Reliable, flexible, zero maintenance

The ultrasonic clamp-on portfolio with manifold strengths for noninvasive flow measurement

- Clamp-on sensor portfolio
- Benefits at a glance
- Options and features
- Industry focus
- Technical data

Endress+Hauser

Clamp-on sensor portfolio

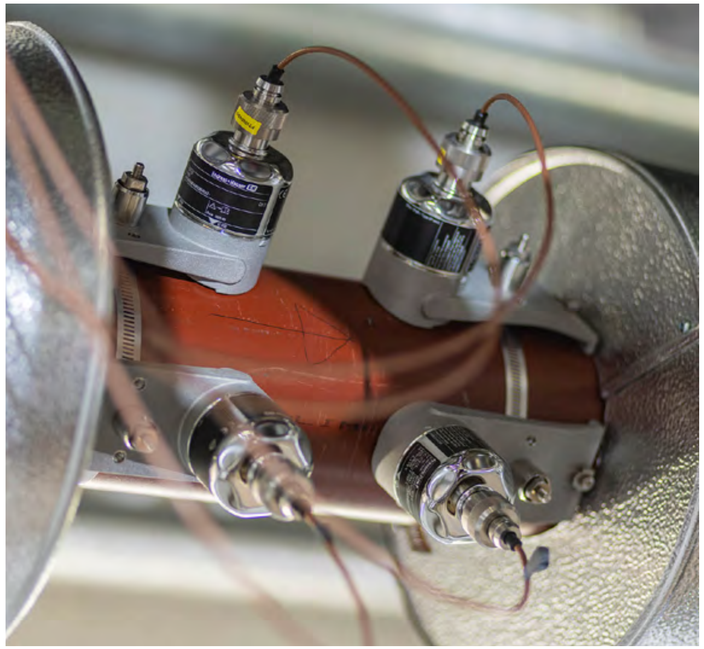
Do you want to measure the flow rate in your application but are unable to interrupt the process? Or is your liquid too aggressive for direct contact with the sensor? These and other situations are no problem for the ultrasonic flowmeters in the clamp-on portfolio from Endress+Hauser. The noninvasive measuring system offers maximum flexibility. It can easily be installed from the outside on a wide variety of pipe types without a need to stop the process. The device reliably calculates the volume flow using the differential transit time method without pressure loss.
A maintenance-free contact agent in the form of coupling pads ensures optimum transmission of sound between the sensor surface and the pipe. The result: a consistently high signal strength and thus stable measurement over the entire life cycle of the measuring device – without any maintenance effort.

The clamp-on sensor portfolio for ultrasonic flow measurement consists of Proline Prosonic Flow P 500 and Proline Prosonic Flow W 400 and is the reliable partner across a variety of industries:

- for quantity and volume measurement
- for totalizing and balancing
- for process monitoring
- for verification of previously installed flowmeters
- for detection of leaks in a pipeline
- for replacement measurement for defective flowmeters during ongoing operation

Prosonic Flow W 400 / I 400

Prosonic Flow P 500



Prosonic Flow W 400 / I 400

For reliable and economic flow measurement of conductive and non-conductive liquids up to 130 °C (266 °F), Prosonic Flow W 400 is the device of choice. It combines the advantages of clamp-on sensors with those of the Proline device line, such as seamless system integration, easy access via web server, or Heartbeat Technology. This allows Prosonic Flow W 400 to tackle many of today's challenges: long-term cost efficiency, comprehensive process monitoring and maximum freedom when planning measuring points.

The FlowDC function is available as a standard feature for all systems with two measurement paths and reduces the required inlet and outlet runs from the usual 15 × DN to just 2 × DN – and the measuring performance remains the same. This opens up new possibilities for flow measurement in very limited spaces.

You can find more information on FlowDC in the “Options and features” chapter (page 7).

Visit the product website

The installation version:
Prosonic Flow I 400 was specially developed for fixed installation in large pipes (DN 200 to 4000/8 to 160"). The measuring system is welded directly into the pipe wall and is ideally suited for countries where fixed device installation is required by law.

Clamp-on sensor portfolio

Prosonic Flow P 500

Prosonic Flow P 500

For highly demanding applications and measurement requirements, Prosonic Flow P 500 is the first choice. The clamp-on installation system enables simple mounting without the need to interrupt an ongoing process. The flagship of the clamp-on sensor portfolio is designed for maintenance-free, long-term operation in a wide range of industries, even under very harsh ambient conditions. The measuring device includes all the functions of Prosonic Flow W 400 and additionally fulfills further requirements:

- Temperature range above 130 °C (266 °F) up to a maximum of 550 °C (1022 °F) – under the pipe insulation with special high-temperature sensors
- A wide range of approvals for hazardous areas
- Developed and certified in accordance with IEC 61508 (SIL)
- Up to 3 I/Os (analog and binary)
- Measurement of liquid hydrocarbons

Click here to visit the product website

Clamp-on sensor portfolio

Prosonic Flow W 400 / I 400

Prosonic Flow P 500 with two measurement paths for FlowDC

Benefits at a glance

Customer benefits and the answer to the individual challenges are at the heart of our device development.

The main advantages of the clamp-on portfolio are seen in the areas of flexibility and safety.

More flexibility

- For independence from pressure, density and pipe materials
- For conductive and non-conductive liquids
- For a wide range of nominal diameters (DN 15 to 4000/½ to 1600") and a large temperature range (−40 to +550 °C/−40 to +1022 °F)
- For simple mounting without opening the pipe or interrupting the process
- For use with very short inlet runs (≥2 × DN) and in the immediate vicinity of flow disturbances
- For corrected volume calculation and product identification of liquid hydrocarbons

More safety

- Through device verification without process interruption, thanks to Heartbeat Technology
- Through maximum reliability, thanks to development in accordance with IEC 61508 requirements (SIL) for functional safety
- Through the possibility of use in hazardous areas, thanks to corresponding approvals for all regions of the world
- Through zero maintenance and consistently high measuring performance, thanks to coupling pads
- Through safe measurement of corrosive, abrasive, and toxic media, thanks to noninvasive installation

Options and features

Reliable and accurate flow measurement is the basic promise we make with our instruments. But that's not all: Additional product features for our clamp-on portfolio offer customized support even in challenging situations.

- FlowDC function
- Installation status
- Heartbeat Technology
- High-temperature sensors
- Petroleum application package

FlowDC function

Flow disturbances and short inlet runs are no problem for FlowDC. The one-of-a-kind firmware function makes it possible to reduce the required inlet and outlet runs for ultrasonic flowmeters from usually at least 15 × DN to just 2 × DN. Nevertheless, FlowDC guarantees consistent, specified measuring performance, and only two sensor pairs or measurement paths are required.

Depending on the type of flow disturbance, the inlet run and the Reynolds number, one of the data sets with compensation factors stored in the firmware is used to compensate for the increased measurement error caused by the flow disturbance.

Thanks to FlowDC, the clamp-on sensors can be installed in the immediate vicinity of pipe bends, pipe extensions or pipe reductions. This offers maximum flexibility when planning process facilities with very close-knit pipe networks.

