Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Flow measurement
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 provider of solutions for instrumentation and automation. Supplying the production and logistic sectors of the process industry, the company develops sensors and systems that obtain information from the process, transmit this data and process it. High-quality products and cutting-edge services support our customers' competitiveness with top-notch quality, dependability and efficiency.

Endress+Hauser works closely with universities and research institutes, and also cooperates with business partners and competitors. The company is committed to continuously expanding its industry-specific know-how and ensuring the competence of its sales, marketing and service. The closely knit network of affiliated production and marketing companies as well as regional representatives establishes and maintains the group's powerful presence in all the world's markets - in other words right on your doorstep.

Endress+Hauser is a byword for independence, continuity and long-term customer relationships. Our 50-plus years of application experience are the foundation on which we have built our enormously wide range of products for metering flow, level, pressure and temperature, complete with fluid analysis, recording and system components. Endress+Hauser is a single-source supplier, so you can always be confident that we will have the optimum solution for your measurement requirements.

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 the global market within the last 30 years. High accuracy, dependable metering, simple commissioning and low maintenance outlay – these are only some of the properties that our customers can always rely on.
Endress+Hauser Flowtec AG currently employs a workforce of more than 1200 at five production facilities in Reinach (Switzerland), Cernay (France), Greenwood (USA), Aurangabad (India) and Suzhou (China).

Welcome to Endress+Hauser


Reinach, Switzerland


Cernay, France


Greenwood, USA

Flow measurement – More important than ever

Plant safety, constant product quality, process optimization, environmental protection – only some reasons why flow measurement is becoming increasingly important in industrial instrumentation. Endress+Hauser supports you with practical, state-of-the-art, high-quality flowmeters to integrate into your process, be it filling and dosing, controlling or recording. You might need a single, intelligent meter with communication interface, or a complete solution for a higher-order process control system. What you can be sure of is that we won't promoting "one size fits all" – instead, we'll offer you a made-to-measure solution tailored to the specifics of your industry, your application, and your requirements.

What flowmeters do

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.

The most important reasons for metering flow include:
– Totalizing, displaying and recording
– Monitoring, controlling and balancing
– Filling (bottling) and dosing

And more especially:
– Metering pulsating flow
– Concentration measurement in two-phase fluids
– Measuring viscosity in-line
– Advanced diagnostics, etc.

You can find flow-metering technology from Endress+Hauser in just about every industry sector, application and utilities:

- Chemicals and petrochemicals
- Petroleum (oil and gas)
- Fueling with gas
- Pharmaceuticals
- Food production
- Breweries
- Dairies
- Water-supply systems
- Wastewater treatment
- Power plants
- Pulp and paper
- Filling and dosing
- Shipbuilding
- Automotive
- Cement
- Mining, etc.


Aurangabad, India


Suzhou, China









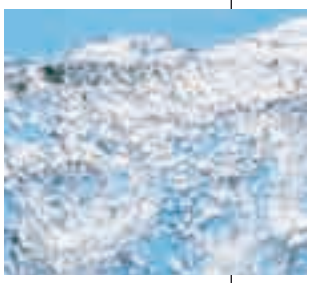



From oxygen to honey
The ideal flow metering system for each fluid

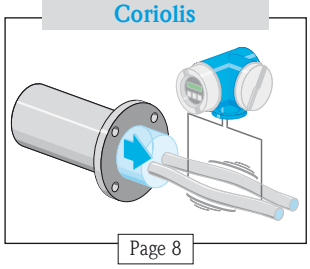
Flow is the process variable most frequently measured in industry. Water, natural gas, steam, mineral oil, chemicals or wastewater are only some examples of fluids that have to be measured day in, day out.

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 suiting for your process needs.

Check it out!

