 20K
- −200 to +400 °C (−328 to +752 °F)
- DN 15 to 150 (½ to 6")

F **L** E X

Prowirl F
Versatile standard device

- Suitable for detecting wet steam
- Correction function for short inlet runs
- Worldwide standardized installation lengths
- Sensor made of stainless steel (CF3M/316/316L) or Alloy C22
- PN 10 to 100 (Class 150 to 600)
- −200 to +400 °C (−328 to +752 °F) (450 °C / 842 °F optional)
- DN 15 to 300 (½ to 12")

F L **E** X

Prowirl R
For low flows

- With a single and double line size reduction for:
  – Increasing the flow velocity
  – Extending the lower measuring range
- PN 10 to 40 (Class 150 to 300), 10 to 20K
- DN 25 to 200 (1 to 8") (single reduction)
- DN 40 to 250 (1½ to 10") (double reduction)

F L **E** X

Prowirl O
The high-pressure specialist

- Flange or butt-weld version
- Sensor made of stainless steel
- PN 160 to 250 (Class 900 to 1500)
- −200 to +400 °C (−328 to +752 °F) (450 °C / 842 °F optional)
- DN 15 to 300 (½ to 12")

F L **E** X

Integrated pressure measurement
As a multivariable vortex flowmeter, Prowirl 200 provides an all-in-one solution: simultaneous measurement of mass flow, corrected volume flow, energy flow, temperature and, for the first time, even the process pressure.
Regardless of the amount of fluctuation in the process variables, Prowirl makes it possible to measure with high precision and thus offers extensive energy management for different fluids like steam, gases, water or hydrocarbons.

Robust DSC sensor
Endress+Hauser's unique, patented DSC (Differential Switched Capacitor) sensor ensures high-precision measured values even under the toughest conditions and features a lifetime calibration factor. With an installed base of over 500 000 devices, this sensor concept has been proving its value for decades.
The sensor is highly resistant to:
- Vibration
- Water hammer and condensation-induced water hammer
- Dirty fluids
- Temperature shocks (>150 K/s)

Optionally, Prowirl is also available with an integrated pressure and/or temperature sensor, for example for direct mass measurement of wet steam, saturated steam and superheated steam.

Proline transmitters

Proline 200

Two-wire loop-powered technology (4–20 mA)

- Four-line display with push buttons or touch control
- Display module with backup and transfer function for configuration data
- HART, PROFIBUS PA, FOUNDATION Fieldbus and PROFINET-APL with pulse/frequency/switch output
- Heartbeat Technology for diagnostics, verification and monitoring
- Versatile system integration:
  - Current input for reading in external measured variables such as pressure or temperature (optional)
  - Current output for multiple measurement parameters (optional)

Advantages of the Proline 200 transmitter ▸ page 9 to 11
Prowirl is the world's first vortex flowmeter developed entirely in accordance with IEC 61508, allowing it to be used in SIL 2/3 applications at any time.

Multivariable measurement

Energy management made easy

All industries have utilities with steam, cooling water or hot water. Generating, transporting and distributing these fluids consumes a lot of energy. Therefore, Proline Prowirl 200 offers everything in one device for a comprehensive energy management:

- Integrated flow computer for calculating:
  - Mass, heat and energy flow of steam and liquids
  - Corrected volume flow and energy flows of gases
- Reading in of external temperature and pressure values via HART, PROFIBUS PA and FOUNDATION Fieldbus as well as via an optional current input
- Integrated pressure and temperature measurement for direct mass measurement of saturated steam and liquids (temperature compensation)

For energy management we offer everything from a single source: flow computers, pressure and temperature sensors as well as Data Manager Memograph M RSG45 with software solutions for energy monitoring.


EngyCal RS33


RSG45


Cerabar


TM131

One-of-a-kind wet steam detection

Process reliability and efficiency

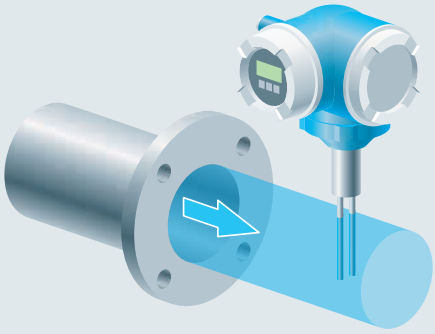
Many industries use large quantities of steam, the generating costs of which are extremely high. Moreover, the transfer of heat energy is energetically efficient only for saturated steam. Often, however, wet steam is what predominates, since fluctuations in pressure and temperature cause water to condense out, or water gets into the steam lines due to disruptions in the boiler system. The consequences are usually serious:

- Low efficiency for the transmission of energy
- Hazardous water hammer and condensate-induced water hammer
- Heavy corrosion from the salts dissolved in the water carried over

Movie – Steam quality:
Prowirl measures all types of steam right in the pipe inclusive steam quality and condensate quantity.
www.eh.digital/3wFpVSr

Thermal mass flowmeters

Proline t-mass – For direct mass measurement of industrial gases, compressed air and aqueous fluids even at the lowest flow velocities and pressures



Measuring principle

Many people are made uncomfortably cold by just a small draft. The thermal flow measuring principle is based on the fact that heat is drawn from a heated body when a fluid flows past.
A thermal flowmeter contains two PT100 temperature sensors for this purpose. One sensor measures the current fluid temperature as a reference. The second sensor is heated and has a constant temperature differential relative to the first sensor at "zero flow."
As soon as the fluid begins to flow in the measuring tube, the heated temperature sensor cools off due to the fluid flowing past – the higher the flow velocity, the greater the cooling effect.
The electric current required to maintain the temperature differential is thus a direct measure of mass flow.