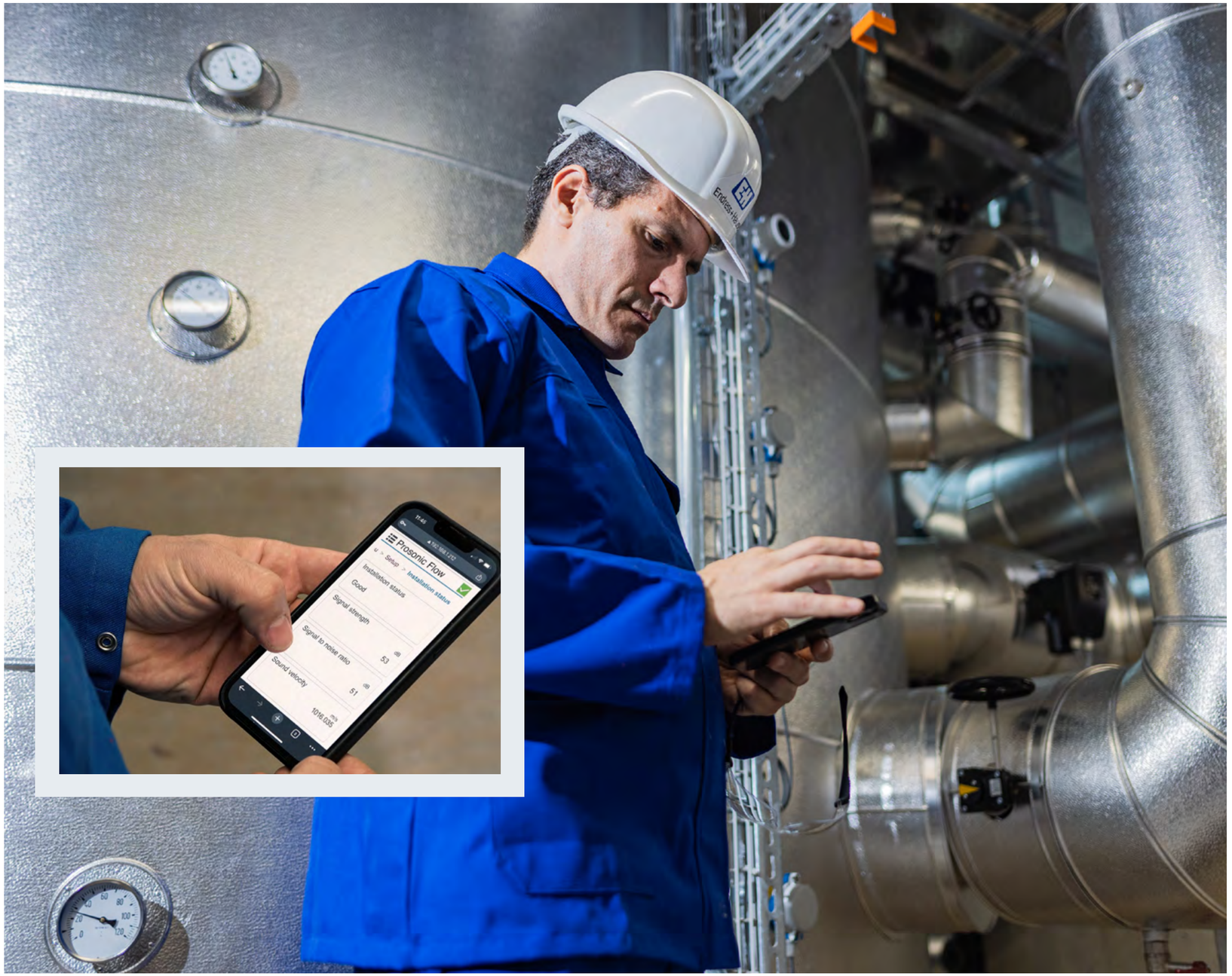
- Animation for FlowDC function
- Demo video for FlowDC function

- Installation status
- Heartbeat Technology
- High-temperature sensors
- Petroleum application package

Installation status

For fast and safe commissioning, Prosonic Flow W 400 and Prosonic Flow P 500 include the option of checking the installation status or rather the device status and the installation quality after mounting. For the purpose of optimizing the mounting position, signal strength, signal-to-noise ratio and sound velocity are displayed. Derived from these values, the installation status is denoted:

- “Good”: No further optimization is necessary
- “Acceptable”: Measuring performance is adequate; optimize if possible
- “Bad”: Unstable measuring performance; optimization is necessary



FlowDC function

Heartbeat Technology

High-temperature sensors

Petroleum application package

Heartbeat Technology

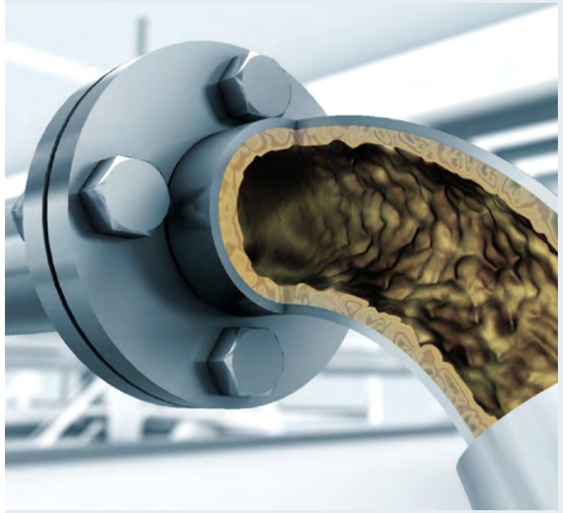
Heartbeat Technology for diagnostics, verification and monitoring is an integral part of the clamp-on portfolio. The integrated functions provide reliable and comprehensive sensor and process data to increase plant availability. As a result, conclusions can be drawn about changes in the process and corrective measures can be initiated. This leads to reduced verification effort and to optimization of processes and maintenance work.

Heartbeat Monitoring detects the formation of build-up, for example:
The attenuated ultrasonic signal indicates a change in the process and pipe conditions.
Gas pockets in the pipe can also be detected with Heartbeat Monitoring:
This monitoring is based on the change in the number of ultrasonic signals received.

Permanent coupling pads ensure lasting maintenance-free coupling of the sensors and stable signal quality over the entire service life of the measurement.