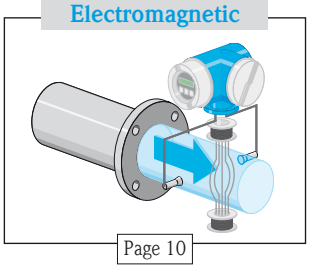


Applicator
The tried-and-tested Endress+Hauser selection and specification software



Coriolis

Page 8

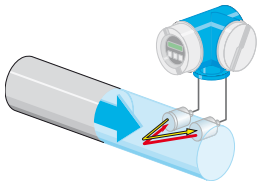
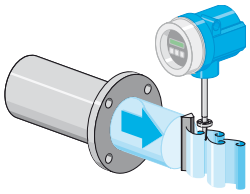
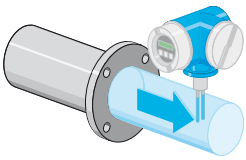
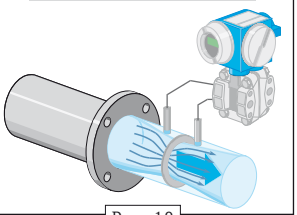


Electromagnetic

Page 10

	Coriolis	Electromagnetic
Liquid applications		
■ Liquids in general (e.g. water)	✓	✓
■ Very low flowrates (< 2 l/h)	✓	✓
■ Very high flowrates (> 100 000 m^3/h)		✓
■ Non-conductive liquids	✓	
■ Viscous liquids (> 50 cP)	✓	✓
■ Cryogenic fluids (e.g. liquid O_2)	✓	
■ Food and beverages (e.g. milk, beer)	✓	✓
Gas/steam applications		
■ Gas flow in general (e.g. air flow)	✓	
■ Low flowrates (< 20 l/min)	✓	
■ High flowrates		
■ Steam	o	
Special applications		
■ Slurries, suspended solids	o	✓
■ Liquid/liquid mixtures (oil/water)	✓	o
■ Liquid/gas mixtures (water/air)	o	o
■ Corrosive liquids (acids, alkalis)	✓	✓
■ Corrosive gas flows (e.g. HCl vapor)	o	
■ Applications in mining (ore slurry)		✓
■ Bidirectional metering (forward/reverse)	✓	✓
■ Measurement from outside without process interruption		
Ranges of application		
■ Nominal diameters	DN 1 to 250	DN 2 to 2200
■ Process pressure	max. 350 bar (400 bar)	max. 40 bar
■ Process temperature	–50 to +350 °C	–40 to +180 °C

✓ suitable ☐ not suitable

Ultrasonic	Vortex	Thermal	Differential pressure
			
Page 12	Page 14	Page 16	Page 18
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DN 15 to 4000	DN 15 to 300	DN 15 to 1500	DN 10 to 4000
Depending on sensor type	max. 250 bar	max. 40 bar	max. 420 bar
–40 to +170 °C	–200 to +400 °C	–40 to +130 °C	–200 to +1000 °C

o conditionally suitable (depending on application, meter design/material). Please contact Endress+Hauser!

The Proline device concept

The industry-optimized product line for metering flow

The requirements that industrial metrology places on flowmeters are demanding and diverse.
Endress+Hauser offers its customers one of the widest ranges of products for metering the flow of liquids, gases and steam. The range covers all important measuring principles. All the product lines are continuously being refined, reflecting ongoing evolution in this technological sector:

- **Proline Promass**
  Coriolis mass flowmeters
- **Proline Promag**
  Electromagnetic flowmeters
- **Proline Prosonic Flow**
  Ultrasonic flowmeters
- **Proline Prowirl**
  Vortex flowmeters
- **Proline t-mass**
  Thermal mass flowmeters
- **Deltatop**
  Differential-pressure flowmeters

The unified platform established for five measuring principles by the Proline concept offers users many advantages. All Proline flowmeters share a common electronics and configuration concept.
And that's not all, as you can see for yourself:

- Unifed components and spare parts minimize storage costs
- Time-saving by easily replaceable components without recalibration
- Multi-option control with local display or configuration software (such as FieldCare), locally through the service interface or by digital communication from a control center
- Better plant availability on account of self-diagnosis functions, data backup (S-DAT, T-DAT), standardized spareparts concept, etc.
- "Quick Setups" and standardized configuration routines for user convenience

Field-proven sensors

The robust, space-saving sensors are available for all the usual nominal diameters, pressure ratings and materials. The choice of process connections is equally wide (EN, DIN, ANSI, JIS, AWWA, AS). Versions for high-temperature and hygienic applications are further examples of the breadth of application.