Advantages at a glance

- Multivariable – direct measurement and display of mass flow and fluid temperature
- No pressure or temperature compensation required
- High turndown (max. up to 1000:1)
- Excellent low-end sensitivity
- Quick reaction to fluctuations in flow
- Negligible pressure loss
- Maintenance-free, no moving parts

Measuring principle movie:
www.eh.digital/3m2U7TP

The thermal measuring principle is widespread in industry and is being used successfully in many applications with gas flow, for example:

- Compressed air (consumption, distribution)
- Carbon dioxide (beverage production, chilling)
- Argon (steel production)
- Nitrogen and oxygen (production)
- Natural gas (burner, boiler feed control)
- Air and biogas measurement (wastewater plants)

Whenever high turndown or low pressure losses are important in gas metering applications, thermal mass flowmeters offer a real alternative to traditional measuring techniques – whether for process control, consumption and supply monitoring, detecting leaks or monitoring distribution networks. Using insertion versions, it is also possible to measure gas flows in very large pipelines or in rectangular ducts.

t-mass sensors

For basic gas applications

t-mass A
Inline version

- Max. measured error:
  ±3% o.r. (15 to 100% o.f.s.)
  ±0.45% o.f.s. (1 to 15% o.f.s.)
- Process pressure:
  PN 10 to 40 (Class 150 to 300)
- −40 to +100 °C
  (−40 to +212 °F)
- DN 15 to 50 (½ to 2")

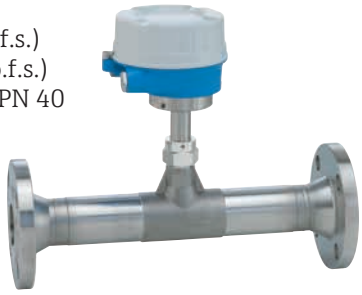
t-mass B
Insertion version

- Suitable for large pipelines and rectangular ducts
- Max. measured error:
  ±3% o.r. (15 to 100% o.f.s.)
  ±0.45% o.f.s. (1 to 15% o.f.s.)
- Process pressure: −0.5 to +20 barg (7 to 290 psig)
- −40 to +100 °C (−40 to +212 °F)
- DN 80 to 1500 (3 to 60")

For demanding gas applications

t-mass F
Inline version

- Max. measured error:
  ±1% o.r. (10 to 100% o.f.s.)
  ±0.1% o.f.s. (1 to 10% o.f.s.)
- Process pressure: Up to PN 40 (up to Class 300)
- −40 to +100 °C
  (−40 to +212 °F)
- DN 15 to 100 (½ to 4")



F L **E** X

t-mass I
Insertion version

- Suitable for large pipelines and rectangular ducts
- Max. measured error:
  ±1% o.r. (10 to 100% o.f.s.)
  ±0.1% o.f.s. (1 to 10% o.f.s.)
- Process pressure: up to 40 barg (580 psig)
- −40 to +130 °C (−40 to +266 °F)
- DN 80 to 1500 (3 to 60")

F L **E** X

Flexible installation

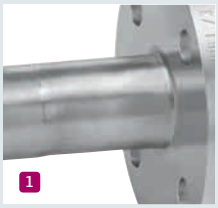
Whether in rectangular ventilation ducts or in pipes – t-mass sensors are always the perfect fit. For installation, both inline and insertion versions in various nominal diameters are available:

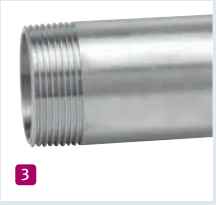
Inline version

1. With flange (t-mass A and F)
2. With lap-joint flange (t-mass A)
3. With external thread (t-mass A and F)

Insertion version

4. Suitable for pipelines or rectangular ventilation ducts up to DN 1500 (60")
5. Optionally with "hot tap" mounting tool for inserting or removing the sensor under operating conditions:
   – For recalibration
   – For certification
   – For service purposes
   – For mobile use





Proline transmitters

t-mass sensors	Proline transmitters		
	150	300	500
			
t-mass A	✔	–	–
t-mass B	✔	–	–
t-mass F	–	✔	✔
t-mass I	–	✔	✔
t-mass T	✔	–	–

Detailed description of the Proline 300/500 transmitters ▸ page 9 to 11

Proline 150

For basic applications (cost-effective measurement)

- For t-mass A, B and T sensors
- Easy-to-understand, four-line display with three push buttons
- Display/outputs for flow and temperature
- Free selection of up to 4 fluids
- Switch and/or relay output for alarm messages
- Totalizer functions

Gas Engine

Gas programming made easy

Depending on pressure and temperature, gases change their volume and their specific properties such as operating density, heat capacity or viscosity. Converting operating volume to standard volume is highly labor-intensive and inconvenient.
With the t-mass transmitter's integrated "Gas Engine" function, and an automatic temperature and pressure compensation, gases and gas mixtures can now be measured highly reliably:

- 22 freely selectable gases (4 gases for Proline 150)
- 2 gas mixtures with up to 8 user-definable components (Proline 300/500)
- Toggling between 2 gas mixtures (Proline 300/500)
- Programmed gases can be changed at any time (without recalibration)

t-mass T 150

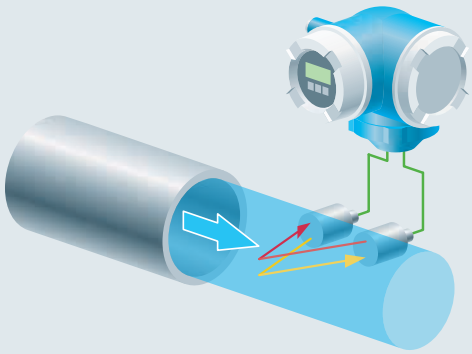
For simple liquid flow monitoring

Many industrial processes and utilities require reliable measurement, monitoring and control of liquid flows. Proline t-mass T 150 works according to the thermal measuring principle and measures all aqueous fluids, for example cooling water, heating water, demineralized water (condensate), industrial water, WFI water, irrigation water or fluids in the wastewater area:

- Independent of the electrical conductivity
- Fast commissioning via the local display
- Compact insertion version (DN 40 to 1000/1½ to 40")
- Standard or hygienic version (3-A, EHEDG)
- Maintenance-free, no moving parts
- Wide variety of applications: monitoring, flow measurement, switch function, etc.