More about Heartbeat Technology

- FlowDC function
- Installation status
- High-temperature sensors
- Petroleum application package



Heartbeat Technology

Heartbeat Technology

For diagnostics

Permanent process and device diagnostics

For verification

Documented device functionality without process interruption

For monitoring

Information on process optimization and predictive maintenance

High-temperature sensors

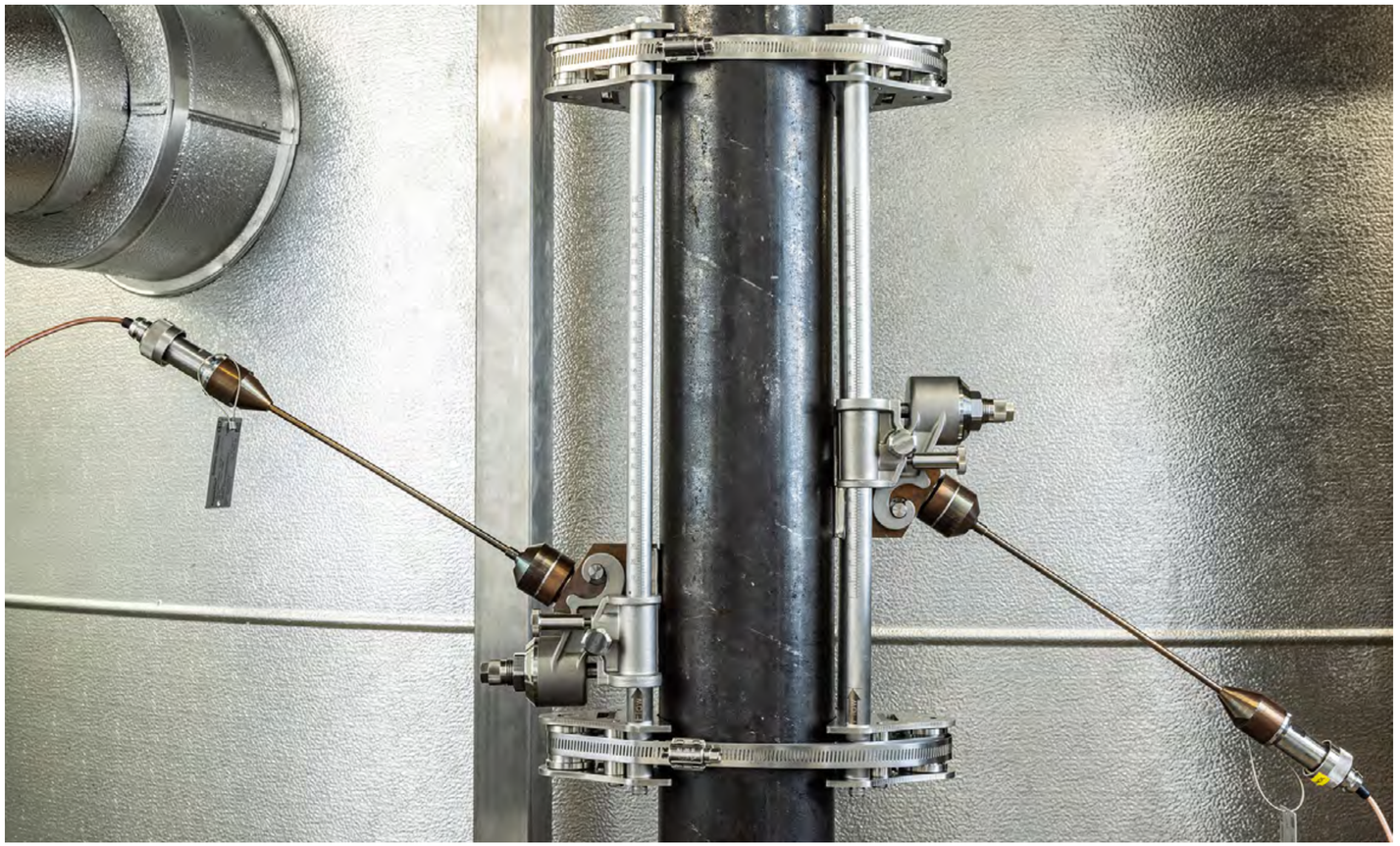
The optional high-temperature sensors for Prosonic Flow P 500 expand the measuring range from −40 to +170 °C (−40 to +338 °F) to up to 550 °C (1022 °F). This means that further applications in the oil and gas, chemical as well as power and energy industries can be handled, such as the measurement of crude oil and coker feeds, in exothermic processes and separators as well as in CSP applications with molten salt and thermal oil.

Direct coupling of the sensors to the measuring tube and the very small coupling surface ensure extremely stable measuring point, which can also be completely insulated to avoid thermal bridges.

Robust mounting and coupling methods have been developed for these demanding applications to achieve optimum attachment. With this innovative solution, accurate and reliable measuring results can be achieved even at very high temperatures. The high-temperature sensors can easily be combined with FlowDC using a second pair of sensors.

▶ Video on the high-temperature sensors

- FlowDC function
- Installation status
- Heartbeat Technology
- Petroleum application package



Petroleum application package

Liquid hydrocarbons are mainly traded by volume, but at the same time they are temperature- and pressure-dependent. The temperature in particular has a major influence on the volume. Accordingly, this has to be calculated back to a reference condition so that there is a common basis for negotiation.

The Petroleum application package (PAP) for Prosonic Flow P 500 enables calculation of the corrected volume to obtain comparable flow data.

For this purpose, the appropriate liquid is selected in the PAP, and an additional temperature measurement is taken, which is fed into the transmitter.

This way it is possible to balance material flows and, for example, detect leaks.

A further advantage is the product identification: PAP enables Prosonic Flow P 500 to identify different liquid hydrocarbons in a multi-product pipeline.

- FlowDC function
- Installation status
- Heartbeat Technology
- High-temperature sensors

Industry focus

Owing to its flexibility as well as the options and features already mentioned, the ultrasonic clamp-on portfolio is designed for a wide variety of measuring points in many industries. Major advantages can be seen particularly in the case of processes that run continuously and do not allow production to be stopped, as well as in the measurement of challenging liquids. These applications are mainly found in the oil and gas, chemical as well as power and energy industries. However, the clamp-on portfolio can also achieve its full potential in the area of water and wastewater as well as in utilities.

In addition, the sensors provide reliable measurement results for a wide variety of pipe types and materials:

- Metal pipes (e.g., steel or cast iron)
- Plastic pipes
- GRP pipes
- Composite materials (with/without liner)

Oil & Gas

Chemicals

Power & Energy

Water & Wastewater

Oil & Gas

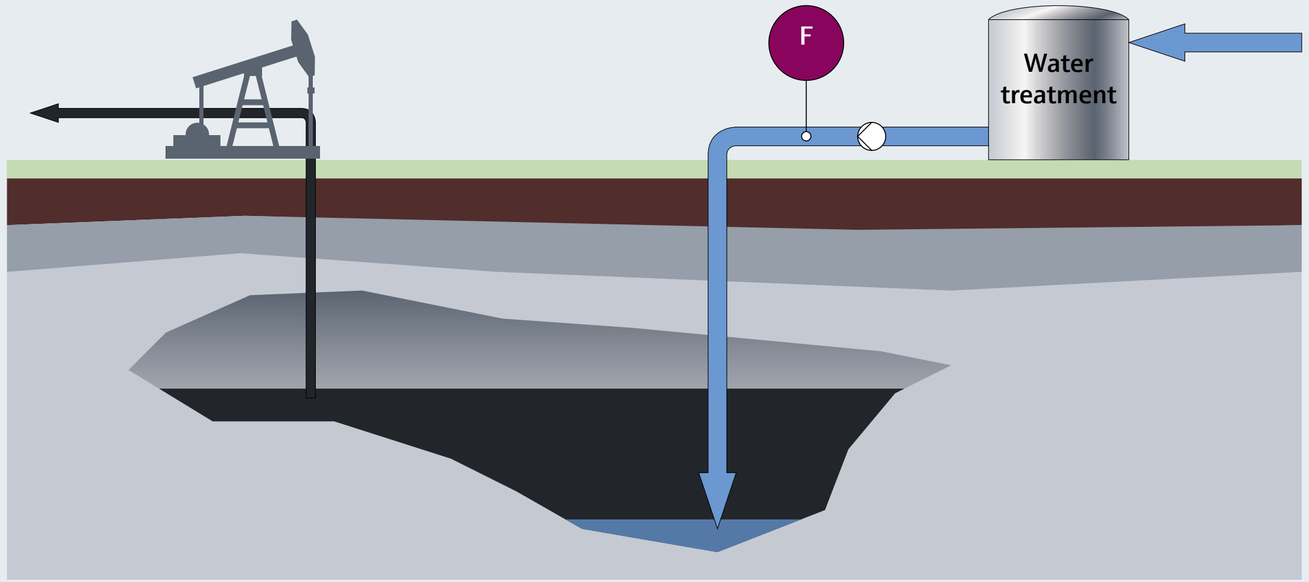
High pressures and enormous flow velocities are generated during oil production. Clamp-on flowmeters are not affected by these challenges due to their noninvasive installation that does not interrupt the process.

