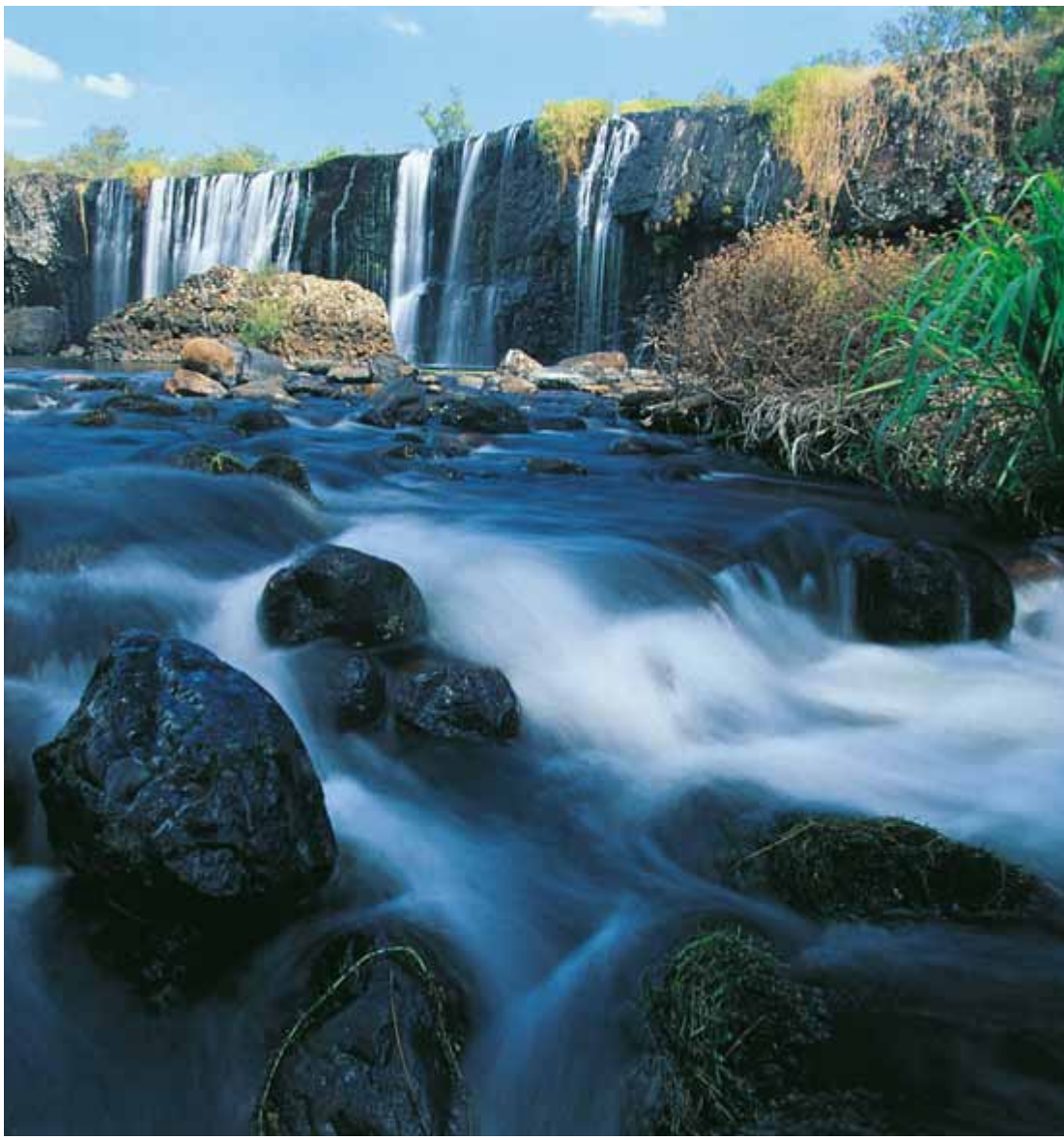
Flow measuring technology
For liquids, gases and steam
Products and services at a glance



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 production 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 science, primary and metal, renewable energy, pulp and paper and shipbuilding industries. Endress+Hauser supports customers to optimize their processes in terms of reliability, safety, economic efficiency and environmental impact.

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

Flow measurement as competence

The Endress+Hauser group is a global player. Within the group, Endress+Hauser Flowtec AG 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 35 years. Endress+Hauser Flowtec AG currently employs a workforce of more than 1700 at six production facilities 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

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 and filling
– Concentration measurement in two-phase fluids
– In-line viscosity measurement
– Condition monitoring and verification

You can find flow measuring technology from Endress+Hauser in almost all industries and utilities: chemical industry, water industry, food and beverage industry, life sciences industry, oil and gas industry, power and energy, primary and metal industry.

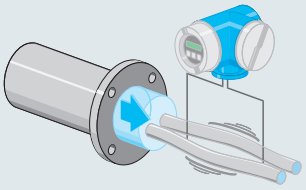
Index

From oxygen to honey

The ideal flow metering system 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.

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



Coriolis

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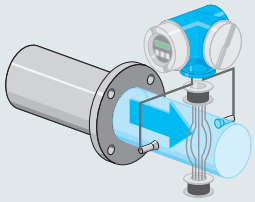

Electromagnetic

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Liquid applications	Coriolis	Electromagnetic
Liquids in general (e.g. water)	✓✓	✓✓
Very low flow rates (< 2 l/h)	✓✓	✓✓
Very high flow rates (> 100 000 m³/h)	⊗	✓✓
Non-conductive liquids	✓✓	⊗
Viscous liquids (> 50 cP)	✓✓	✓✓
Cryogenic fluids (e.g. liquified natural gas)	✓✓	⊗
Hygienic applications	✓✓	✓✓

Gas/steam applications	Coriolis	Electromagnetic
Gas flow in general (e.g. air flow)	✓✓	⊗
Wet/dirty gases (e.g. biogas)	⊗	⊗
Low flow rates (< 20 l/min)	✓✓	⊗
High flow rates	✓✓	⊗
Steam	✓	⊗

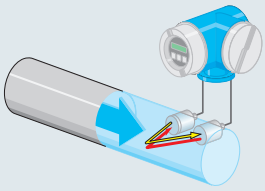
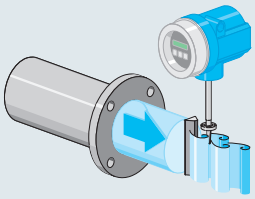
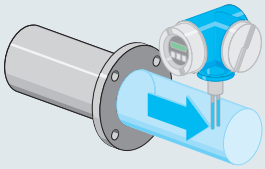
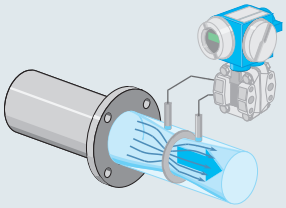
Special applications	Coriolis	Electromagnetic
Slurries, suspended solids	✓	✓✓
Liquid/liquid mixtures (oil/water)	✓✓	✓
Liquid/gas mixtures (water/air)	✓	✓
Corrosive liquids (acids, alkalis)	✓✓	✓✓
Corrosive gas flows (e.g. HCl vapor)	✓✓	⊗
Applications in mining (ore slurry)	⊗	✓✓
Bidirectional metering (forward/reverse)	✓✓	✓✓
Measurement from outside without process interruption	⊗	⊗

Range of applications	Coriolis	Electromagnetic
Nominal diameters	DN 1 to 400	DN 2 to 2400
Process pressure	max. 400 bar	max. 40 bar
Process temperature	–196 to +350 °C	–40 to +180 °C





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

Ultrasonic	Vortex	Thermal	Differential pressure
			
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DN 15 to 4000 Depending on sensor −40 to +200 °C	DN 15 to 300 max. 250 bar −200 to +400 °C	DN 15 to 1500 max. 40 bar −40 to +130 °C	DN 10 to 4000 max. 420 bar −200 to +1000 °C

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 35 years, Endress+Hauser has been providing its customers with one of the most comprehensive flow measurement product portfolios for liquids, gases and steam. And for the past 20 years, Proline has ensured that our customers get the best possible flowmeters for their applications in such industries as the chemical/petrochemical, food and beverage, water and wastewater, life science, oil and gas, power and energy, renewable energy, primary and metal, or pulp and paper industries.

Intensive research, combined with the knowledge of our customers' experience, has directly influenced the continuing development of our product portfolio. Since 1977, Endress+Hauser has installed over 2.9 million flowmeters. Based on these many years of experience, the latest Proline generation persists in providing industry-specific solutions for future demands. Your benefits: time and cost savings as well as maximum safety over the entire life cycle of your plant.

Industry-optimized sensors

The robust Proline sensors have proven their worth with the utmost success in hundreds of thousands of applications. Incorporating all modern technologies for flow measurement, Proline guarantees exactly the right sensor and the best possible performance for each application. The great variety of nominal diameters, designs, materials, approvals, certificates and process connections ensures an easy-to-use product for the customer while fulfilling all relevant industrial needs.