Ultrasonic flowmeters

Proline Prosonic Flow – Whether mounted on the outer wall of the pipe or directly into the pipe: ultrasonic sensors guarantee versatile and economical measurement of gases and liquids up to a nominal diameter DN 4000 (160")



Measuring principle

Swimming against the flow requires more power and more time than swimming with the flow. This simple fact is the basis for ultrasonic flow measurement according to the "differential transit time" method: This method uses two sensors, set opposite each other in the measuring tube.
Each sensor can alternately transmit and receive ultrasonic signals while simultaneously measuring the signal transit time. As soon as the fluid in the tube starts to flow, the signals are accelerated in the direction of flow but delayed in the opposite direction. The differential transit time, measured by the two sensors, is directly proportional to the flow rate.

Advantages at a glance

- Measurement independent of pressure, conductivity and viscosity (for homogeneous fluids)
- Free pipe cross-section, no pressure loss
- No moving parts, minimum maintenance and upkeep
- Long service life, no abrasion or corrosion from the fluid
- Inline or clamp-on design for stationary or temporary flow measurements

Measuring principle movie:
www.eh.digital/3E6tW4Z

Using ultrasonic waves, the flow volume of a wide variety of gases and liquids can be measured reliably – independent of electrical conductivity, pressure or viscosity.
In applications that require traceable and guaranteed accuracy, inline sensors are preferred for use – in petrochemicals and other chemicals as well as in the water industry.
Clamp-on ultrasonic sensors, on the other hand, are installed on the outer wall of the pipe and thus also enable temporary measurements. Their spectrum of use ranges from applications in the water industry to industrial process engineering.

Clamp-on sensors

- For retrofitted installation without process interruption
- Aggressive fluids can be measured without any problem, even under high pressure
- Suitable for pipes made of plastic, steel, cast iron or composite materials (lined/unlined)
- Ideally suited for flow monitoring, network balancing and verification of previously installed devices
- High cost-effectiveness with increasing pipe diameter (up to DN 4000/160")

Inline sensors

- Guaranteed accuracy thanks to traceable factory calibration
- Robust industrial design in accordance with ASME and EN
- Short inlet runs


Endress+Hauser

Prosonic Flow sensors

For measuring from outside (clamp-on sensors)

Prosonic Flow W
Water applications

- For water, wastewater, hot/cold water in utilities
- Process temperature: −20 to +80 °C (−4 to +176 °F)
- DN 15 to 4000 (½ to 160")

F L **E** X

Prosonic Flow P
Process industry

- For chemicals, petrochemicals, life sciences, oil/gas, energy
- Process temperature: −40 to +170 °C (−40 to +338 °F)
- With hazardous area approvals
- DN 15 to 4000 (½ to 160")

F L **E** X

For guaranteed accuracy (inline sensors)

Prosonic Flow B
For biogas, landfill and digester gas

- Ideally suited for wet or dirty gases under low pressure
- Traceable factory calibration (±1.5% o.r.)
- Direct monitoring of the methane content
- Calculating corrected volume, calorific value, Wobbe index
- DN 50 to 200 (2 to 8")

F L E **X**

Prosonic Flow E
Fresh water, feed water, condensate

- For process water in steam circuits (0 to 150 °C / 32 to 302 °F)
- Independent of conductivity and magnetite content
- Integrated temperature measurement (energy content)
- Traceable factory calibration: ±0.5% o.r. ± 0.02% o.f.s.
- DN 50 to 150 (2 to 6")

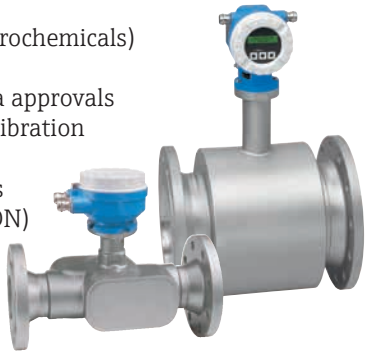
Prosonic Flow E Heat
Certified industrial heat flow sensor

- Ideally suited for custody transfer with warm and hot water (0 to 150 °C / 32 to 302 °F), such as for heat transfer measuring points in district heating networks
- Custody transfer approval in accordance with MI 004, EN 1434 (accuracy class 2)

F L **E** X

Prosonic Flow F
Liquids (chemicals/petrochemicals)

- With hazardous area approvals
- Traceable factory calibration (±0.3 to 0.5% o.r.)
- For compact systems (inlet run max. 5 × DN)
- −40 to +200 °C (−40 to +392 °F)
- DN 25 to 300 (1 to 12")



F L **E** X

Prosonic Flow G
Oil and gas applications, chemical industries

- For raw and processed natural gas, coal seam gas, shale gas, process gas, gas mixtures as well as wet biogas and digester gas
- Up to 150 °C (302 °F)
- Up to 100 bar (1450 psi)
- High measuring accuracy (±0.5%) and turndown (>133:1)
- 1-path version DN 25 (1") 2-path version DN 50 to 300 (2 to 12")

F L **E** X

For attenuating pipe materials

Prosonic Flow I (insertion sensor)
Water & Wastewater

- Installation using sensor holders welded into the piping
- Option of a dual path version (for short inlet runs)
- DN 200 to 4000 (8 to 160")

F L **E** X

Proline transmitters

Prosonic Flow sensors	Proline transmitters						
	92*	93**	100	200	300	400	500
							
Prosonic Flow W	–	✔	–	–	–	✔	✔
Prosonic Flow P	–	✔	–	–	–	✔	✔
Prosonic Flow I	–	–	–	–	–	✔	–
Prosonic Flow G	–	–	–	–	✔	–	✔
Prosonic Flow B	–	–	–	✔	–	–	–
Prosonic Flow E	–	–	✔	–	–	–	–
Prosonic Flow F	✔	–	–	–	–	–	–

* two-wire transmitter for Prosonic Flow F, old generation / ** also available as portable transmitter (93T) for Prosonic Flow P

Detailed description of all Proline transmitters ▸ page 9 to 11

In-line measurement with Prosonic Flow 92F

The right choice for measurement of liquids under difficult installation conditions:

- For conductive and non-conductive liquids in the chemical and petrochemical industry, e.g. high purity or demineralized water, steam condensate return or for energy monitoring
- Loop-powered transmitter (2-wire) for reduced installation costs
- Minimal installation requirements
- Obstruction-free flow measurement with minimal pressure loss and reduced pumping and electrical costs