Here you can find examples of industrial applications for the clamp-on portfolio.

- High-pressure water injection
- Tank dewatering

High-pressure water injection

Water injection in enhanced oil recovery ensures greater efficiency, higher operational safety and re-stimulation of production in the oil fields. High pressures, complex pipe systems and real-time optimization are challenges that meters typically have to face in this application. In addition, abrasive liquids cause increased wear on in-line flowmeters.



Your challenge
Measuring task: Flow measurement for optimizations in real time
Measuring point: Water injection well
Measuring range: DN 50 to 450 (2 to 18") with wall thicknesses up to 30 mm
Liquid: Water with abrasive components such as sand
Process pressure: 120 to 420 bar (1740 to 6092 psi)

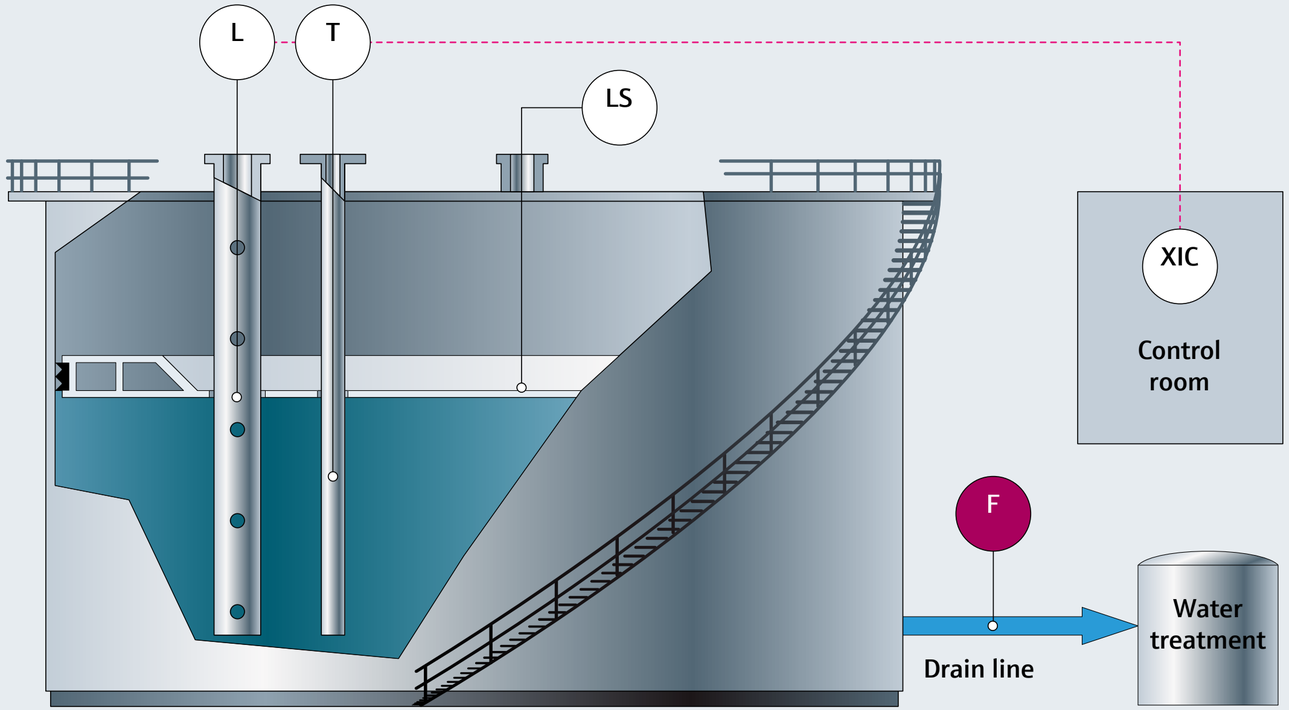
Our answer
Prosonic Flow P 500 or Prosonic Flow W 400 – depending on which approvals for hazardous areas are required. Neither of the measuring systems is affected by high pressures or abrasive components in the liquid. Despite the demanding conditions, they return accurate and reliable values without the risk of process interruptions. In addition, no regular maintenance is required and, thanks to FlowDC, the clamp-on sensors can be used even with very limited inlet and outlet runs.

Tank dewatering

Tank dewatering

In crude oil tanks, water collects at the bottom. Before further processing in refineries, this water must be removed to avoid problems in downstream processes. For this purpose, a separate drainage pipe with a shut-off valve is used at the bottom of the tank. After the valve is opened, the speed of sound waves in the liquid is monitored, and if this changes rapidly, it indicates a transition between water and oil.

The meter detects this change immediately and sends a signal to close the shut-off valve. This allows the dewatering to be automated and ensures that very little oil gets into the water treatment system. This optimizes the process and reduces the risk from human misjudgments. At the same time, the amount of drained water is recorded and the result is used for the subsequent treatment process.



Your challenge
Measuring task: Flow measurement for the automation of dewatering
Measuring point: Drainage pipe on the crude oil tank
Measuring range: Up to 15 m/s (49 ft/s) depending on nominal diameter, tank size and fill level
Liquid: Water and transition to emulsion/oil

Our answer
Prosonic Flow P 500 with approvals for hazardous areas in all regions of the world. With its comprehensive I/Os, this ultrasonic meter offers the best conditions for automating the dewatering process. In addition, it can be used even with very limited inlet and outlet runs, thanks to FlowDC with two measurement paths in one measuring point.