Successful in action since 1977:

- Over 1.8 million electromagnetic flowmeters
- Over 340 000 vortex flowmeters
- Over 640 000 Coriolis flowmeters
- Over 55 000 thermal flowmeters
- Over 55 000 ultrasonic flowmeters

Electromagnetic | Vortex | Coriolis | Thermal | Ultrasonic

Intelligent transmitters

Area of use, process requirements, accessibility, installation, ambient conditions and regulations – such factors define the functionality and suitability of a transmitter for a particular application. Proline transmitters are easy to use and are available with various types of equipment, suitable for your measuring needs:

- Compact or remote version
- With various functionality
- Permanent installation or portable, in two or four-wire technology, with/without battery operation
- Available in various materials (depending on the application)
- With/without digital communication (fieldbuses)
- With/without approvals and certificates

Proline – Added values in every respect

The new generation of Proline transmitters support you with outstanding advantages over the entire life cycle of your plant (▸ page 8 to 9):

- Seamless system integration – Proline fits every where
- Web server – easy on-site configuration
- Operation concept – uniform and time-saving
- HistoROM – automatic data storage
- Heartbeat Technology – reliable self-monitoring
- W@M Life Cycle Management – optimal business processes

Approvals, certificates and integration

Flowmeters from Endress+Hauser are available with a wide variety of approvals and certificates. This benefits our customers in many ways:

- Flexibility for planning your plant
- Reliability during operation
- High product quality
- Precise billing in custody transfer

Ex approvals
ATEX, IECEx, FM, CSA, NEPSI, TIIS, INMETRO

Device safety / functional safety
CE, ✔, SIL

Custody transfer approvals
e.g. MID, PTB, NMi, NTEP, MC, METAS, BEV

Drinking water approvals
e.g. KTW/W270, ACS, NSF 61, WRAS BS 6920

Pressure equipment directives
PED, CRN, AD 2000

Hygienic safety
3A, EHEDG, ASME BPE, ISPE, FDA

Communication
HART 7, PROFIBUS, FOUNDATION Fieldbus, Modbus RS485, EtherNet/IP

Shipbuilding
GL (German Lloyds), ABS (American Bureau of Shipping), BV (Bureau Veritas), DNV (Det Norske Veritas), LR (Lloyds Register)

Your Endress+Hauser representative can provide you with information on additional approvals and certificates!

Proline – Added values in every respect

Seamless system integration

Greater transparency through added information from your process: only digital signal transmission can enable device and process data to be transmitted and used simultaneously. Therefore, Endress+Hauser flowmeters are available with all state-of-the-art fieldbus technologies:

- A wide range of fieldbuses ensures the most direct and transparent integration of devices
- Risk-free integration: extended host testing and certification ensures perfect interaction between device and host
- Guaranteed compatibility between devices and process control systems at all times. User-friendly exchange of devices without expert knowledge.

Web server

The new generation of Proline flow measuring devices features an integrated web server. This enables quick and easy on-site operation and convenient access to device data, regardless of which fieldbus protocol is used. In difficult applications this attribute increases plant accessibility, thus preventing unnecessary plant down-time.

- Time-saving on-site operation without additional software thanks to standardized Ethernet technology (e.g. via laptop and a LAN cable)
- Comprehensive access to device, diagnostics and process information
- Faster up-/download of device data during maintenance or service, e.g. for storage of data or documentation of parameter settings.

Operation concept (HMI)

Endress+Hauser flow measuring devices reduce complexity of operation through a standardized, user-intuitive “human-machine interface.” Whenever you have to configure a device, Endress+Hauser’s operating concept enables a time-saving and safe operation in the field or via remote access:

- Guided parameterization for faultless operation
- Plain text information during operation
- 17 display languages for worldwide use
- Uniform menu structures – whether you operate your device via display, web server, operation software or control room.

HistoROM

Just as an airplane has a black box, a Proline flowmeter has built-in data storage modules as a standard to save data securely:

- Automatic storage of all device and configuration data for maximum plant safety
- Automatic restoration of device and configuration data for servicing
- Straightforward transfer of device configurations to other measuring points
- Data logger for safe monitoring and analyzing of data series
- Logbook function for recording status and error messages – for example during commissioning, maintenance or service

Heartbeat Technology

Striving for the highest operational safety and quality is a must for every plant operator. Embedded in the electronics, Heartbeat Technology continuously checks your Proline device for proper functionality (Diagnostics), allows recording of process-related measuring data (Monitoring) or performing a compliant verification at anytime (Verification):

- Reliable self-diagnostics – compliant and traceable testing (audited and attested)
- Automated testing procedures, e.g. for easy verification without process interruption. With electronic or printed documents for quality reporting (ISO 9001)
- Satisfies all SIL and NAMUR NE107 requirements (standardized status signals, e.g. in case of failure)
- Allows extended intervals for recalibration and proof testing.
- Metrologically traceable verification results. Immediately available for recurring tests.
- No presence in the field required: remote access via digital field network. Verification can be activated via any device interface when needed.

W@M Life Cycle Management

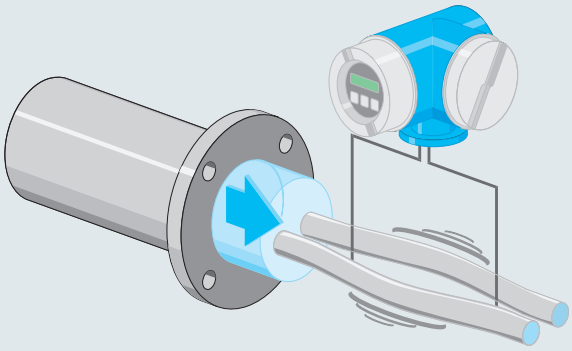
Device data from your installed base that is complete and instantly available throughout the entire life cycle is a key to successful plant operation. Our W@M Life Cycle Management provides access to diverse services, products or software programs from Endress+Hauser – such as are needed for optimal asset management:

- Open and flexible information platform – boosts productivity in every phase of an instrument's life
- Reduced engineering time for plant design – e.g. with Applicator for selecting and sizing instruments
- Improved plant performance and maintenance – thanks to quick access to critical asset information on the installed base

More about W@M Life Cycle Management ▸ page 56 to 57

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 the "phase difference." This difference is a direct measure of the mass flow. In addition, the fluid density can also 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 measurement – 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

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
- Solids contents in a fluid
- Concentrations in multiple-phase fluids
- Special density values such as reference density, °Brix, °Baumé, °API, °Balling or °Plato

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 640 000 Coriolis flowmeters have been successfully installed by Endress+Hauser since 1986.

Promass sensors

Promass F
For universal use

- Tube material: stainless steel, Alloy C22
- Optional up to +350 °C
- For custody transfer
- DN 8 to 250

Promass A
For low flows

- Tube material: stainless steel, Alloy C22
- For custody transfer
- DN 1 to 4 (up to PN 400)

Promass I
Straight single-tube

- Easy-to-clean single-tube system
- Tube material: titanium
- Optionally with viscosity measurement
- DN 8 to 80

Promass H
For aggressive fluids

- Bent single-tube system
- Tube material: zirconium, tantalum
- Highest corrosion resistance
- DN 8 to 50

Promass E
For basic applications

- Cost-effective sensor
- Tube material: stainless steel
- DN 8 to 80

Promass S
Food industry

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

Promass P
Life sciences industry

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

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 (PN 250)

Promass X
For maximum flow rates

- Highly accurate four-tube measurement technology
- Tubes and housing: stainless steel
- For custody transfer
- DN 300 to 400 (up to 4100 t/h)

Promass G
For highest pressures

- Ultra-compact design with threaded connections
- Up to 350 bar
- Tube material: stainless steel
- DN 8 to 25

Cubemass C
For low flows

- Space-saving, multivariable measuring system
- Tube material: stainless steel
- Optional with local operation
- DN 1 to 6

Sensors for filling applications ▸ Page 34 to 37

Promass transmitters

Promass 40
Basic applications

- Cost-effective transmitter for low-end applications
- Display without operation

Promass 80
Standard applications

- Two-line, backlit display with push buttons
- Compact and remote version

Promass 83/84
Demanding applications

- Four-line, backlit display with Touch Control
- Software options (F-CHIP) for batching, viscosity and concentration measurement, etc.
- Promass 84 for custody transfer

Promass 40
Aluminium housing

Promass 80
Stainless steel housing

Promass 83/84
Aluminium housing

Promass 83/84
Ex housing (stainless steel)

Promass 83/84
Wall-mount housing

Promass 100
Transmitter in a compact design

- Space-saving device for modular process facilities (skids)
- Housing: aluminum, stainless steel (optionally in IP69K)
- Ultra-compact version with plug connector
- Optional with local display
- Full functionality: Viscosity and concentration measurement, Heartbeat Technology, etc.
- HART, PROFIBUS DP, Modbus RS485 or EtherNet/IP

Promass 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
- Heartbeat Diagnostics, Monitoring and Verification
- HART, PROFIBUS PA, FOUNDATION Fieldbus

Promass 100 / 200 are transmitters of the new Proline device generation. Advantages ▸ Page 6 to 9

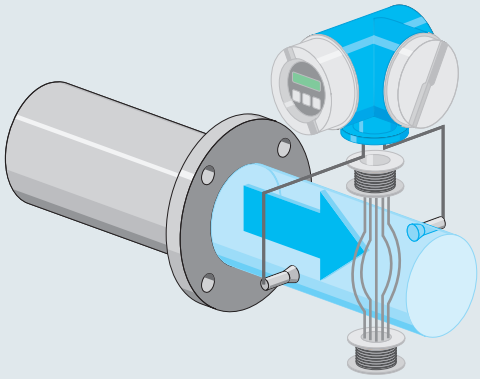
Promass 200
In genuine two-wire technology (4–20 mA)

Combining the benefits of the Coriolis flow measuring principle with those of two-wire technology no longer requires compromises. As a true two-wire loop-powered device (4–20 mA), the Promass 200 can be integrated into existing plant systems seamlessly and effortlessly:

- High operational safety due to intrinsically safe design (Ex ia)
- Developed for SIL 2/3 applications
- Suitable for use in safety devices
- Reduced costs for installation and wiring
- Familiar installation procedure

Electromagnetic flowmeters

Proline Promag – Universally applicable in all industries and in pipes from 2 millimeters to 2.4 meters. Since 1977, Endress+Hauser has successfully installed over 1.8 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 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 2400)
- 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

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 50 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.