Clamp-on measurement with Prosonic Flow W and P

With Prosonic Flow P and W, our clamp-on sensor portfolio meets all requirements for non-intrusive measurement of liquids:

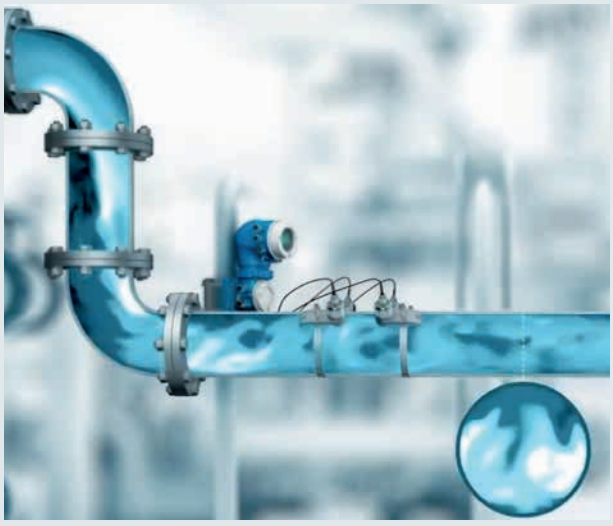
- Available with different frequencies to ensure optimum signal quality in regard to pipe diameter, fluid and pipe material
- Display of current measuring quality during installation for adjustment of the mounting position
- FlowDC function for maximum installation flexibility in confined spaces (see below)

FlowDC function: constantly high performance

Endress+Hauser's newly developed FlowDC function guarantees consistent (specified) measuring performance even downstream of turbulence-generating fittings:

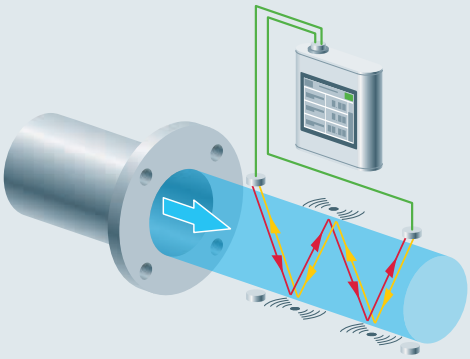
- Massive reduction of required inlet run from the usual min. 15 × DN down to just 2 × DN
- Ideal for installation after single/double pipe bends (in/out of plane), pipe reducers or pipe expanders
- Maximum flexibility when planning process facilities where space for piping is at a minimum
- Simple retrofitting of measuring points with almost no limitations

Movie about FlowDC function:
www.eh.digital/3CC22NN



Ultrasonic concentration meters

Teqwave – The smart and flexible inline concentration measuring device



Measuring principle

The core of Teqwave is an acoustic waveguide that measures liquid concentrations extremely fast and accurately using ultrasound. The ultrasonic waves are created by a piezoelectric transducer and then propagate in the waveguide. A double arrangement of transmitter and receiver allows for a highly precise evaluation of the transmission times and amplitudes of the measured sound waves.
This enables Teqwave to simultaneously measure the speed of sound, density (using acoustic core impedance) and temperature within nanoseconds. The combination of all these characteristic values makes it possible to determine the composition and the substance concentrations within a mixture of liquids reliably and exactly.

Advantages at a glance

- Real-time in-situ liquid analysis
- Constant monitoring of product quality without sampling
- Just one sensor for a wide variety of concentrations
- Reliable metering due to robust, maintenance-free sensor without wear parts, no danger of drifting
- Innovative application concept, expendable for changing measuring tasks
- High accuracy and repeatability thanks to concentration calculation with latest algorithms

No matter what industry you work in: Teqwave can be used to measure multiple liquid parameters simultaneously by means of ultrasound. It records concentrations of ternary mixtures (up to 3 components), along with speed of sound, density and temperature. The range of applications is flexible, including inline versions for installation in pipes, insertion versions for use in vessels and large pipes as well as portable device versions for various measuring points. Thanks to precise factory calibration, Teqwave is highly accurate. It comes with various inputs and outputs: current output, voltage output, Ethernet (Modbus TCP) and relay contact.

Teqwave enables reliable in-line measurement of concentrations, as opposed to titrations or refractometers, which must often be carried out manually in the laboratory and are time consuming and expensive:

- Alcohol concentrations of distilled beverages
- Cleaning agents and disinfectants in food and beverage processes
- Sugar concentration of soft drinks and fruit juices
- Cleaning agents of industrial parts cleaning baths
- Hardening fluids such as quenching polymers

Teqwave portfolio

For in-line measurement

Teqwave F
For pipes, especially skids

- Full-bore design without pressure loss
- Flow velocity up to 10 m/s (33 ft/s)
- Process connections: flange, thread
- DN 8 to 25 (⅜ to 1")

Teqwave H
For food and beverage industries

- Hygienic design, EHEDG/3-A certified
- Concentration measurement of alcohol and/or sugar in beverages as well as cleaning agents and disinfectants
- High accuracy and repeatability due to latest algorithms
- Process connections: Clamp, Tri-Clamp, flange, welding nipple, thread
- DN 25 (1")

For insertion measurement

Teqwave I
For vessels and larger pipes

- Maintenance-free, no moving parts
- Accurate and independent of flow profile
- Process connection: flange, thread
- Insertion length: 180 mm (7 in) or 500 mm (20 in)

Teqwave T
For temporary measurement of liquids

- Flexible concentration measurement of liquids at various measuring points in plant and laboratory
- Robust, portable transmitter with Li-ion battery 2300 mAh
- Integrated data storage for over 3000 measured values
- Insertion length: 180 mm (7 in)

Seamless system integration

Greater transparency through added information: only digital signal transmission enables device and process data to be transmitted and used simultaneously. That is why Endress+Hauser flowmeters are available with all state-of-the-art fieldbus technologies, Industrial Ethernet protocols and PROFINET-APL.