Promass | Promag | Prosonic Flow | Prowirl | t-mass

Versatile transmitters

According to your application, you can choose the most suitable transmitter:

- Choice of functionality for basic applications/standard applications/extended-functionality applications
- Flexible areas of application: Permanently installed or portable transmitters, two-wire or four-wire installations, meters for custody transfer, with or without certificates (e.g. SIL2), for fluids with high solids content, etc.
- Field, wall or stainless-steel housings in compact and remote versions
- Variety of input and output configurations (current, pulse, frequency or relay outputs; status input)
- With/without digital communication
- With world-wide accepted Ex-approvals

Aluminium housing | Stainless-steel housing | Wall-mount housing | Two-wire device

Easily comprehensible local display

All Proline transmitters have an easily comprehensible display for operation and for showing brief messages and measured values:

- Backlit display (two-line or four-line)
- Multiplex mode for more information (up to six process variables and status messages can be shown in parallel)
- Operation by means of pushbuttons or Touch Control (operation from outside, no need to open the housing, maximum safety in hazardous areas)

Time-saving "Quick Setups"

The Quick Setup menus make commissioning fast and straightforward. It guides you step by step through all the operation-relevant parameters. Quick Setups are available as follows:

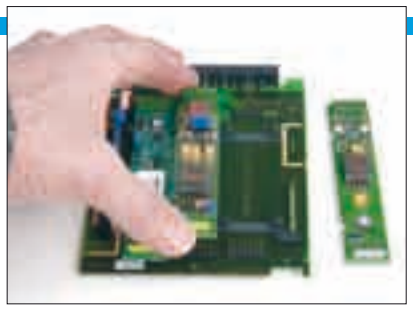
- For standard commissioning
- For metering pulsating flow
- For metering gas flow (Coriolis)
- For filling and dosing applications
- For sensor installation and wall thickness measurement (ultrasonic)
- For configuring the Fieldbus interface

Additional device functions may have to be configured for complex metering tasks. A function matrix enables you to select the functions you need and configure them for your process conditions: System units, inputs/outputs, totalizers, system parameters, process parameters and display, diagnosis, monitoring and special functions, etc.

Flexible inputs/outputs

Depending on the application, you can specify which inputs and outputs you need for your process control when you place your order. Modular electronics afford enhanced flexibility for retrofitting and for upgrading existing meters.

In other words, you buy exactly what you need!



Safe data management

All device data programmed in the factory or onsite is stored safely in replaceable data memory modules:

- S-DAT®: Data memory for sensor calibration data. Saves time when sensors are replaced.
- T-DAT®: Data memory for stored device parameters. Increases plant availability.
- F-CHIP®: Special-software upgrades for process optimization (filling and dosing, advanced diagnostics, density/concentration functions, viscosity measurement, electrode cleaning).

Permanent self-diagnosis

All Proline flowmeters have continous self-diagnosis during operation. Faults, if they occur, are unambiguously classified. So you have maximized process dependability.

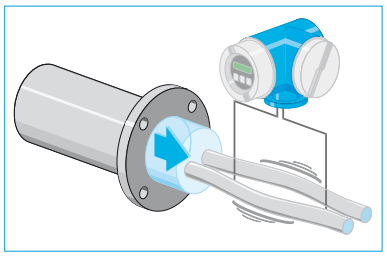
Solutions to go with your meters

Just buying a flowmeter isn't the whole story. Special software for commissioning, testing and simulation will help you optimize the performance of the measuring point – a whole life long (see Page 22).

– Applicator® for selecting and sizing flowmeters
– FieldCare® for onsite configuration and commissioning
– Fieldcheck® for testing flowmeters in-line

Coriolis mass flowmeters

Simultaneous measurement of mass, density, temperature and viscosity



Measuring principle

If a moving mass is subjected to an oscillation perpendicular to its direction of movement, Coriolis forces occur depending on the mass flow.
A Coriolis mass flowmeter has oscillating measuring tubes to precisely achieve this effect. Coriolis forces are generated when a fluid (= mass) flows through these oscillating tubes. Sensors at the inlet and outlet ends register the resultant phase shift in the tube's oscillation geometry. The processor analyzes this information and uses it to compute the rate of mass flow. The oscillation frequency of the measuring tubes themselves, moreover, is a direct measure of the fluids' density. The temperature of the measuring tube is also registered for compensating thermal influences. This signal corresponds to the process temperature and is also available as an output signal.