Promag sensors

Promag H
Food industry

- For the chemicals, life sciences, processing and food industries
- Robust stainless steel housing (3A, EHEDG)
- CIP/SIP cleanable
- PFA liner (–20 to +150 °C)
- Flexible connection concept
- DN 2 to 150

Promag S
For demanding fluids

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

Promag P
Chemical and processing industries

- With all common Ex approvals
- For custody transfer
- PTFE (–40 to +130 °C)
  PFA (–20 to +180 °C)
- DN 15 to 600

Promag D
Water/wastewater

- Wafer device with shorter installation length and less weight
- Drinking water approvals
- Lining: Polyamide (0 to +60 °C)
- DN 25 to 100

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), polyurethane (–20 to +50 °C)
- DN 25 to 2000

Promag L
Water/wastewater

- Drinking water approvals
- Up to 30% less weight
- Lap-joint flanges up to DN 300
- Linings: polyurethane (–20 to +50 °C), PTFE (–20 to +90 °C), hard rubber (0 to +80 °C)
- DN 25 to 2400

Magphant
Limit switch

- For cost-effective flow monitoring
- For steel or plastic pipes
- DN 15 to 2000

Sensors for filling applications ▸ Page 34 to 35

Promag W – long-lasting and resilient
Whether in the ground, in water, in saline air or for greatly fluctuating moisture and temperature conditions – Promag W guarantees long-term reliability in operation without additional protective measures:

- Certified corrosion protection (EN ISO 12944)
- Multi-seal with corrosion-resistant connection housing made of polycarbonate
- No ingress of water, completely welded sensor (IP68/Type 6P enclosure)

Promag transmitters

Promag 10
Basic applications

- Cost-effective transmitter in a compact design
- Two-line display with push buttons

Promag 50/51
Standard applications

- For custody transfer (Promag 51P, 51H)
- Two-line backlit display with push buttons

Promag 53/55
Demanding applications

- Four-line, backlit display with Touch Control
- Software options (F-CHIP) for batching, dosing, electrode cleaning, diagnostics etc.
- Signal inputs for temperature or density
- Reliable measurement of difficult fluids such as ore slurry or fruit mash (Promag 55S, 55H)

Promag 10
Aluminium housing

Promag 50/51
Stainless steel housing

Promag 53/55
Aluminium housing

Promag 53/55
Wall-mount housing

Promag 100
Transmitter in a compact design

- Space-saving device for modular systems (skids)
- Housing: aluminum, stainless steel (optionally in IP69K)
- Ultra-compact version with plug connector
- Optionally with local display
- Full functionality: Electrode cleaning, Heartbeat Technology, etc.
- HART, PROFIBUS DP, Modbus RS485 or EtherNet/IP

Promag 200
Two-wire loop-powered technology (4–20 mA)

- Four-line display with push buttons or Touch Control
- Line recorder function
- Heartbeat Diagnostics, Monitoring and Verification
- Display module with transfer and backup function for configuration data
- HART, PROFIBUS PA, FF

Promag 400
For water/wastewater

- Corrosion-resistant housing
- Four-line, backlit display with Touch Control
- High plant availability due to automatic data storage (HistoROM)
- Time-saving operation via integrated web server
- Heartbeat Technology for monitoring and verification

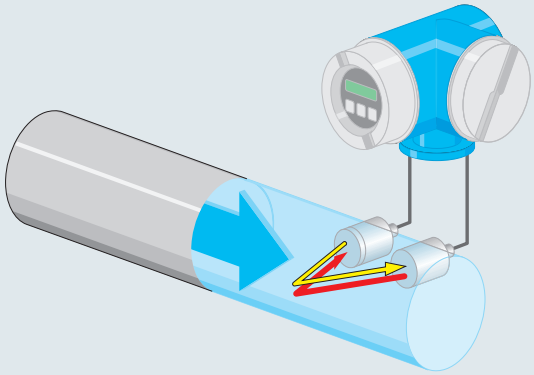
Promag 800
Battery-powered

- Long-term operation up to 15 years
- Eight-line display with push buttons
- Corrosion-resistant polycarbonate housing
- Measured values stored in non-volatile memory in a data logger (SD card)
- Worldwide data transmission and retrieval via GSM/GPRS

Promag 100 / 200 / 400 / 800
are transmitters of the new Proline device generation. Advantages ▸ Page 6 to 9

Ultrasonic flowmeters

Proline Prosonic Flow – Whether mounted on the outer wall of the pipe or directly in the pipe – ultrasonic sensors guarantee versatile and economical measurement of gases and liquids up to a nominal diameter DN 4000.



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, density, temperature, 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

Using ultrasonic waves, the flow volume of a wide variety of gases and liquids can be measured reliably – independent of electrical conductivity, pressure, temperature 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 range of applications extends from applications in the water industry to industrial process engineering.

Clamp-on sensors

- For retrofitted installation without interrupting the process
- Aggressive fluids can be measured without any problems, even under high pressure
- Suitable for pipes made of plastic, steel, cast iron or composite materials (lined/unlined)
- For pipe diameters up to DN 4000

Inline sensors

- Guaranteed accuracy thanks to traceable factory calibration
- Robust industrial design in accordance with ASME and EN
- Short inlet runs
- For pipelines up to DN 2000


Endress+Hauser

Prosonic Flow sensors

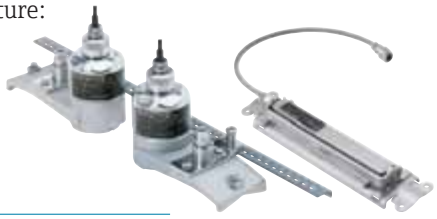
For measuring from outside (clamp-on sensors)

Prosonic Flow W
Water applications

- For water, wastewater, hot/cold water in utilities
- Process temperature: –20 to +80 °C
- DN 15 to 4000

Prosonic Flow P
Process industry

- For chemicals, petrochemicals, life sciences, oil/gas, energy
- With Ex approvals
- Process temperature: –40 to +170 °C
- DN 15 to 4000



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

Prosonic Flow F
Liquids (chemicals/petrochemicals)

- With Ex approvals
- Traceable factory calibration (±0.3 to 0.5% o.r.)
- For compact systems (inlet run max. 5 × DN)
- –40 to +200 °C
- DN 25 to 300

Prosonic Flow C
Water/wastewater

- Drinking water approvals
- Traceable factory calibration (±0.5% o.r.)
- DN 300 to 2000

For attenuating pipe materials

Prosonic Flow W (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

Clamp-on technology
Flexible measurement

This design features advantages offered by no other measurement technology:

- Ideally suited for flow monitoring and network balancing
- Low capital investment – cost-effectiveness increases with pipe diameter (up to DN 4000)
- For temporary flow measurement without interrupting the process
- Verifying already installed measuring devices

Prosonic Flow transmitters

For clamp-on sensors (W, P)

Prosonic Flow 91
Basic applications

- Cost-effective transmitter in a compact design
- Two-line display with push buttons

Prosonic Flow 93T
Portable transmitter

- For temporary monitoring and test measurements with clamp-on sensors
- Integral data logger
- Data transmission via USB memory stick
- Four-line, backlit display with Touch Control

For sensors W, P or C

Prosonic Flow 93
Standard applications

- With extended functionality in process applications
- With Ex approvals and Fieldbus connection
- Four-line, backlit display with Touch Control

For sensor F (inline)

Prosonic Flow 92
Two-wire loop-powered technology (4–20 mA)

- With Ex approvals (Ex i, Ex d)
- With current (HART), pulse, switch outputs; PROFIBUS PA and FOUNDATION Fieldbus
- Two-line display with push buttons

For sensor B (inline)

Prosonic Flow 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
- Event logbook and data logging functionality
- Heartbeat Diagnostics, Monitoring and Verification

Prosonic Flow 200 is a transmitter of the new Proline device generation. Advantages:
▸ Page 6 to 9

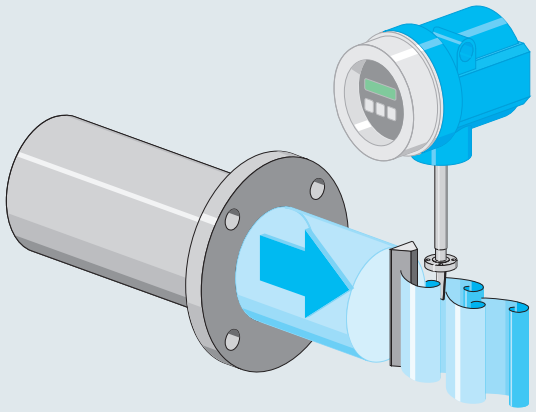
Biogas and methane measurement
Reliable process control

Previously, reliable measurement of slow-flowing, wet or dirty gases in pipes was nearly impossible. With the new Prosonic Flow B 200, gas quantity and methane content can now be measured simultaneously – this is unique worldwide:

- Continuous monitoring of gas quantity and quality
- Fast reaction in case of interference during the fermentation process
- Efficient process control and energy balancing

Vortex flowmeters

Proline Prowirl – Robust and universally applicable. For measuring the volume flow of liquids, gases and steam up to 250 bar and 400 °C 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 mean flow velocity and thus to 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 and 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 (+450 °C on demand)

Measuring principle movie

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 temperature sensor and 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 the TÜV 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 (Cl 150 to 300)
- –200 to +400 °C
- DN 15 to 150

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 40 (Cl 150 to 300)
- –200 to +400 °C (+450 °C optional)
- DN 15 to 300

Prowirl R

For low flows

- With a single and even double line size reduction for:
  - Increasing the flow velocity
  - Extending the lower measuring range
- PN 10 to 40 (Cl 150 to 300)
- DN 25 to 200 (single reduct.)
- DN 40 to 250 (double reduct.)