In many process facilities, data transmission between measuring devices/actuators and higher-level automation systems still uses analog signals. This fact significantly limits the amount of information that can be transferred. However, most modern field devices are equipped with Industrial Ethernet technology and offer the user a vast assortment of information. State-of-the-art and multi-functional flowmeters like those from Endress+Hauser do not just monitor their own functional capability but also what is happening in the process.

The benefits associated with this are obvious:
- Simplified maintenance through advanced diagnostics
- More efficient process control and excellent product quality
- Optimized plant availability due to fewer idle times
- Maximum process reliability

Endress+Hauser's fieldbus laboratory in Reinach (Switzerland)

Additional advantages

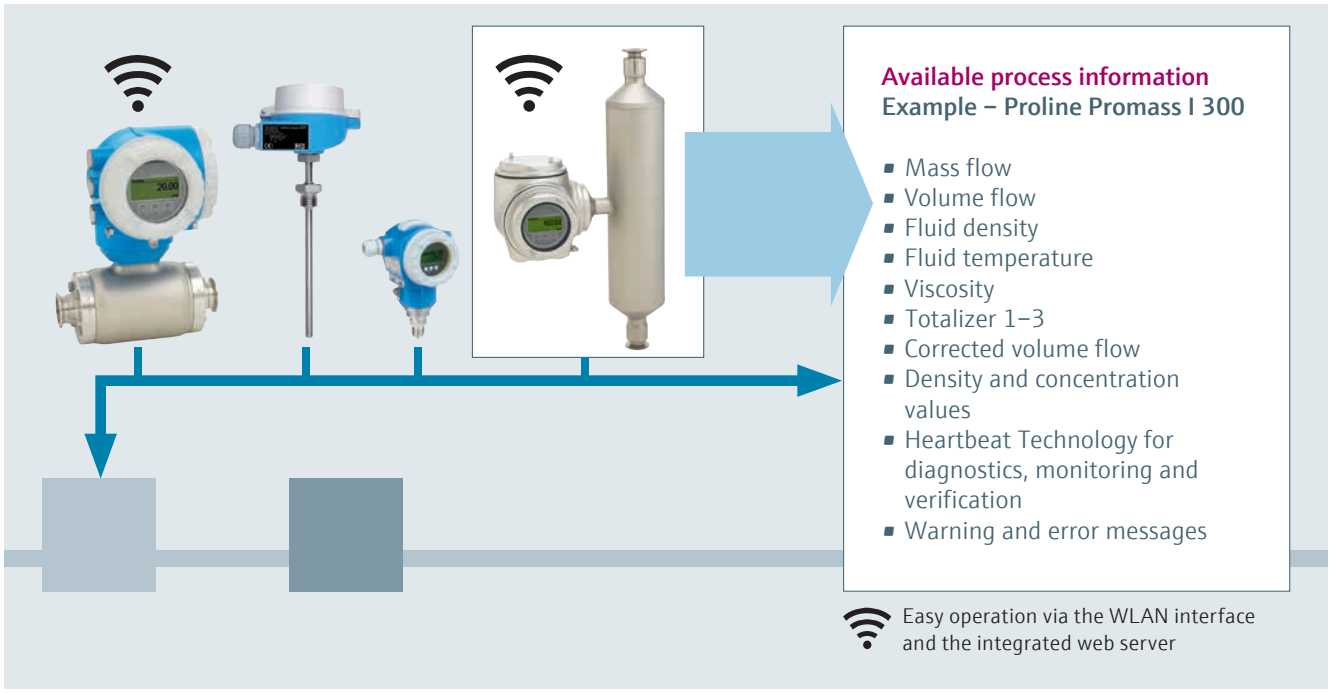
Digital communication via fieldbusses or Industrial Ethernet has many other properties, offering users more cost-effectiveness and enhanced dependability:
- Greater flexibility in production thanks to improved plant productivity
- Access to all important process data at all times
- Devices can easily be replaced even in hazardous areas
- Intrinsically safe fieldbus technology for hazardous areas
- Lower cabling costs due to savings on materials and installation
- Heavily reduced costs for commissioning thanks to simplified loop check

Endress+Hauser ensures full access to all device and diagnostic information via process control and asset management systems.

Digital connectivity at Endress+Hauser

Endress+Hauser only uses internationally recognized, open standards for digital communication for its field devices. This ensures seamless integration into plants and guaranteed investment protection. Various communication systems that Endress+Hauser also supports have become established in the area of process automation:
▪ HART 7 ▪ PROFIBUS DP/PA ▪ FOUNDATION Fieldbus ▪ Modbus RS485 ▪ EtherNet/IP ▪ PROFINET ▪ PROFINET-APL ▪ OPC-UA

Endress+Hauser is one of the pioneers of Industrial Ethernet technology. The company plays a leading role in the definition and standardization of latest Ethernet-APL technology:
▪ Accredited PROFIBUS and PROFINET Competence Center ▪ Engineering of fieldbus networks ▪ System integration testing ▪ Training courses, seminars ▪ Customer service



Available process information
Example – Proline Promass I 300

- Mass flow
- Volume flow
- Fluid density
- Fluid temperature
- Viscosity
- Totalizer 1–3
- Corrected volume flow
- Density and concentration values
- Heartbeat Technology for diagnostics, monitoring and verification
- Warning and error messages

Easy operation via the WLAN interface and the integrated web server

Netilion – the multi-brand ecosystem

Netilion is a cloud-based IIoT ecosystem, designed for industrial processes. It connects the physical and digital worlds to send valuable information from the field straight to your phone, tablet or other devices. Netilion empowers you to improve efficiency and drive innovation.

Multi-brand ecosystem

You have equipment from various vendors in your installation. An IIoT solution should provide data from as many assets as possible, and Netilion can do that. This multi-brand ecosystem brings transparency into a plant regardless of device type or manufacturer.

Security and privacy

Your facility's information is valuable and needs protection. Netilion allows users to access data digitally because it meets internationally recognized standards of cloud-platform security. It's a safe harbor for your data.