Advantages at a glance

- Universal measuring principle for liquids and gases
- Simultaneous and direct measurement of mass flow, density, temperature and viscosity (multivariable sensors)
- Measuring principle is independent of the physical fluid properties
- Very high measuring accuracy
  – typically ±0.1% o.r.
  – optionally ±0.05% o.r.
- Not affected by flow profile
- No inlet/outlet runs necessary

The advantages of Coriolis mass-flow measurement are self-evident. It comes as no surprise, therefore, to find that this principle is used in a huge range of industry sectors, including pharmaceuticals, chemicals and petrochemicals, oil and gas, food, and also in custody transfer applications in general.

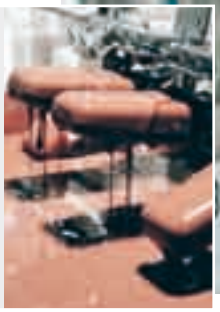
Virtually all fluids can be measured: cleaning agents and solvents, fuels, vegetable oils, animal fats, latex, silicon oils, alcohol, fruit solutions, toothpaste, vinegar, ketchup, mayonnaise, gases, liquefied gases, etc.

One for all – multivariable metering

Coriolis flowmeters have the ability to measure several process variables all at the same time. This opens up completely new perspectives in process control, quality assurance and plant protection.
Mass flow, density and temperature, the primary measured variables, can be used to derive other values such as volume flow, solids content, or concentrations and complex density functions.

World first – viscosity measurement direct inline

Promass 83I is the world's first flowmeter capable of measuring viscosity inline while metering flow. Perfect for monitoring product consistency, for example.



Proline Promass

Transmitters – Unified operating concept, flexible outputs, software packages, Fieldbus interface, Ex-approvals and much more – all a matter of course for Promass transmitters.

Promass 40
- Cost-effective transmitter for low-end applications
- No local operating interface

Promass TB2
- Two-wire transmitter
- Reduced cost of installation and operating overheads

Promass 80
- Transmitter for all standard applications
- Two-line, backlit display
- Pushbutton controls

Promass 83/84
- Extended functionality for special applications, e.g. custody transfer
- Four-line, backlit display with optical keys (Touch Control)
- F-CHIP: application software for batching, viscosity, concentration (specialized density functions), advanced diagnostics
- T-DAT and S-DAT for parameter backup

Aluminium housing | Stainless-steel housing | Ex stainless-steel housing | Wall-mount housing

Sensors – The Promass sensors covers a very wide range of requirements. The choice of materials, process connections, hygienic versions, accessories etc. is correspondingly broad. Accuracy: typically ±0.1% o.r., optionally ±0.05% o.r. (mass flow, liquids).

Promass A
- For very low flow rates and high pressures (DN 1 to 4, up to PN 400)
- Tube material: Stainless steel, Alloy C-22
- Also for custody transfer

Promass F
- For universal use (DN 8 to 250)
- Tube material: Stainless steel, Alloy C-22
- High-temperature version up to 350 °C
- Also for custody transfer

Promass F/DN 25 High-temperature version

Promass F/DN 250 (0 to 2 200 000 kg/h)

Promass H
- Single-tube system especially for chemically aggressive fluids (DN 8 to 50)
- Tube material: Zirconium

Promass E
- Cost-effective sensor for low-end applications (DN 8 to 80)
- Tube material: Stainless steel

Promass S
- Single-tube hygienic sensor for the food industry (DN 8 to 50)
- Standard approvals: 3A, EHEDG, FDA and SIL 2
- Tube material: Stainless steel

Promass M
- For high pressures up to 350 bar (DN 8 to 80)
- Tube material: Titanium
- Also for custody transfer

Promass I
- Straight, easily cleanable single-tube system for hygienic applications (DN 8 to 80)
- Tube material: Titanium
- Viscosity measurement (optional)