High-pressure water injection

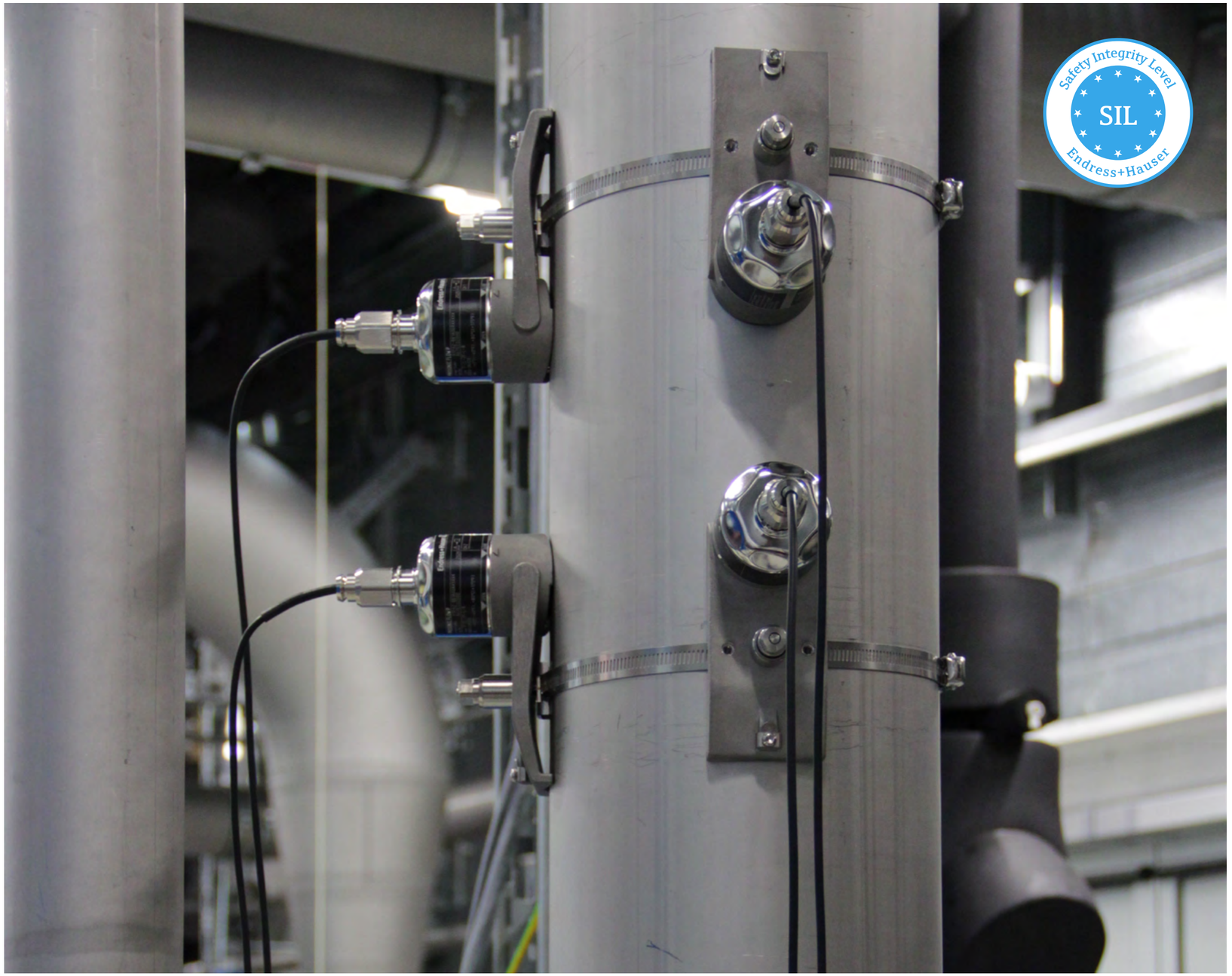
Chemicals

Safety is the top priority in the chemical industry. The noninvasive clamp-on sensors can also be used to measure corrosive, abrasive or toxic liquids – even at high pressures. The sensors are mounted on pipes from the outside and thus do not interrupt the process. They are also suitable for retrofitting or as a replacement for defective in-line meters.

Prosonic Flow P 500 meets the highest safety standards and has been developed in accordance with IEC 61508 to ensure the requirements for functional safety. The measuring system also has international approvals for hazardous areas (ATEX, IECEx, FM/CSA, EAC, UK Ex, INMETRO, NEPSI, JPN) and can be used in safety-related applications immediately after installation.

Furthermore, Heartbeat Technology increases plant safety and performance through its diagnostic, verification and monitoring functions and enables continuous transparency in the process.

Batch reactors

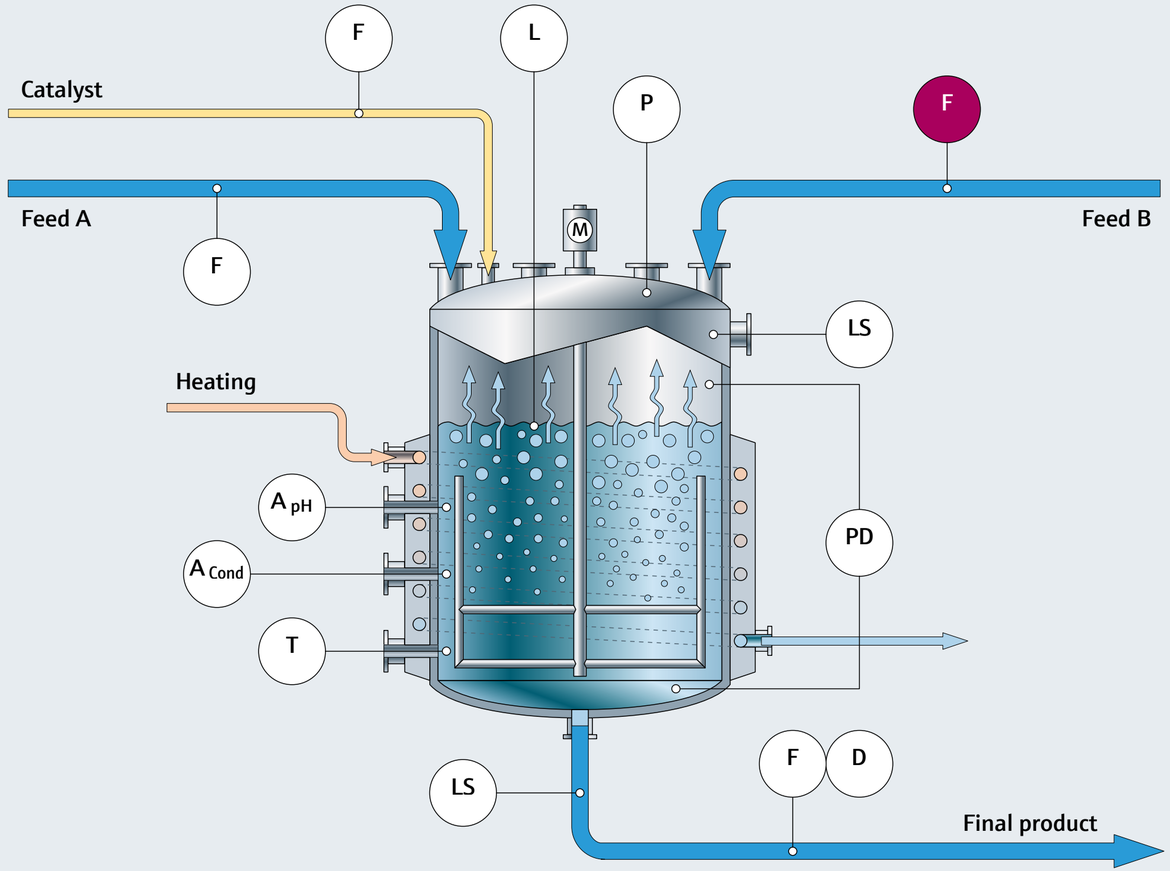


Batch reactors

In batch production in the chemical industry, a product runs through one or more reactors and remains there until the reaction is complete. The next production step is not carried out until this is done. This process provides a high degree of flexibility and is suitable for efficiently manufacturing different products and for smaller batches with simple quality control.