Decentralized processes monitored efficiently

- Reduction of routine checkup tours through comprehensive visualization of essential process variables, e.g. flow quantities, limit values, levels, temperature, pressure or physicochemical quality parameters
- Low operating costs through fast reaction in case of failure

Legal compliance thanks to automation

- Continuous measurement of quantitative and qualitative parameters
- Generation of legally compliant documentation thanks to integrated reporting systems

Data access around the clock

- Complete data access independent of time and place
- Numerous options to analyze and visualize ratios, amounts, thresholds, time series and trends, as well as balances
- Everything at a glance thanks to the web-based visualization of networks with optimized depiction for highly diverse terminal devices

More about Netilion:
www.netilion.endress.com

5. Data fusion and analysis

Algorithms for leakage detection, verification, forecasts, etc.

4. Data management and visualization

Monitoring of networks and decentralized infrastructures

3. Data collection and transmission

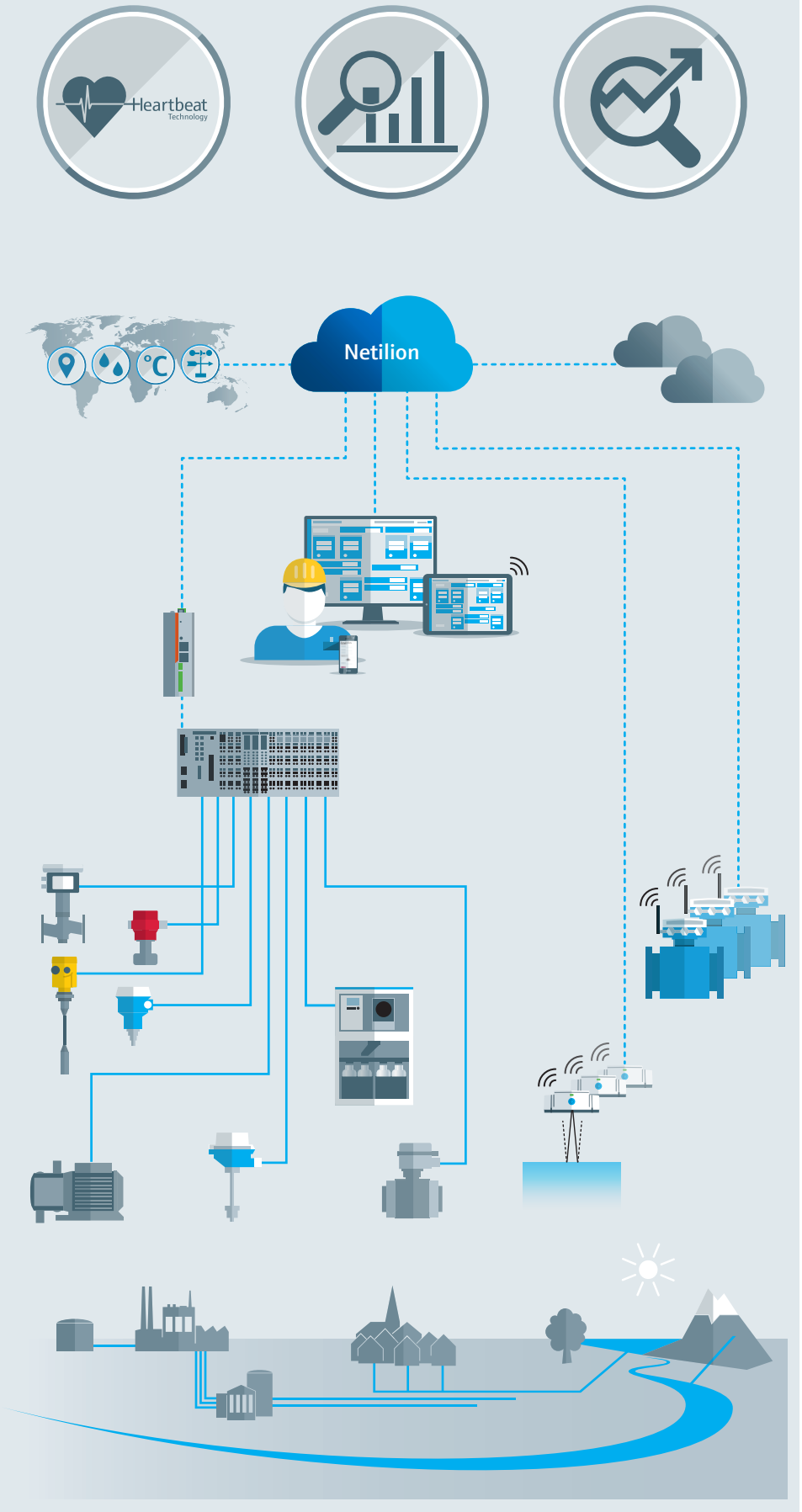
Flexible edge connectivity solutions

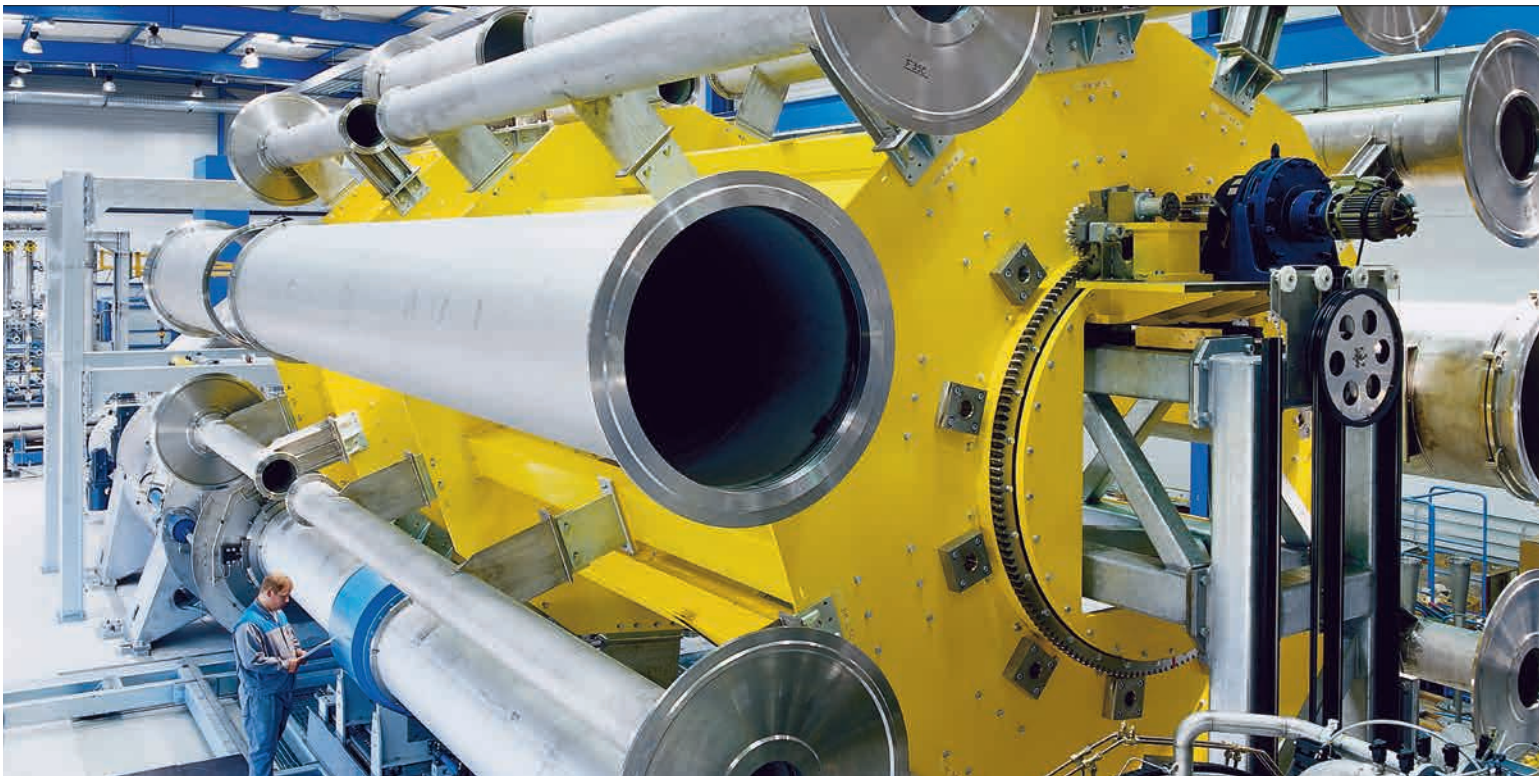
2. Data collection and control

Smart field devices and sensors (flow, analysis, pressure, level, temperature, etc.)

1. Physical world

Infrastructure (pipes, pumps, valves, etc.)





Global calibration and verification services

At Endress+Hauser, all flowmeters are tested, calibrated and adjusted on the world's most state-of-the-art calibration rigs

In many industrial applications, long-term stability and guaranteed traceability are essential aspects of flow metering. They are prerequisites for precise, dependable, cost-effective controlling and batching, and for substance cost allocation in custody transfer applications, for example.

For over 40 years, Endress+Hauser develops and builds high-tech calibration rigs to document the accuracy of its devices in a reliable and traceable manner. There is one motto that stands above all others: "Consistently high measurement quality for customers around the world." Based on this philosophy, a global calibration and verification concept has been developed that offers our customers maximum confidence and security:

- Calibration service in more than 40 countries
- Worldwide accreditation of our flow calibration rigs (ISO/IEC 17025)
- Periodic inspection by national accreditation bodies
- Full traceability to national standards, such as: PTB (Germany), LNE (France), METAS (Switzerland), NIST (USA) and NIM (China)
- Continuous transfer of knowledge through internal and external training
- Identically designed calibration rigs worldwide