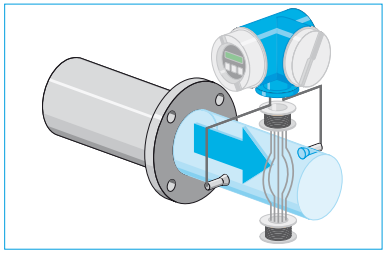
Promass P
- Single-tube hygienic sensor for life sciences industries (DN 8 to 50)
- Complying with industry standards, e.g. ASME, BPE, ISPE, FDA, EHEDG and 3A
- Tube material: Stainless steel

Electromagnetic flowmeters

Universally useable throughout industry
For nominal diameters DN 2 to 2200

This method has been in use around the world for 50 years and more, as witnessed by the popularity of these meters that continues unabated in virtually all sectors of industry.

Magmeters can be used to measure all electrically conductive liquids (> 1 µS/cm) with or without solids, e.g. water, wastewater, sludge, slurries, pastes, acids, alkalis, juices or fruit pulp. In the industrial environment, sectors that utilize this measuring principle include: water/wastewater, chemicals, pharmaceuticals, pulp and paper, foodstuffs, etc.
Magmeters are even robust enough to be used in mining.



Measuring principle

Faraday's law of induction states that a conductor moving in a magnetic field induces an electrical voltage.

With a magmeter, the flowing fluid is the moving conductor. The constant-strength magnetic field is generated by two field coils, one on either side of the measuring tube. Two measuring electrodes on the inside wall of the tube are at right angles to the coils and detect the voltage induced by the fluid flowing through the magnetic field. The induced voltage is proportional to flow velocity and thus to volume flow.

The magnetic field is generated by a pulsed direct current with alternating polarity. This ensures a stable zero point, and makes the measurement insensitive to influences from multiphase or inhomogeneous liquids, or low conductivity.

Advantages at a glance

- The principle is virtually independent of pressure, density, temperature and viscosity
- Even fluids with entrained solids can be metered (e.g. ore slurry, cellulose pulp)
- Large nominal-diameter range available (DN 2 to 2200)
- Free pipe cross-section (CIP/SIP cleaning, piggable)
- No moving parts
- Minimum outlay for maintenance and upkeep
- No pressure losses
- Very high turndown up to 1000:1
- High degree of measuring dependability and reproducibility, good long-term stability

Magphant (insertion sensor)

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

Proline Promag

Transmitters – Unified operating concept, flexible outputs, software packages, Fieldbus interface, Ex-approvals and much more – all a matter of course for the Promag transmitters.

Promag 10

- Cost-effective transmitter for basic applications
- Compact design with minimal space requirements

Promag 23

- Two-wire transmitter
- Reduced cost of installation and operating overheads

Promag 50/51

- Transmitters for all standard applications and for custody transfer
- MID approval (Measurement Instrument Directive)
- Two-line, backlit display with pushbutton controls

Promag 53/55

- With extended functionality suitable for special applications
- Four-line, backlit display. Touch Control operation from outside
- Measures pulsating flow or liquids with entrained solids
- F-CHIP (software upgrade options): filling and dosing, electrode cleaning, advanced diagnostics, calculation of solid flows
- T-DAT: Data memory for device parameters
- Signal inputs for temperature or density

Aluminium housing | Stainless-steel housing | Wall-mount housing

Sensors – The robust Promag sensors have a wide range of materials, measuring-tube liners and process connections (EN [DIN], ANSI, JIS, AWWA, AS) to cover virtually any application. Accuracy: typically ±0.2 to 0.5% o.r.

Promag W

- For water and waste water
- Drinking water approvals: KTW/W270, ACS, NSF 61, WRAS BS 6920
- Approved for custody transfer applications in accordance with MI-001
- Nominal diameters: DN 25 to 2200
- 0 to +80 °C (hard rubber)
  –20 to +50 °C (polyurethane)

Promag L

- For water and waste water
- Drinking water approvals: KTW/W270, ACS, NSF 61, WRAS BS 6920
- Up to 30% less dead weight
- Simple installation thanks to lap-joint flanges
- Nominal diameters: DN 50 to 300
- –20 to +50 °C (polyurethane)
  –20 to +90 °C (PTFE)