Prowirl O

The high-pressure specialist

- Flange or butt-weld version
- Worldwide standardized installation lengths
- Sensor made of stainless steel
- PN 63 to 250 (Cl 600 to 1500)
- –200 to +400 °C (+450 °C optional)
- DN 15 to 150

Dualsens version

To ensure safety, critical applications often require redundant measurements. Therefore all Prowirl sensors are also available in a Dualsens version; in other words, with two separate DSC sensors and two measuring electronics. Through development in accordance with IEC 61508, the redundant measuring system can even be used in SIL 3 applications.

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 300 000 devices, this sensor concept has been proving its value for decades.
The sensor is highly resistant to:

- Vibration
- Dirty fluids
- Water hammer
- Temperature shocks (>150 K/s)

Optionally, the DSC sensor is also available with a built-in temperature sensor, for example for direct mass measurement of saturated steam.

Prowirl transmitters

Prowirl 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 with pulse/frequency/switch output
- Heartbeat Diagnostics, Monitoring and Verification
- Versatile system integration:
  - Current input for reading in external measured variables such as pressure or temperature (optional)
  - Current output for multiple measurement parameters (optional)

Prowirl 200 is a transmitter of the new Proline device generation. Advantages ▸ Page 6 to 9
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 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 external temperature and pressure values via HART, PROFIBUS PA and FOUNDATION Fieldbus as well as via an optional current input
- Integrated 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 software solutions for energy monitoring (e.g. eSight).

EngyCal RS33 | RSG40 | Cerabar M | Omnigrad TR

One-of-a-kind wet steam detection
Process reliability and efficiency

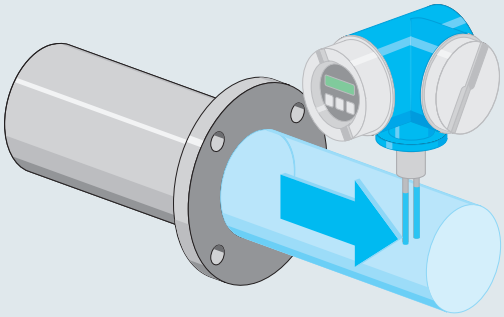
Many industries use large quantities of steam, the generating costs of which are extremely high. Moreover, the transfer of heat energy is energetically efficient only for "saturated steam." Often, however, "wet steam" is what predominates, since fluctuations in pressure and temperature cause water to 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
- Heavy corrosion from the salts dissolved in the water carried over

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.

Thermal mass flowmeters

Proline t-mass – For direct mass measurement of industrial gases and compressed air, even at the lowest flow velocities and low pressure.



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 (100:1)
- Excellent low-end sensitivity
- Quick reaction to fluctuations in flow
- Negligible pressure loss
- Maintenance-free, no moving parts

Measuring principle movie

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 (for fermenting and chilling)
- Argon (in steel production)
- Nitrogen and oxygen (production)
- Natural gas (for burner and boiler feed control)
- Air and biogas measurement (e.g. in 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 applications (cost-effective measurement)

t-mass A
Inline version

- For t-mass 150 transmitter
- 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 40 bar g
- −40 to +100 °C
- DN 15 to 50

t-mass B
Insertion version

- For t-mass 150 transmitter
- 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 bar g
- −40 to +100 °C
- DN 80 to 1500

For demanding applications

t-mass F
Inline version

- For t-mass 65 transmitter
- Max. measured error:
  ±1.5% o.r. (10 to 100% o.f.s.)
  ±0.15% o.f.s. (1 to 10% o.f.s.)
- Process pressure:
  up to 40 bar g
- −40 to +100 °C
- DN 15 to 100

t-mass I
Insertion version

- For t-mass 65 transmitter
- Suitable for large pipelines and rectangular ducts
- Max. measured error:
  ±1.5% o.r. (10 to 100% o.f.s.)
  ±0.15% o.f.s. (1 to 10% o.f.s.)
- Process pressure: up to 20 bar g
- −40 to +130 °C
- DN 80 to 1500

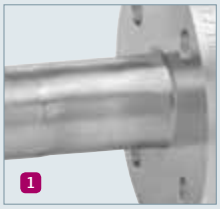
Flexible installation
Whether in rectangular ventilation ducts or in pipes – t-mass sensors are always the perfect fit. For installation, both inline and insertion versions in various nominal diameters are available:

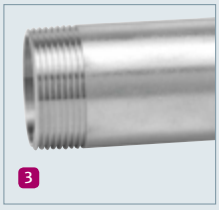
Inline version

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

Insertion version

4. Suitable for pipelines or rectangular ventilation ducts up to DN 1500
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





t-mass – transmitters

t-mass 65
For demanding applications

- For t-mass F and I sensors
- Two-line, backlit display with three push buttons
- Free selection of up to 20 gases, including gas mixtures with up to 8 components (e.g. digester gas)
- Display/outputs for flow and temperature
- Worldwide recognized Ex approvals
- System integration via PROFIBUS DP, PROFIBUS PA, Modbus RS485, FOUNDATION Fieldbus
- Switch and/or relay output for alarm messages
- Totalizer functions
- Current input for reading external measured variables (e.g. pressure, gas concentration)

t-mass 150
For basic applications (cost-effective measurement)

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

t-mass 150 is a transmitter of the new Proline device generation. Advantages ▸ Page 6 to 9

Intelligence in operation
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:

- 20 freely selectable gases (4 gases for t-mass 150)
- 2 gas mixtures with up to 8 user-definable components (only t-mass 65)
- Toggling between 2 gas mixtures (only t-mass 65)
- Programmed gases can be changed at any time (without recalibration)

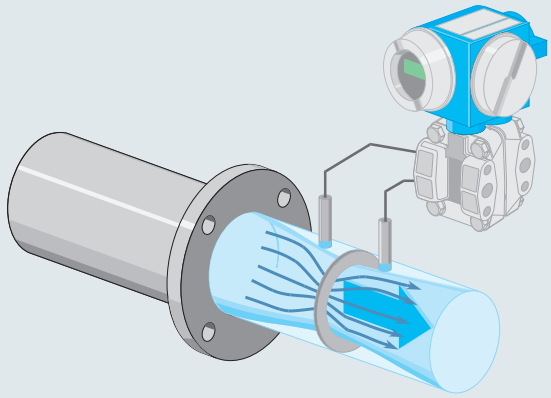
t-mass T 150
For simple liquid flow monitoring

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, 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)
- Standard or hygienic version (3A, EHEDG)
- Maintenance-free, no moving parts
- Wide variety of applications: monitoring, flow measurement, switch function, etc.

Differential-pressure flowmeters

Deltatop – Universally applicable measurement technology for liquids, gases and steam even under extreme process conditions up to 420 bar and 1000 °C.



Measuring principle

In pipelines there is a direct relationship between the cross-sectional area, the pressure and the speed of a flowing fluid.

Orifice plate, nozzle, Venturi tube

The measuring tubes of these differential-pressure flowmeters have an artificial constriction. As soon as the fluid starts moving, the natural laws governing the mechanics of flow dictate that pressure upstream of the constriction increases, to drop again immediately downstream of the constriction. This difference in pressure provides a direct measure of the flow rate.

Pitot tube

This method uses a rod-shaped sensor. This sensor has a series of leading and trailing pressure-tapping ports. The upstream, leading array registers dynamic pressure and static pressure, the trailing array registers only static pressure. The pressure differential is a direct measure of the velocity and flow rate.

Advantages at a glance

- Universally applicable for liquids, gases and steam
- Worldwide recognized standards (since 1929)
- Long measurement tradition and high acceptance
- For extreme conditions up to 420 bar and 1000 °C
- Robust primary elements that are purely mechanical and without moving parts
- Wide nominal diameter range:
  – Restriction type devices: DN 10 to 4000
  – Pitot tube: up to DN 12 000 (optionally)
- Transmitter exchange without process interruption

Measuring principle movie (Orifice, nozzle, Venturi tube)

Differential-pressure flow measurement is one of the most frequently used methods in industry. Thanks to a vast wealth of expertise that is reflected in numerous sets of standards, this technology has been accepted worldwide and become ubiquitous. Now as before, metering in hot water and cooling circuits, as well as metering steam and condensate at very high temperatures in utilities, are the primary applications.