- On-site calibration/verification routines are always governed by Standard Operating Procedures (SOPs), ensuring repeatable results anywhere and at any time

Accreditation certificates:
CNAS (China), NABL (India), SAS (Switzerland), A2LA (USA), INMETRO (Brazil)

Accredited calibration services

In many industry sectors, flowmeters are in permanent operation under extreme process conditions. Depending on the application and required accuracy, these devices have to be calibrated or verified on a regular basis. Consequently, Endress+Hauser offers its customers a comprehensive calibration service. This service is also available for other-make flowmeters.

On-site verification:
- Traceable verification method compliant to ISO 9001
- Via ultrasonic clamp-on flowmeters
- Via Heartbeat Technology for the new Proline flowmeter generation (▸ page 7)
- Via Fieldcheck (tester/simulator) for the old Proline flowmeter generation

Mobile on-site calibration:
- Full compliance and audit readiness due to fully traceable calibration according to ISO/IEC 17025
- Calibration of the device under test at the customer's site
- Mobile calibration rig consisting of one or more Coriolis flowmeters used as master meters, previously calibrated by an accredited flow laboratory

Factory calibration:
- Fully traceable calibration according to ISO/IEC 17025
- "As found" calibration service:
  - The flowmeter is calibrated but not adjusted
  - Calibration certificate is delivered
- "As left" calibration:
  - The flowmeter is calibrated and adjusted
  - Two calibration certificates are delivered (with and without adjustment)

Our services on site

Endress+Hauser provides proven instrumentation and maintenance know-how that ensures compliance to legal requirements, reduction of unplanned downtime, and optimized maintenance costs.
- Professional management of national and international projects
- Consulting from experts on site
- Planning, engineering and design of custody transfer measuring points (duty meters)
- Coordination of commissioning and on-site verifications/calibrations using master meters
- Troubleshooting, repair and spare parts
- Maintenance (maintenance contracts)
- Support in audits and acceptance procedures from metrology and/or customs authorities

Flow calibration rig for largest diameters (DN ≤ 3000/120")
Suzhou (China)

- Closed water circuit with 6 pumps
- 4 measuring sections (of 76 m/249 ft each) for DN 1400/56", DN 1600/64", DN 1800/72" and DN 2000 to 3000 (80 to 120")
- Max. flow: 24 000 m^3/h (6666 l/s)
- Measurement uncertainty: 0.066% o.r.
- Reference devices (master meters): 14 Coriolis Promass X flowmeters (DN 300/12")
- Automatic testing of reference devices by means of a traceable 20-ton weighing system