Promag D

- For water and waste water
- Drinking water approvals: KTW/W270, ACS, NSF 61, WRAS BS 6920
- Wafer device with minimal face-to-face length and low dead weight
- Nominal diameters: DN 25 to 100
- 0 to +60 °C (polyamide)

Promag P

- PTFE and PFA liners for all applications in the chemical and process industry (PFA is specially for high process temperatures/severe temperature shocks, –40 to +180 °C)
- Nominal diameters: DN 15 to 600 (also for custody transfer)

Promag S

- For difficult fluids of all kinds (e.g. ore slurry, paper pulp or fruit mash)
- Nominal diameters: DN 15 to 600
- Industry-optimized measuring electrodes and linings for process temperatures up to 180 °C

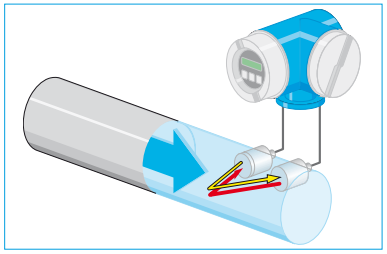
Promag H

- For very low flow rates (DN 2 to 100)
- PFA liner for all applications in the chemical, pharmaceutical, process and food industries
- Robust stainless-steel housing
- CIP/SIP (3-A approval and EHEDG certification)
- Flexible process connection concept

Ultrasonic flowmeters

Flexible, economical flow measurement

Ultrasonic transit-time differential measurement can be employed to measure the volume flow of any liquid, regardless of electrical conductivity. Two different types of sensors enable users to meter flow cost-effectively, economically and flexibly, anywhere in the process and at any time.



Measuring principle

Swimming against the flow requires more power and more time than swimming with the flow. Ultrasonic flow measurement is based on this elementary transit time difference effect.

Two or more pairs of sensors mounted on the pipe simultaneously send and receive ultrasonic pulses. At zero flow, both sensors receive the transmitted ultrasonic wave at the same time, i.e. without transit time delay.
When the fluid is in motion, however, the waves of ultrasonic sound do not reach the two sensors at the same time. This measured "transit time difference" is directly proportional to the flow velocity and therefore to volume flow.

Advantages at a glance

- With homogeneous fluids, the principle is independent of pressure, temperature, conductivity and viscosity
- Usable for a wide range of nominal diameters (DN 15 to 4000)
- Application-specific clamp-on and inline sensors

  Clamp-on sensors:
  – versatile
  – ideal for retrofitting without process interruptions
  – aggressive fluids can be measured without a problem (even at high pressure)

  Inline sensors:
  – for guaranteed accuracy
  – robust design (fully welded) for direct installation in the piping run
- No pipe constrictions, no pressure losses
- No moving parts. Minimum outlay for maintenance and upkeep
- High life expectancy (no abrasion or corrosion by the fluid)

Clamp-on sensors

The outstanding feature of clamp-on sensors is that they can be installed on the outside of existing pipes at any time. That makes them ideal for various applications ranging from the water industry through to industrial process engineering.

- For pipe diameters up to 4000 mm
- Suitable for all materials used in piping systems: plastic, steel, cast iron and composites, with or without linings
- Ideal for retrofitting without process interruption

Inline sensors

Guaranteed, traceable accuracy is a must in many applications, and this is where inline sensors are used to full advantage – in the chemical and petrochemical industries as well as in the water industry. These sensors, calibrated on our state-of-the-art company calibration rigs, are directly installed in the pipe.

- For pipe diameters up to 2000 mm
- Unobstructed pipe cross-section, no pressure loss
- Short inlet runs
- Robust industrial design to ASME and EN

Proline Prosonic Flow

Transmitters – The transmitters are available as wall-mount or field housings for hazardous areas and for the process industry. These meters integrate easily into higher-order process-control systems and support the mainstream Fieldbus systems. The choice of transmitter depends on process requirements and on the type of sensor.