A wide variety of materials and designs enables differential pressure flowmeters to be adapted optimally to prevailing process conditions. Instead of the more common orifice plates, Pitot tubes can be used, particularly wherever low pressure loss is required, or for measurement in large pipes several meters in diameter.

Measuring principle movie (Pitot tube)

Deltatop – sensors

Deltatop DO
Orifice plates

- Standard orifice: DN 25 to 1000
- Flanged orifice: DN 25 to 600
- Meter run (calibrated): DN 10 to 50


Standard orifice (remote)


Standard orifice (compact)


Flanged orifice


Meter run

Deltatop DN
Nozzles

- Standardized as per ISO 5167
- Little pressure loss
- Also for higher flow velocities
- DN 50 to 500

Deltatop DV
Venturi tubes

- Standardized as per ISO 5167
- Available as welded-in or flanged version
- Little pressure loss
- Unaffected by dirt and abrasion
- DN 50 to 2000

Deltatop DP
Pitot tube

- Insertion version
- Easy to install
- Optionally for installation without interrupting the process
- Bidirectional measurement possible
- Very low pressure loss
- DN 40 to 12 000


Remote version


Compact version

Accessories
Various accessories and fittings are available for the remote version, with a wide choice of materials and designs.


Shut-off valves


Manifolds


Condensate chambers


Purge units

Deltatop – transmitters

Deltabar M (PMD 55)
For all standard applications

- Compact transmitter
- Four-line display, operation via push buttons
- Transmitter in two-wire technology
- Fast commissioning via DIP switches
- Easy, secure and menu-guided operation
- Digital communication: HART, PROFIBUS PA, FF

Deltabar S (PMD 70/75)
For demanding measuring tasks

- Function-monitored from measuring cell to electronics
- Retrofitted HistoROM/M-DAT memory module for data duplication or cyclic data recording
- Extensive diagnostic functions
- Quick commissioning with Quick Setup menu
- Digital communication: HART, PROFIBUS PA, FF
- Functional Safety to IEC 61508 up to SIL 3

Robust and customized

Orifice plates are widely used and easy to install. The other primary elements available from Endress+Hauser are also used in nearly all applications and industries. In addition to orifice plates, our product line includes Pitot tubes, nozzles, V-cone, wedgemeters and Venturi tubes with little pressure loss, as well as special designs for difficult fluids or bidirectional measurement.

Because primary elements are extremely robust, work entirely mechanically and do not have any moving parts, they can be made of almost any material and be used even in highly demanding applications. The broad spectrum includes primary elements made of plastic for chemically aggressive fluids, versions for steam or hydraulic oil up to 420 bar, and models for gas measurement at extremely high temperatures up to 1000 °C and higher.

Different constriction diameters make it possible for all of these designs to match both the pressure loss and the differential pressure optimally to the process conditions.

A great advantage is that differential-pressure transmitters can be exchanged at any time without interrupting a process. They can be easily isolated from the process by means of shut-off valves or a manifold installed in the impulse lines.

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
- 3A approval and EHEDG certified
- Measuring system 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 efficiency in metering
In real-world terms, cost-efficient means no unnecessary downtime caused by maintenance or repair. This is exactly where the Dosimass and Dosimag support you with an ideal device concept:

- Functions for self-monitoring and diagnosis
- Maintenance-free, no moving parts in the measuring tube
- SIP and CIP cleanable (up to +150 °C 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 1.66 l/s
- Applicable up to +130 °C and 16 bar
- DN 4 to 15

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/100 bar
- Especially for handling different fluids
- DN 8 to 25


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 Ex approvals (e.g. ATEX, FM or CSA)
- Numerous custody transfer approvals (e.g. PTB, NMi, 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, DN 15, DN 25
- Direct mass flow measurement
- Max.150 kg/min
- Max. 350 bar
- –50 to +125 °C
- Process connection: Internal thread
- Modbus RS485, pulse/ frequency/switch output
- High vibration resistance
- 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
- 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

- For dispensers or tank trucks
- DN 8, DN 15, DN 25, DN 40
- Direct mass or volume flow metering
- Max. 750 kg/min
- Max. 40 bar
- −40 to +125 °C
- 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
- API table integrated as standard

For liquefied natural gas (LNG)

LNGmass

- For dispensers
- DN 8, DN 15, DN 25
- Direct mass flow measurement
- Max. 300 kg/min
- Max. 40 bar
- −196 to +125 °C
- 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 temperatures down to −196 °C

Global chemicals, competitive and safe

Get the extra project skill and know-how you need to boost your plant's safe performance.

You gain concrete benefits from a partner who has first-hand knowledge of your sector's issues around the globe: on increased safety, on environmental protection, on over-supply leading to cost pressure and on finding engineering support and service when required. You can rely on our help to become more competitive in your line of business.

With a long history of industry firsts we have grown with the sector by listening, acting and innovating to better serve you with:

- Safety, built-in
- The technology to lead
- Best-fit project management

Product highlights

Two-wire loop-powered flowmeters

Promass F 200 (Coriolis)

For demanding applications
Robust device with highest performance under varying process conditions. Simultaneous measurement of mass, volume, density and temperature (+200 °C). SIL 2/3 (IEC 61508), Ex approvals, self-diagnostics (NE107), NAMUR lengths, PED, CRN. No inlet/outlet runs.

Promag P 200 (Electromagnetic)

For corrosive liquids
Robust device for all conductive liquids (≥20 µS/cm), e.g. water, acids or alkalis. Corrosion-resistant PTFE or PFA linings (+150 °C). SIL 2/3 (IEC 61508), Ex approvals (Ex i, Ex d), self-diagnostics (NE107), No pressure loss.

Prowirl F 200 (Vortex)

The specialist for gas and steam
Multivariable flow and temperature measurement (+400 °C). Flow computer for mass and energy flow calculation. Unique wet steam measurement for highest safety. SIL 2/3 (IEC 61508), Ex approvals, self-diagnostics (NE107). Lifetime calibration factor.

Prosonic Flow 92F (Ultrasonic)

Cost-effective metering of all liquids
Inline ultrasonic flowmeter with high accuracy (±0.3%). Ex approvals (Ex i, Ex d). Applicable up to +200 °C. No pressure loss.

Four-wire flowmeters

Promass 83F (Coriolis)

For premium accuracy
Robust device with highest performance under varying process conditions. Simultaneous measurement of mass, volume, density and temperature (+350 °C). Ex approvals, SIL 2/3. Max. measured error: ±0.05% (PremiumCal). No inlet/outlet runs.

Promag 53P (Electromagnetic)

The standard device – proven for decades
For corrosive liquids (>5 µS/cm) and high process temperatures. Corrosion-resistant PTFE or PFA linings (up to +180 °C). Ex approvals, SIL 2. Software for pulsating flow. No 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 you 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 constant self-diagnostics
- Best-in-class diagnostic coverage (SFF ~ 98%)
- Inline verification possible at any time without process interruption
- Electronically stored verification results in the flowmeter, uploaded to the asset management system
- Easy, safe and seamless documentation in accordance with your local standards
- Generation of secure 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 your operational reliability and reduce costs for planning, purchasing and operation:

- High operational safety and safe device access in Ex 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 is our life

Water quality, discharges, regulations, the environment … just rely on a trusted partner.

As budgets shrink and legislative demands soar, we bring expertise to challenging needs. Safe potable water, discharges, environmental penalties, water infrastructure for developing countries, energy monitoring, the rising quantities of sludge from wastewater treatment and the opportunities they create for biogas – we make sense of it all for your every need with experienced thinking supported by process technology solutions.

Working with water in over 100 countries, Endress+Hauser offers a refreshing alternative:

- Improve plant safety and availability
- Optimize costs in your internal water processes
- Support your risk and failure management

Product highlights

Promag L 400 (Electromagnetic)

The standard device for water
Suitable for many different applications. Flexible mounting by lap-joint flanges (DN ≤ 350). Maintenance-free. Drinking water approvals. Heartbeat Verification without process interruption. Automatic data storage (HistoROM). Integrated web server for time-saving operation. Up to DN 2400.

Promag W 400 (Electromagnetic)

The specialist for water
Approved for custody transfer to MI-001/ OIML R49. Reliable long-term operation underwater or underground thanks to IP68 (Type 6P) and certified corrosion protection (EN ISO 12944). With drinking water approvals. Heartbeat Verification without process interruption. Up to DN 2000.

Promag 10L (Electromagnetic)

Cost-effective metering of water
Suitable for standard applications and direct integration. Proven sensor with drinking water approvals. 2-line display with push buttons for easily readable process information. Compact or remote version (HART). Maintenance-free. Up to DN 2400.

t-mass A/B 150 (Thermal)

Cost-effective metering of utility gases
Reliable monitoring and quantity measurement of air, oxygen and biogas in wastewater treatment plants. Minimum maintenance and negligible pressure loss. Inline versions (A) as well as insertion version (B) for pipes and rectangular ducts.

Prosonic Flow B 200 (Ultrasonic)

The specialist for wet biogas
Simultaneous measurement of volume flow, methane content and gas temperature also under low process pressure, low flow rates and varying gas compositions. Comprehensive energy balancing by calculating corrected volume, calorific value and Wobbe index. Ex approvals.