For optimal flow of batch production, the dosing of a wide variety of chemicals, some of which are highly viscous, must be precisely monitored. In addition to process safety, the general requirements for this flow measuring point are high accuracy, reliability and repeatability with the lowest possible pressure loss.

The meter being used must also function reliably even at process temperatures of up to 240 °C (464 °F) and a process pressure of up to 40 bar (580 psi).



Your challenge

Measuring task: Recording of the quantity of raw material B being fed

Measuring point: Feed of raw material B into the batch reactor

Liquid: Liquid chemical raw material

Process temperature: up to 240 °C (464 °F)

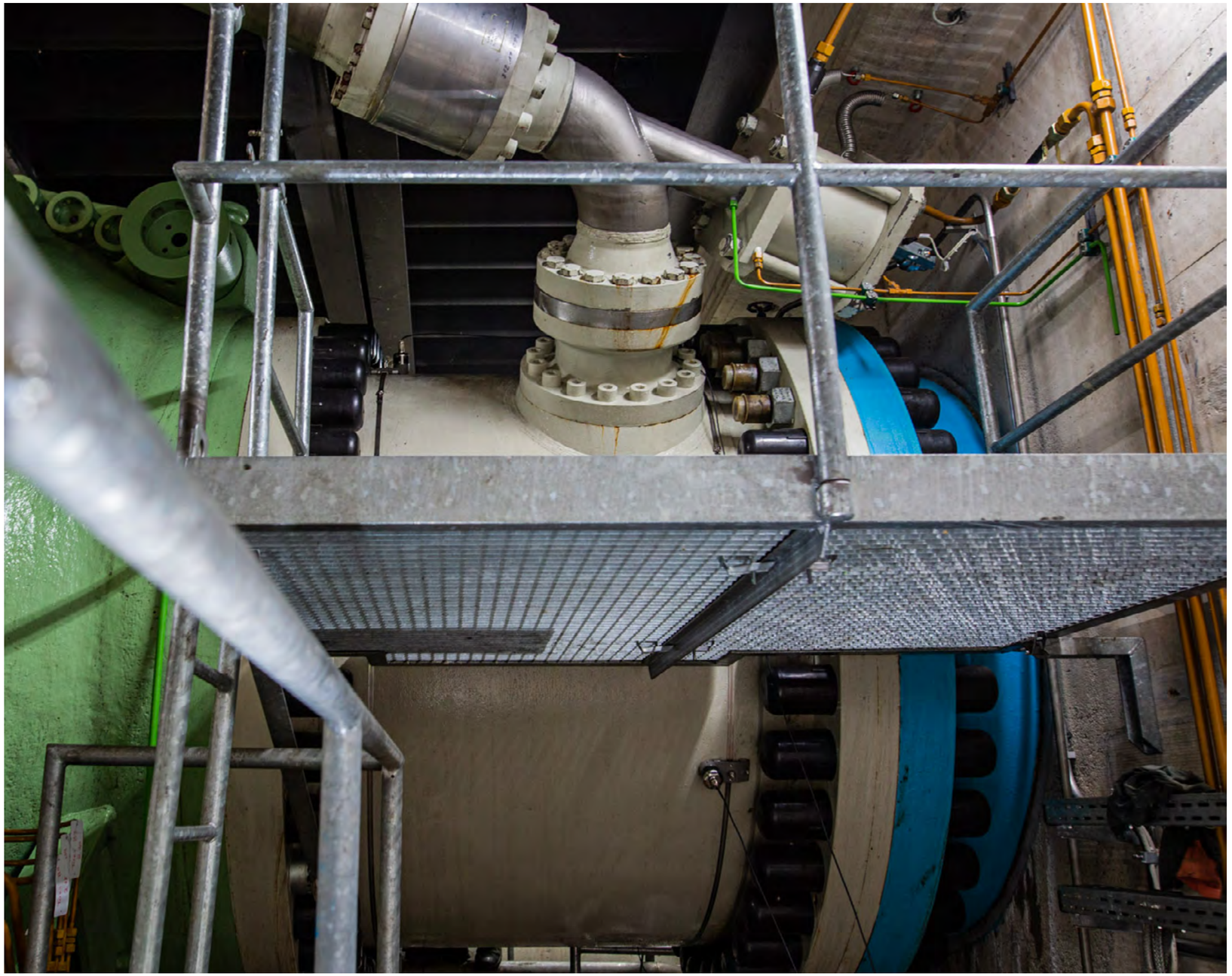
Process pressure: up to 40 bar (580 psi)

Our answer

Prosonic Flow P 500 in combination with the high-temperature sensors for measurements up to 550 °C (1022 °F) and approvals for hazardous areas. The device is mounted on the pipe from the outside, without interfering with the process. Thanks to FlowDC, the high-temperature sensors can even be used with limited inlet runs of down to 2 × DN, with two measurement paths in one measuring point. This system can also be used for thermal oil applications and up to DN 600 (24").

Power & Energy

Particularly in the case of very large penstocks in hydro power plants, noninvasive clamp-on flowmeters can generate real added value:
They enable simple and flexible installation without interrupting the process – even up to a nominal diameter of DN 4000 (160"), when other measuring principles can no longer be used or would be very costly. The relatively inexpensive devices can also be used for supply and fuel measurement.