Prosonic Flow 92
Two-wire transmitter

- For Prosonic Flow F sensor
- Remote/Compact version
- Suitable for hazardous areas (Ex i, Ex d)
- Two-line display
- Pushbutton controls
- With current output (HART), pulse and status output, PROFIBUS PA or FF

Prosonic Flow 91

- For basis applications
- For clamp-on sensors
- Two-line display
- Pushbutton controls
- With current output (HART)

Prosonic Flow 93T

- Portable ultrasonic transmitter for temporary metering
- For all clamp-on sensors
- With integrated data logger
- For monitoring processes and for test measurements
- Easy data transfer via USB memory stick

Prosonic Flow 93

- For extended functionality in process applications and hazardous areas (incl. Fieldbus communications)
- For clamp-on, insertion or inline sensors
- Four-line, backlit display
- Touch Control operation from outside
- For registering flow at two measuring points or with two ultrasonic paths (two-channel measurement)

Sensors – The range of sensors is extensive, so widely differing sets of requirements can be satisfied. Clamp-on sensors retrofit to the outside of existing pipes, e.g. for verifying other meters or for temporary flow measurement (accuracy: typically ±2% o.r.).
Inline sensors for direct installation in the pipe meet higher accuracy requirements (±0.3 to 0.5% o.r.).

For measuring from outside (clamp-on sensors)

Prosonic Flow W

- For standard applications (–20 to +130 °C)
- DN 50 to 4000

Prosonic Flow P

- For industrial process applications (–40 to +170 °C)
- Ex-approvals
- DN 50 to 4000

- For industrial process applications (–40 to +150 °C)
- Ex-approvals
- DN 15 to 65

For guaranteed accuracy (inline sensors)

Prosonic Flow F

- For all liquids, e.g. in the chemical and petrochemical industries (–40 to +150 °C)
- Nominal diameters: DN 25 to 150
- EN (DIN), ANSI process connections
- Traceable accuracy (±0.3 to 0.5% o.r.) by factory calibration
- For limited space (inlet run only 5 × DN)

Prosonic Flow C

- For water/wastewater applications (up to 60 °C)
- Nominal diameters: DN 300 to 2000
- EN (DIN), ANSI and AWWA process connections
- Traceable accuracy (±0.5% o.r.) by factory calibration
- Cost-effective alternative to large magmeters
- With approval for potable water

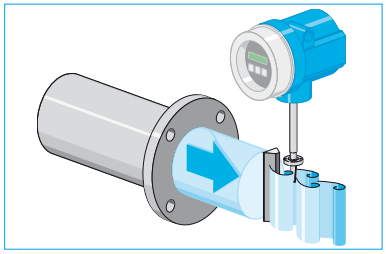
For sonically non-conductive pipes

Insertion sensor Prosonic Flow W

- For water/wastewater applications (–20 to +80 °C)
- For diameters DN 200 to 4000
- Optional as two-path version for short inlet runs

Vortex flowmeters

Robust and universal – for liquids, gases and steam



Measuring principle

This measuring principle is based on the fact that vortices are formed downstream of an obstacle in a fluid flow, e.g. behind a bridge pillar. This phenomenon is commonly known as the Kármán vortex street.

When the fluid flows past a bluff body in the measuring tube, vortices are alternately formed on each side of this body. The frequency of vortex shedding down each side of the bluff body is directly proportional to mean flow velocity and therefore to volume flow. As they shed in the downstream flow, each of the alternating vortices creates a local low pressure area in the measuring tube. This is detected by a capacitive sensor and fed to the electronic processor as a primary, digitized, linear signal.

The measuring signal is not subject to drift. Consequently, vortex meters can operate throughout their life cycle without recalibration.

Advantages at a glance

- Universally suitable for measuring liquids, gases and steam
- Largely unaffected by changes in pressure, temperature and viscosity
- High long-term stability (lifetime K factor), no zero-point drift
- No moving parts
- Marginal pressure loss
- Easy to install and commission
- Large turndown of typically 10:1 to 30:1 for gas/steam or 40:1 for liquids
- Large temperature range from –200 to +400 °C

Vortex meters are used in numerous branches of industry to measure the volume flow of liquids, gases and steam. Applications in the chemicals and petrochemicals industries, for example, in power generation and heat-supply systems involve widely differing fluids: saturated steam, superheated steam, compressed air, nitrogen, liquefied gases, flue gases, carbon dioxide, fully demineralized water, solvents, heat-transfer oils, boiler feedwater, condensate, etc.