Verification made easy with Heartbeat Technology

The smallest measurement 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 be inspected and verified in accordance with the law?
- Is it possible to extend the calibration cycles specified by law?

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

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

Nourishing your productivity

Your global partner for accurate measurements and expert support in food and beverage automation.

From hygiene regulations and food safety to the basic demands of reliability and uptime, high-quality food and beverage producers profit from our experience in more than 100 countries. Get it right the first time and make your safe choice:

- Constant food quality and compliance
- Resources savings
- An expert partner

Product highlights

Promag 50/53H (Electromagnetic)

The proven standard device for all cases
For all hygienic applications in the food industry. Local display with push buttons (Promag 50) or Touch Control (Promag 53). No pressure loss. Easy to clean (SIP/CIP) and piggable. Software for batching or pulsating flow.

Promag H 100 (Electromagnetic)

Compact design for hygienic applications
Proven sensor for demanding hygienic requirements; ideally suited for skid-mounted process facilities. Simultaneous measurement of volume flow, temperature and conductivity. No pressure loss. Easy to clean (SIP/CIP) and piggable. Highest degree of protection (IP69K).

Promass S 100 (Coriolis)

The food specialist in a compact design
Ideally suited for skids. Simultaneous measurement of mass, volume, density, concentration and temperature. Completely drainable, single-tube system without shear forces. Fast recovery from CIP and SIP cleaning. Highest degree of protection (IP69K). No inlet/outlet runs.

Promass 83I (Coriolis)

For in-line viscosity measurement
Simultaneous measurement of mass, volume, density and temperature. Unique in-line viscosity measurement for optimal process control. Straight, self-drainable single-tube system. No shear stress for the fluid being measured. Easy to clean and piggable.

Promass 83F (Coriolis)

For premium accuracy, robustness and extended functionality
Simultaneous measurement of mass, volume, density and temperature. Software for filling, dosing, density, concentration measurement and diagnostics. Highest performance under varying, demanding process conditions. Max. measured error: ±0.05% (PremiumCal). No inlet/outlet runs.

Process control made easy – Viscosity and density measurement

The trend toward more efficient processes and higher quality requirements is leading to the need for also monitoring ever more parameters in the food industry. With Promass, you have what you need for this "all-in-one." This Coriolis flowmeter not only measures the mass flow with peak accuracy, but, in addition to fluid density, volume flow and temperature, it also measures industry-specific density values and even the viscosity directly in the piping.

Density functions (Promass F, I, S)

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 (%) – 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.

The pulse of life sciences

Trust a reliable partner who puts quality, compliance and cost control at the heart of life sciences.

It is a daily task to meet stringent GxP regulations and productivity goals throughout your product lifecycle. You can count not only on our world-class instruments, designed to ASME-BPE standards, but also on our highly qualified engineering input and experienced service teams. We partner with you to generate process optimization, higher plant availability and continuous improvement.

Our experience, gained at the heart of the sector, will help you to:

- Streamline your projects
- Attain operational experience
- Make the right decisions

Product highlights

Promass 83P, Promass P 100 (Coriolis)

The specialist for sterile processes
Simultaneous measurement of mass, volume, density and temperature. Highest process safety – full conformity with ASME BPE, 3A and EHEDG; low delta ferrite. Electropolished process-wetted parts. Completely drainable single-tube system independent of installation orientation. Highest accuracy when dosing, mixing and filling expensive active ingredients. Fewer downtimes thanks to immediate availability after SIP and CIP cleanings.

Promass P 100:
Ultra-compact device for space-saving installation, e.g. in skids. With or without display.

Promass F 100

For accurate density measurement
Ultra-compact design with full functionality in a small package – ideally suited for modular skid-mounted process facilities. Robust, universally applicable device with highest performance under varying, demanding process conditions (+200 °C). Simultaneous measurement of mass, volume, density and temperature. Ex approvals, self-diagnostics acc. to NE 107. No inlet/outlet runs. Max. measured error (density): ±0.0005 g/cm³.

Promag H 100 (Electromagnetic)

Cost-efficient metering of small flow rates
Ultra-compact design with full functionality in a small package – ideally suited for modular skid-mounted process facilities. Simultaneous measurement of flow, temperature and conductivity in a broad range of applications. No pressure loss. Flexible installation due to numerous hygienic process connections. Highest degree of protection (IP69k)

Prosonic Flow 93P (Ultrasonic)

Cost-effective flow measurement from outside
Non-contact measurement, particularly suitable for ultrapure fluids. Measurement independent of pressure, density, temperature, conductivity and viscosity. Precise measurement results due to an easy, menu-guided sensor mounting procedure. Long-term system integrity thanks to robust sensor and industrial mounting kit design.

Extended calibration cycles 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 removal of devices and broken seals.
With Heartbeat Technology, available for all Proline 100 flowmeters, calibration cycles can now 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 around 95% – allowing for calibration intervals taken, for example, from 6 to 24 months, or from 2 to 5 years.

Fuel for thought

With vast experience in the oil and gas sector, we help you to perform, comply and thrive.

From exploration to refinery, from storage to distribution, from plant upgrades to new projects, we have the application expertise to help you succeed. At a time when the sector faces skills shortages and tightening of regulations, our organization is here across the full life cycle of your project always keeping your deadlines in mind.

While complexity of facilities and processes are ever increasing, and downtime must be reduced, your competitiveness is enhanced with reliable, accurate and traceable asset information. In short, you need to do more with less, benefiting from a stable partner who is here for the long haul and ready across the globe, offering:

- Assured plant safety
- Optimized return on investment
- Best-fit products, solutions and services

Product highlights

Promass 83X/84X (Coriolis)

Four-tube flowmeter for highest capacity
Increased profit thanks to a single installation point providing premium accuracy for large quantities. Worldwide recognized custody transfer approvals.
Maximum measured error: ±0.05%.

Promass 83F/84F (Coriolis)

For premium accuracy and extended functionality
Immune to fluctuating and harsh environments. Worldwide recognized custody transfer approvals. Maximum measured error: ±0.05%.

Promass 83O/84O (Coriolis)

Robust high-pressure flowmeter
For process pressures up to PN 250 (Class 1500) and premium accuracy. Highest resistance to stress corrosion cracking – measuring tubes in Super Duplex. Worldwide recognized custody transfer approvals.
Maximum measured error: ±0.05%.

Prosonic Flow 92F (Ultrasonic)

Cost-effective flowmeter for hydrocarbons
Two-wire loop-powered inline flowmeter (4–20 mA)with high accuracy (±0.3%). Reduced inlet/outlet runs (≤5 DN) due to its innovative three and four-beam design. Free cross section, no pressure drop.

Prowirl F 200 (Vortex)

The universal "workhorse"
Versatile and robust vortex meter, available in a dualsense version with two sensors and transmitters for redundant measurements and highest operational safety (e.g. with steam). No maintenance. Lifetime calibration factor (K-factor). SIL 2/3.

Prowirl O 200 (Vortex)

For high-pressure applications
Robust vortex meter for process pressures up to PN 250 (Class 1500). Highest mechanical integrity thanks to special measuring tube material. High resistance to vibrations, temperature shocks and water hammer.

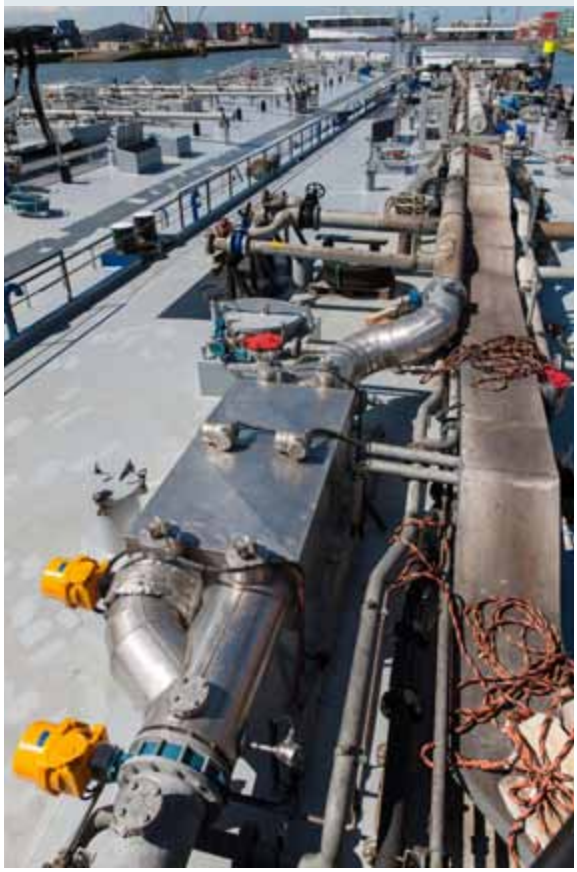
Certified bunker fuel metering systems

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 we all know, 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 measurement 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 up your plant

Power plants play a vital role. We help minimize downtime while delivering safety and productivity.

Your plant needs a multi-skilled, versatile partner. You need reliable solutions that meet your application requirements and industry quality standards. And you may need to upgrade ageing plants with proven and state-of-the-art technologies, to keep output consistently high.