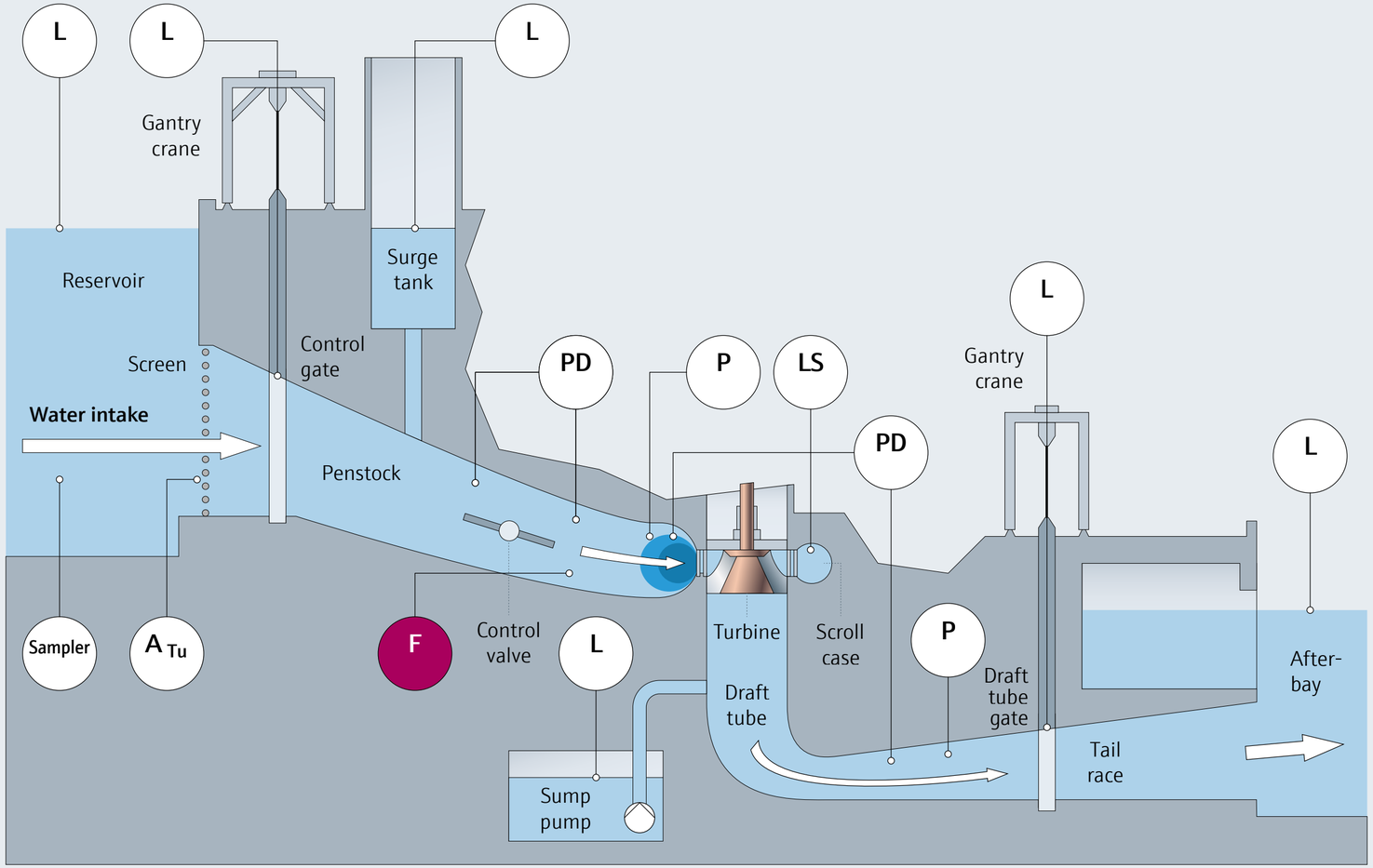


Penstocks

Penstocks

To optimize the turbines in hydro power plants, it is necessary to balance the flow in the penstocks. With the precise recording of the amount of water in the individual areas of the hydraulic system, an exact comparison with the flow required for the turbine flow can be made.

The particular challenges involved: Very often, these penstocks are designed with nominal diameters of up to DN 4000 (160") and have a flow rate of up to 80 m^3/s (262 ft/s). In addition, noninvasive measurement is required.



Your challenge
Measuring task: Flow measurement to optimize turbine operation
Measuring point: Penstocks in hydro power plants
Measuring range: Nominal diameters of up to DN 4000 (160") / flow rates of up to 80 m^3/s (262 ft/s)
Liquid: Water

Our answer
Prosonic Flow W 400 as a cost-efficient and maintenance-free measuring system for large nominal diameters and flow ranges. Thanks to the FlowDC function, consistently high measuring performance is achieved even under difficult flow conditions and with very limited inlet and outlet runs.

"*Thanks to Endress+Hauser, we were finally able to find a solution for our difficult measuring task. The comparison measurement confirmed the accuracy and reliability of the ultrasonic flowmeter, which is why we have now equipped all four turbines with Prosonic Flow W 400.*"

Andreas Huber
Deputy Plant Manager of Schluchseewerk AG

Read the case study of Schluchseewerk AG

Water & Wastewater

In today's water and wastewater industry, the focus is on improving water safety while budgets are usually shrinking. This makes it all the more important to protect, maintain and optimize processes so that a safe water supply can be guaranteed in the future, too. This requires the most accurate process data possible, which can be ideally recorded with the flexible and cost-efficient clamp-on ultrasonic flowmeters.

Reverse osmosis

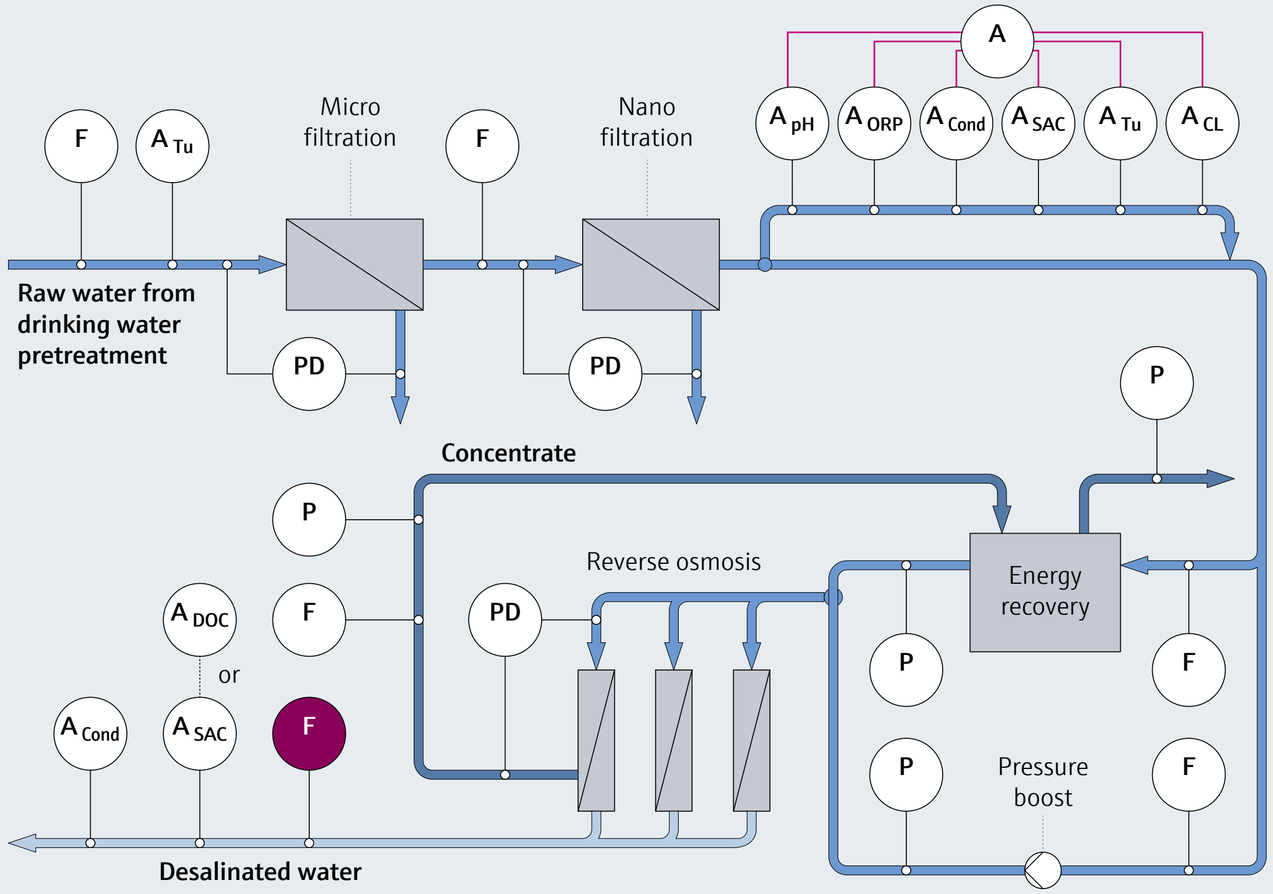
Reverse osmosis

Reverse osmosis is the only membrane technology process that is not based on the principle of energy-intensive distillation and yet also achieves a very high degree of purity in water treatment.