Calibration rig for hydrocarbons

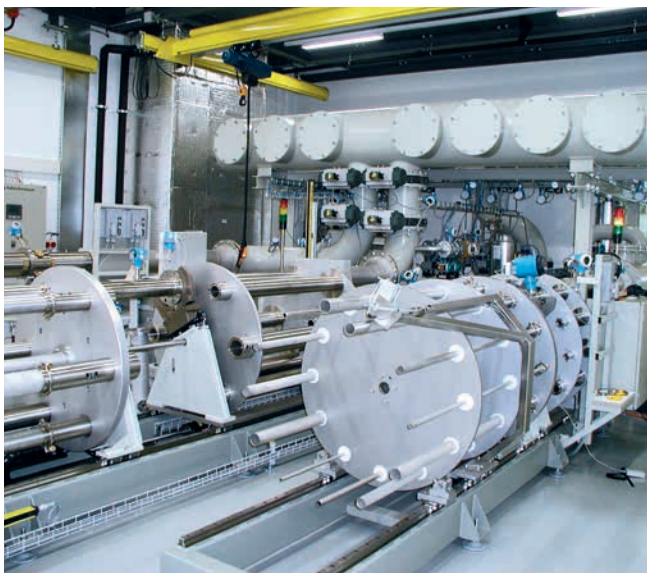
It is standard practice in the oil industry to have custody transfer measuring points verified with respect to an on-site reference. Depending on the capacity and location of the measuring point, such verifications are very complex and costly – or for practical reasons simply not possible. Therefore, the oil industry often requests an advance calibration with hydrocarbons as additional verification for the "integrity" of the meter in question.

Endress+Hauser is one of the few Coriolis flowmeter manufacturers which offer such calibrations directly at the factory:

- Flow range:
  - FCP 21 rig: 2 to 1200 m^3/h (8.8 to 5283 gal/min)
  - FCP 22 rig: 2 to 800 m^3/h (8.8 to 3523 gal/min)
- Viscosity range:
  - FCP 21 rig: 15 to 32 cSt
  - FCP 22 rig: 100 to 300 cSt
- Diameters (FCP 21/22): DN 50 to 400 (2 to 16")
- Expanded measurement uncertainty: 0.05% o.r.

PremiumCal – for highest accuracy

Highly accurate flowmeters are being used more and more frequently in process control. In order to verify the excellent accuracy of modern Coriolis flowmeters in accordance with internationally accepted standards, a team of engineers, technicians and designers got together at Endress+Hauser with the aim of improving the design of an existing, highly accurate production calibration rig to make it – from a production site perspective – the best in the world.
The measurement uncertainty achieved with this PremiumCal rig is 0.015% – equivalent to the content of a single champagne glass per one thousand liters of water! Thus, Promass F/Q/O/X Coriolis mass flowmeters from DN 8 to 400 (⅜ to 16") can be calibrated to a maximum permissible error of ±0.05%.



Calibration with air

When calibrating mass flowmeters with air as a reference fluid, Endress+Hauser sets the bar very high as well. The air calibration rigs installed for this purpose in Reinach (Switzerland) and Greenwood (USA) are one of the few that operate with such a high degree of automation. Multiple adapter revolvers enable the devices under test to be slotted and perfectly aligned with the rig pipeline for different nominal diameters DN 15 to 100 (½ to 4"). The system is also capable of running fully automated leak tests. The air flow range of such a calibration system is between 0.05 to 10 000 kg/h at laboratory conditions.

An array of traceable and periodically calibrated reference meters (nozzles, rotary piston and turbines) ensure the calibration of customers' flowmeters within a measurement uncertainty of 0.3%. A special climate control system keeps the air inside the calibration laboratory at a constant 24 °C (75.2 °F) and 40% humidity day and night.

Endress+Hauser calibration concept movie:
www.eh.digital/3cyVwft

Service and support the smart way

Only production plants that run properly guarantee financial success. Our Sales and Service Centers in over 40 countries ensure that you are always up and running. We are always close at hand, no matter whether you produce in Europe, America, Asia, Africa or Australia.

Consulting and planning

Highly skilled technicians, engineers and application consultants support you on site to find the best solution for your application in terms of technology and budget. For sizing measuring points, you can also benefit from our Applicator software, which has proven its value for decades. It includes an engineering tool for managing measurement and control projects.

Support services

Do you need immediate advice in emergencies or support for a maintenance schedule? The Sales and Service Centers not only provide services on site on demand, they also propose a range of expert services remotely and thus support you with:

- Device set-up, configuration and replacement
- Remote diagnostics and troubleshooting
- Performing a service operation
- Improving performance of the application

Thanks to innovative remote connectivity solutions and unique expert knowledge, support services aim at reducing unexpected downtimes, effort on local maintenance staff, and the costs of field service visit or instrument returns.

Factory witness testing

Customer satisfaction is a keynote issue for Endress+Hauser. Therefore, we offer a tailored inspection service on request. You can come to our factory and see for yourself that the meters ordered are being produced to your specification and are complete, and that they leave our plant in perfect condition. You also have the option to be represented by a plant engineering company or an inspection agency such as TÜV, Lloyds, SVTI, Bureau Veritas or SGS. Examples of the tests carried out in your presence include:

- Hydrostatic pressure testing
- Insulation testing for hazardous area devices
- Visual inspection: specifications, documentation, process connections, materials and acceptance-test certificates, etc.
- Metrological audits, check of measuring accuracy
- Performance tests
- Verification of analog/digital communication

Documentation

Our device documentation contains all the important information you need for commissioning and operation, such as installation and safety instructions, wiring diagrams, function descriptions and many other resources.
Endress+Hauser also publishes technical books and basic information on a very wide range of topics associated with industrial instrumentation.

Trade shows

We exhibit at all the major trade shows. Take the opportunity to consult our specialists to find out about the latest products and innovations from Endress+Hauser.

Training and information

Being informed means being confident. We organize training courses and seminars to pass on our expertise to you:
▪ Industry seminars ▪ Service seminars ▪ Specialist seminars
▪ Workshops ▪ Technology forums ▪ Introductory seminars
▪ Special-interest subjects

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Endress+Hauser

People for Process Automation