As the industry shifts towards natural gas, renewables and the new market dynamics driven by shale gas, our mission is to provide the all-round support and experience you need. This includes elevated standards of safety for your staff – and the ability to meet even-higher environmental demands in flue gas cleaning processes such as SCR catalysts for nitrogen oxide reduction, electrostatic precipitators (ESPs) for particle separation, and limestone scrubbing processes for desulphurization.

When you choose us, you:

- Boost the efficiency of your plant
- Heighten safety
- Maintain expertise

Product highlights

Prowirl F 200 (Vortex)

Standard device for demineralized water, steam and gas
Multivariable loop-powered two-wire device (4–20 mA). With temperature measurement and a flow computer to calculate mass and energy flow. With worldwide unique inline wet steam measurement. No maintenance. Lifetime calibration factor (K-factor).

Promass F 200 (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.

Promag L 400/W 400 (Electromagnetic)

For the accurate metering of raw and cooling water
The measuring principle is independent of pressure, density and temperature. With an integrated electrode cleaning function (ECC) to prevent conductive magnetite deposits. Maintenance-free, no moving parts.

Promass 83I (Coriolis)

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

Deltatop (Differential pressure)

For extreme process conditions
Up to 1000 °C and 420 bar. Standardized measuring principle (ISO 5167) for steam, liquids and gas. Long measurement tradition since 1929. Low pressure loss (Venturi, nozzle). High long-term stability due to robust primary elements that are purely mechanical. No moving parts.

Multivariable measurement for more transparency

You can use Promass and Prowirl — without additional sensors — to measure multiple variables simultaneously and thereby control your processes optimally while saving money.

Cost-reduced combustion

The Promass 83I 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

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 200 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

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.

Extracting more from less

In a world of lower grades, skills gaps and excavation challenges – we can help you hit your targets.

We've seen how lower grades are driving an acute need for ever-better automation and controls. You are also facing an emerging skills gap, requiring better-informed industry partners.
At the same time, energy costs are only going one way, and the legislative environment is becoming increasingly stringent. Tough challenges call for experienced heads who can:

- Reduce your metal and mineral production costs
- Keep your plant safe
- Boost compliance and responsibility

Product highlights

Promag 55S (Electromagnetic)

For inhomogeneous or abrasive fluids
For slurries with high solids contents, fine or rocky size. High resistance to abrasion thanks to industry-optimized linings. Excellent accuracy and repeatability.
Calculation of mass flow and solids content.
No maintenance.

Promag L 400 / W 400 (Electromagnetic)

For industrial wastewater
Corrosion-resistant polycarbonate transmitter housing. Promag W with completely welded sensor in IP68 (Type 6P) and with certified corrosion protection (EN ISO 12944) for reliable long-term operation.
No maintenance.

Prowirl F 200 (Vortex)

The specialist for gas and steam
Multivariable loop-powered two-wire device (4–20 mA). With temperature measurement and a flow computer for the calculation of mass and energy flow. Unique wet steam measurement for highest safety.
No maintenance. Lifetime calibration factor.

Promass I 100 (Coriolis)

For fuel measurement
Simultaneous measurement of mass, volume, density and temperature. With unique inline 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.

Prosonic Flow 92F (Ultrasonic)

For cooling water
Ideally suited for cooling circuits of electric arc furnaces (EAF). Unaffected by the electrical field strength in the surrounding area.
Two-wire loop-powered flowmeter (4–20 mA) with high accuracy (±0.3%).
No pressure loss.

Promag P 100 (Electromagnetic)

For dosing corrosive chemicals
For aggressive fluids at high process temperatures, e.g. during the leaching of metals from stone slurries using sulfuric acid. Ex approvals. Acid- and alkali-resistant PTFE or PFA lining (+180 °C). No pressure loss.
Maintenance-free. Robust ultra-compact design.

Measuring flows with solids reliably

Plant operators who pump slurries – for example in mining or in dredging applications – 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 M 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 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 M (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.

Are you the maintenance technician, engineer or plant manager whose job it is to maintain competent support for the gas, steam or water utilities of your company? Are you the process or finance manager who has to balance the "trade-off" between increasing plant efficiency and reducing operating overheads and energy costs? Do you find that the dictates of quality audits, standard operating procedures and environmental protection require ever-stricter process monitoring?

Yes? Then you can fully count on Endress+Hauser in regard to energy and cost savings. We can offer the all-inclusive solutions package you need:

- Customized solutions for your energy applications
- Competent planning, commissioning and maintenance
- Engineering, project management of simple solutions, for example, for boiler houses all the way to complete system solutions
- Professional support from specialists in all sectors

Product highlights

Prowirl F 200 (Vortex)

The all-rounder for steam, gas and air
Multivariable loop-powered two-wire device (4–20 mA). With temperature measurement and a flow computer for the calculation of mass and energy flow. With worldwide unique inline wet steam measurement. No maintenance. Lifetime calibration factor.

Promag L 400/W 400 (Electromagnetic)

For process, cooling and wastewater
Measurement is independent of pressure, density and temperature. No pressure loss. Maintenance-free, no moving parts. 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.

t-mass A/B 150 (Thermal)

Cost-effective metering of utility gases
For leakage detection in gas networks and/or in-house consumption accountancy of air, compressed air, CO_2, nitrogen or argon. Simultaneous measurement of mass flow, corrected volume flow, FAD volume flow and temperature. Inline versions (A) as well as insertion version (B) for pipes and rectangular ducts.

t-mass 65 F/I (Thermal)

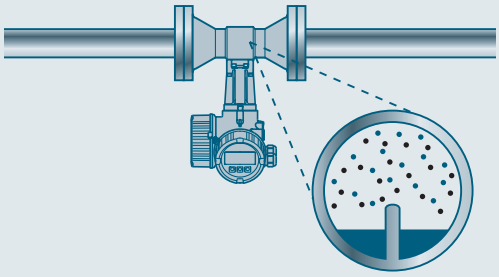
High-performance gas measurement
Suitable for a broad range of utility gases and gas mixtures (freely definable using integrated “Gas Engine”). High turndown and low pressure drop. Inline versions (F) as well as insertion version (I) for pipes and rectangular ducts.

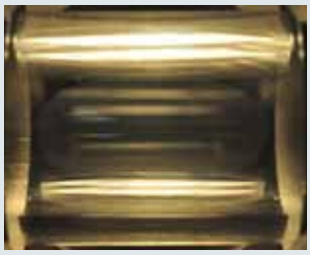
Don’t give wet steam a chance

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.

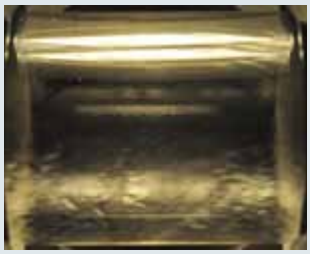
Wet steam occurs through the condensation of steam. First, the condensate flows at the bottom of the pipe and then smears up the wall, which affects the measuring signal of the Prowirl F 200. This effect can be used to determine the steam quality, which can be outputted as measured variables:

- 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, x = 1)



90% dryness fraction (x = 0.9)
10% condensate (with wavy flow)

80% dryness fraction (x = 0.8)
20% condensate (with annular flow)
→ Alarm ⚠

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.

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 fieldbus technology and offer the user a vast assortment of information. State-of-the-art and multifunctional 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 (CH)

Additional advantages

Fieldbuses have many other properties, offering users more cost-efficiveness and enhanced dependability:

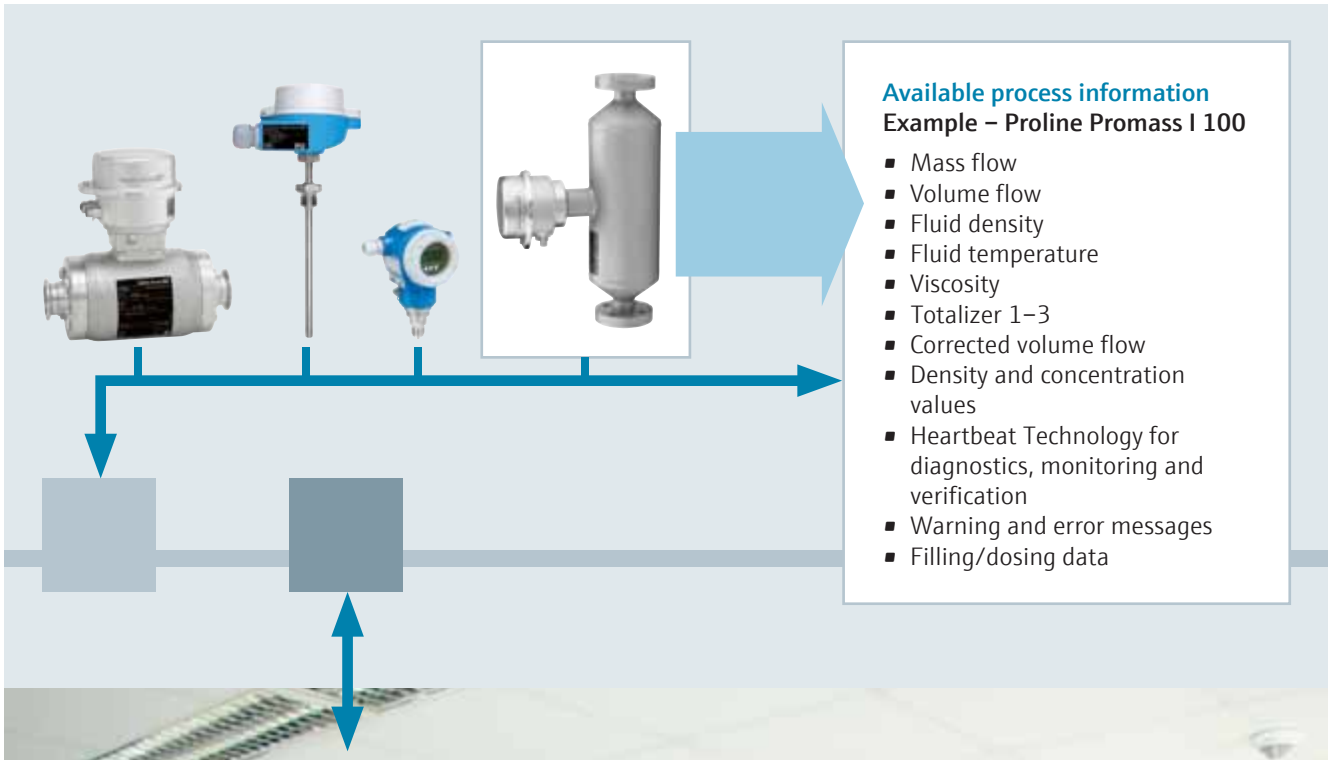
- Greater flexibility in production thanks to improved plant productivity
- Access to all important process data at all time
- Devices can easily be replaced even in Ex areas
- Intrinsically safe fieldbus technology for hazardous areas
- Lower cabling costs due to savings on materials and installation
- 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.