Breaking down water and dirt particles allows for all substances dissolved in the water to be removed, such as uranium, nitrate, nitrite, drug residues, viruses, bacteria, fungicides, herbicides, asbestos, hormones, germs or simply lime.

All substances that could be harmful to health are removed in this way.

This process is often used in industries with very high water demand, such as the automotive industry. However, these are continuous processes that cannot be easily interrupted.



Your challenge
Measuring task: Balance purified water
Measuring point: Downstream of reverse osmosis
Measuring range: DN 50 to 400 (2 to 16")
Liquid: Osmotic water
Process pressure: 4 to 30 bar (58 to 435 psi)

Our answer
Depending on the requirements regarding approvals for hazardous areas, Prosonic Flow P 500 or Prosonic Flow W 400 are very well suited for this measuring point due to their noninvasive and maintenance-free design and thanks to FlowDC. These advantages also mean the clamp-on portfolio is good for flow measurement of influent raw water for microfiltration.

Technical data

Overview of clamp-on portfolio

The clamp-on portfolio is based on two proven transmitter platforms: Proline 400 and Proline 500.

Learn more about the technical data of the sensors and transmitters on the following pages.

The Prosonic Flow W 400 and P 500 measuring systems satisfy the EMC requirements in accordance with IEC/EN 61326 and based on NAMUR NE21. They are compliant with the requirements of the EC and ACMA guidelines and are labeled with the CE or RCM symbol.

Clamp-on
sensor

- Installation on the outer wall of the pipe without opening the pipeline
- Consistently high measuring performance provided by coupling pads for reliable sound transmission
- Suitable for pipes made of metal, plastic, GRP or composite materials (lined/unlined)

Proline 400
transmitter

- Corrosion-resistant housing made of aluminum or polycarbonate
- Safe operation: no need to open the device, thanks to the display with touch control and backlighting
- Integrated web server to save time operating it on-site (via laptop and standard Ethernet cable or via WLAN)

Proline 500
transmitter

- Aluminum housing or stainless die-cast housing for applications with demanding ambient conditions
- Up to 3 inputs and outputs
- Worldwide approvals for hazardous areas

Clamp-on

Sensor

The clamp-on sensors are available with different frequencies to ensure optimum signal quality with regard to pipe diameter, liquid and pipe material.

More details on the technical data can be found on the right.

Overview

Proline 400

Proline 500

Prosonic Flow W / Prosonic Flow P

Nominal diameters	DN 15 to 4000 (½ to 160")
Max. flow rate	Depending on the sensor version at max. 15 m/s (50 ft/s): 0 to 678 550 m³/h (0 to 2 987 656 gal/min)
Process pressure	No pressure limit (measurement from the outside)
Process temperature	**W:** –40 to +130 °C (–40 to +266 °F)
	P: Standard: –40 to +170 °C (–40 to +338 °F) Option: –40 to +550 °C (–40 to +1022 °F)
Degree of protection	**W:** Standard: IP66/67 (Type 4X enclosure) Option: IP68 (Type 6P enclosure)
	P: IP68 (Type 6P enclosure) Option: IP66/67 (Type 4X enclosure)
Max. measured error (volume flow)	DN 15 (½"): ±3% o.r. ± 5 mm/s (±0.20 in/s) DN 25 to 200 (1 to 8"): ±2% o.r. ± 7.5 mm/s (±0.30 in/s) DN ≥ 200 (8"): ±2% o.r. ± 3 mm/s (±0.12 in/s)
Operable flow range	Over 150:1
Materials	Stainless steel (ultrasonic sensor, sensor holder, tensioning bands)
Pressure loss	No pressure loss (measurement from the outside)
Approvals	**W:** cCSAus NI Class I Division 2 Gr. ABCD, EAC, UR, etc.
	P: ATEX, IECEx, cCSAus, NEPSI, INMETRO, EAC, UB, DU, UR, etc.

Subject to modifications and amendments

Proline 400

Transmitter

The cost-efficient Proline 400 transmitter features a corrosion-resistant housing made of aluminum or polycarbonate and can be operated safely without being opened, thanks to the display with touch control.

Read more about the technical data on this page.

Display	4-line, backlit display with touch control (external operation)
Operation	▪ Via the web server (WLAN) ▪ Via the on-site display ▪ Via operating tools, such as FieldCare from Endress+Hauser ▪ Via a HART-handheld terminal
Materials	Polycarbonate, aluminum
Power supply	With wide-range power supply: – DC 24 V – AC 24 V (50/60 Hz) – AC 100 to 240 V (50/60 Hz)
Connecting cable lenght	Transmitter/sensor: Cable length 5, 10, 15 and 30 meters (15, 30, 45 and 100 ft)
Ambient temperature	–40 to +60 °C (–40 to +140 °F)
Degree of protection	IP66/67 (Type 4X enclosure)
Outputs **Inputs** **Communication**	▪ Port 1: current output (0/4–20 mA HART) or digital communication via Modbus RS485 ▪ Port 2: pulse/frequency/switch output ▪ Port 3: switch output or pulse/frequency/switch output ▪ Port 4: status input or digital communication via Modbus
Approvals	cCSAus Class I Division 2 Gr. ABCD, UR

Subject to modifications and amendments

Overview

Clamp-on

Proline 500

Proline 500

Transmitter

The multifunctional Proline 500 transmitter in a remote version offers maximum measuring performance and, in addition to the aluminum housing, is also available with a stainless die-cast housing for applications with demanding ambient conditions. The transmitter also has up to three inputs and outputs.

Read more about the technical data on this page.

Overview

Clamp-on

Proline 400

back to overview

Display	4-line, backlit display with touch control (external operation)
Operation	▪ Via the web server (WLAN) ▪ Via the on-site display ▪ Via operating tools, such as FieldCare from Endress+Hauser ▪ Via a HART-handheld terminal
Materials	Aluminum, die-cast
Power supply	With wide-range power supply: – DC 24 V – AC 24 V (50/60 Hz) – AC 100 to 240 V (50/60 Hz)
Connecting cable length	Transmitter/sensor: Cable length 5, 10, 15 and 30 meters (15, 30, 45 and 100 ft)
Ambient temperature	–40 to +60 °C (–40 to +140 °F)
Degree of protection	IP66/67 (Type 4X enclosure)
Outputs **Communication**	▪ Port 1 (communication): current output (4–20 mA, HART) or digital communication via Modbus RS485 ▪ Port 2/3 – freely configurable I/O modules: – Current output (4–20 mA) – Pulse/frequency/switch output – Pulse output (phase-shifted) – Relay output – Current input (4–20 mA) – Status input
Approvals	▪ ATEX, IECEx, cCSAus, NEPSI, INMETRO, EAC, UB, UD, UR, etc. ▪ SIL: Use for flow monitoring up to SIL 2 (single-channel architecture) or SIL 3 (multichannel architecture with homogeneous redundancy) ▪ Radio approval

Subject to modifications and amendments

People for Process Automation

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