Fieldbus technology 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

Endress+Hauser is one of the pioneers of fieldbus technology. The company plays a leading role in the implementation of HART, PROFIBUS DP/PA and FOUNDATION fieldbus technology. Endress+Hauser operates its own fieldbus laboratory in Reinach (CH):
▪ Accredited PROFIBUS Competence Center ▪ Engineering of fieldbus networks ▪ System integration testing ▪ Training courses, seminars ▪ Customer service



Available process information
Example – Proline Promass I 100

- 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
- Filling/dosing data

W@M Life Cycle Management

Complete and instantly available device information is a key to any successful production plant operation. Endress+Hauser's W@M Life Cycle Management is an intelligent information platform designed to support you end-to-end throughout your facility's life cycle.

Data for actuators and sensors is continuously generated when designing and procuring components, during installation and commissioning and finally during operation and maintenance. These kinds of information can be retrieved worldwide with W@M Life Cycle Management – wherever and whenever you want. Your benefits: Increased process reliability and product quality around the clock; and service technicians receive quick and targeted assistance in the event of disruptions or during maintenance:

W@M Life Cycle Management ...
- is an open information system based on intranet and internet technology
- brings together software, products and services from Endress+Hauser
- ensures the worldwide availability of equipment and plant data
- puts an end to time-consuming searches for device information in archive

Plant Asset Management (W@M Portal)
- Managing the installed base
- Worldwide requesting/ordering of spare parts, software versions, device data, documentation, etc.

Configuring/parameterizing devices
- With FieldCare (software for Plant Asset Management)
- With Field Xpert (handheld terminal)
- Quick local operation thanks to the integrated **web server** and uniform **operating concept**
- Quick restoration of device data in case of service (**HistoROM**)

Calibration management
- CompuCal: Software for the administration of maintenance and calibration tasks
- Device on-site verification with FieldCheck (test instrument) or **Heartbeat Verification** (device function)

Proline ▸ Page 6 to 9

Finding documentation quickly
Downloadable online in multiple languages via "Device viewer" or the "Operations App":
- Technical information brochures
- Operating manuals
- Approvals
- Calibration certificates, etc.

Defining products
- Selecting, sizing and documenting measuring instruments using "Applicator"
- Project documentation

Configuring products
- Generating product codes with the "Product Configurator"
- Customer-specific pre-configuration

Finding spare parts
- With the Spare Part Finder (SPF)

Ordering online
- Ordering standard products, services and spare parts
- Pricing information
- Delivery times
- Order status and shipping status

Selecting the right device

Applicator is a proven selection and sizing program from Endress+Hauser. Applicator has been built around 30 years of industry experience and expert knowledge:

- Targeted product search by measuring task, measured variable, approvals, process data, communication, etc.
- Dependable sizing without specialized knowledge
- Display and depiction of important parameters such as optimal nominal diameter, pressure loss, etc.
- Direct link to Product Configurator and online shop
- Cost-saving administration and documentation of plant projects (project module)
- Language versions: English, German, French, Spanish, Russian, Chinese and Japanese

Applicator (select and size products)
http://www.endress.com/applicator

Calibration management

In certain industries, measuring devices have to be serviced regularly due to regulations or internal directives. This also includes recalibrating quality-critical measuring points within the installed base. CompuCal is a program that provides optimal assistance in this process:

- Planning, monitoring and documenting calibration, inspection and maintenance cycles
- Complete traceability in conjunction with the test equipment used by Endress+Hauser
- Comprehensive, global data access thanks to web-based software
- Conforms completely to FDA 21 CFR Part 11 – Electronic Records; Electronic Signatures Validation

Operations App

The Operations App from Endress+Hauser offers fast access to the latest product information bulletins and device details, including order codes, availability, spare parts, successor products and general product information – wherever you are, whenever you need the data. Just key in the serial number or scan the 2D code on the device to download the information.

Available on the App Store | ANDROID APP ON Google play

Easy commissioning and maintenance

The modular FieldCare software from Endress+Hauser provides users with an extensive toolset for field support of their measuring points (Plant Asset Management).

Basic functions:

- Configuring and commissioning via fieldbuses or service interface
- Detecting and rectifying errors
- Documenting measuring points (data printout/export)
- Comparing measuring point parameters (set/actual value)
- Backing up/archiving data (upload/download)

Expension functions:

- Presenting the measured values graphically
- Calling up service functions
- Monitoring diagnostic data
- Evaluating verification results

Global calibration concept

"Consistently high measurement quality for customers around the world" – Following this motto, Endress+Hauser subjects all flowmeters to strict quality checks. They are tested, calibrated and adjusted on the world's most state-of-the-art calibration rigs.

Long-term stability and guaranteed traceability are essential aspects of flow metering for users. They are prerequisites for precise, dependable, cost-effective controlling and batch-ing, and for substance cost allocation in custody transfer applications, for example.

For over 35 years, we have developed and built high-tech calibration rigs to document the accuracy of our devices in a reliable and traceable manner. There is one motto that stands above all others: "Consistently high measurement quality for our customers around the world." Based on this philosophy we have developed a global calibration concept that offers our customers maximum confidence and security:

- Calibration service in more than 40 countries
- Worldwide accreditation of our flow calibration rigs
- Periodic inspection by national accreditation bodies
- Full traceability to national standards in accordance with ISO/IEC 17025, PTB (Germany), LNE (France), NIST (USA) and CN (China)
- Continuous transfer of knowledge through internal and external training
- Identically designed high-tech calibration rigs

Accreditation certificates: A2LA (USA), CNAS (China), SAS (Switzerland)

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 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:
- Via ultrasonic clamp-on flow sensors
- Via Fieldcheck (flowmeter testing/simulation device)
- Via Heartbeat Technology (integrated device functionality ▸ page 8)

Mobile on-site calibration:
- Calibration of the device under test at the customer's site
- A mobile calibration rig consisting of one or more Coriolis flowmeters used as a reference system, which has been 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
  - Calibration certificate is delivered (without and with adjustment)

Endress+Hauser calibration concept movie

Constant measuring conditions

Stable, repeatable and reproducible measurement conditions are decisive to allow for the calibration results to be universally applicable. This is particularly a challenge when large flowmeters with nominal diameters up to 2.4 meters are calibrated. Therefore, the largest calibration rig operated by Endress+Hauser for this purpose in Cernay (France) works with a water tower and a constant 28-meter water column that offers the following advantages:

- Constant water flow
- Constant pressure conditions for the device under test
- No flow pulsation caused by pumps

Flow rates from a few liters to up to 6 million liters per hour can be measured with an expanded measuring uncertainty of ±0.05%.

PremiumCal – the world's best production calibration facilities

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 26 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/O/X Coriolis mass flowmeters from DN 8 to 400 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 operates 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. 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 three 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 chamber at a constant 24 °C and 40% humidity day and night.

Service and support the smart way

Only production plants that run properly, guarantee financial success. Endress+Hauser has over 40 Sales and Service Centers that ensure 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.

Service

Do you need some fast advice on the phone, or support for a maintenance schedule? The Sales and Service Centers not only provide support in emergencies, they also maintain a help desk and provide spare parts and consumables whenever and wherever you need them. The individual services at your disposal include:

- Commissioning and configuration
- Inspection and maintenance (service contracts)
- Factory or on-site calibration
- Repair service, spare parts, conversion kits

Factory witness testing

Customer satisfaction is a keynote issue for Endress+Hauser. 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 Ex devices

- Visual inspection: specifications, documentation, process connections, materials and acceptance-test certificates, etc.
- Check of measuring accuracy
- Metrological audits
- 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

www.addresses.endress.com

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Endress+Hauser

People for Process Automation