Vortex flowmeters are widely used throughout industry to measure the mass flow of steam, saturated steam and liquids. Modern vortex meters such as Prowirl 73, therefore, 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, moreover, external pressure values can be read in digitally and with high accuracy via HART, PROFIBUS or FOUNDATION Fieldbus. The latest vortex meters even offer the possibility of reduced line sizes which also allows measurements at lower flow velocities (retaining the same face-to-face length).

Proline Prowirl

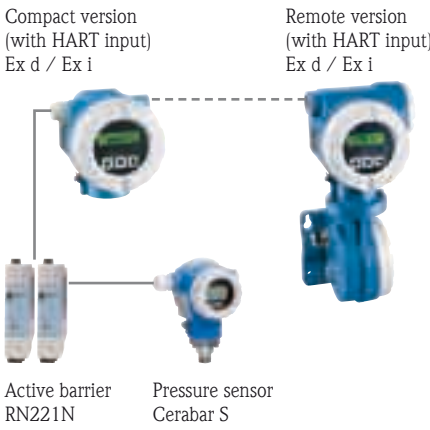
Transmitters – The transmitter housings are available either intrinsically safe (Ex i) or explosion-proof (Ex d) for hazardous areas, and as compact or remote versions. Both versions of the two-wire transmitter can output volume flow and mass flow.

Prowirl 72

- For standard applications and applications up to SIL 2
- Mass flow is computed by entering fixed operating density values or by pressure/temperature-compensated calculation by an external flow computer (e.g. RMS621 or RMC621)

Prowirl 73

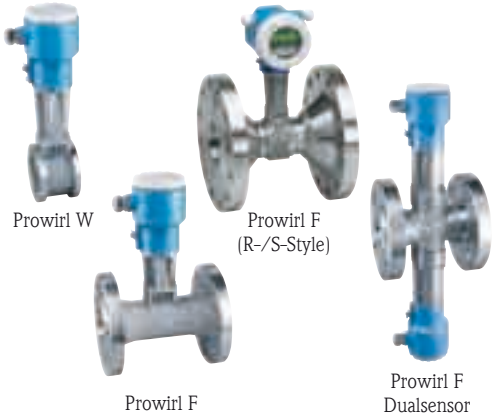
- Features an integral flow computer for extended functionality
- Direct mass-flow metering of saturated steam or liquids with temperature compensation (temperature sensor integrated into the sensor).
- HART, PROFIBUS PA and FF for reading in external pressure values (for calculating gas or steam mass with an accuracy of ±1.7% o.r.).
- HART for reading in external temperature values (for calculating heat differentials and energy).



Sensors – Safety and dependability in the process and in utility systems require proven and robust sensors that withstand high pressures, temperatures and corrosive fluids. Accuracy: ±0.75% o.r. (liquids); ±1% o.r. (gas/steam).

Prowirl F/W

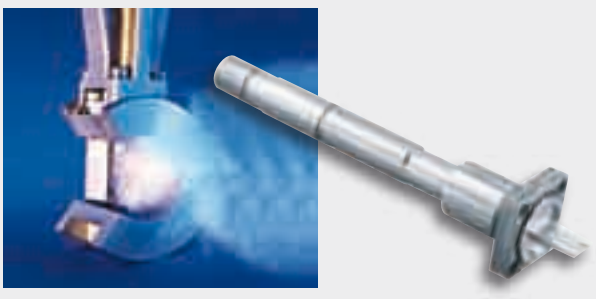
- For process temperatures –200 to +400 °C (+450 °C on request)
- Wide range of nominal diameters from DN 15 to 300
- High-pressure version up to PN 250/Cl 1500
- Flanged (Prowirl F) or wafer (Prowirl W) versions
- Dualsensor for redundant safety requirements/availability (e.g. nuclear)
- With measuring-tube cross-section reduced by one stage (R Style) or two stages (S Style) to enlarge the lower part of the measuring range
- EN (DIN), ANSI or JIS stainless-steel process connections
- Fitting lengths standardized worldwide
- With integrated temperature measurement for computing mass flow and heat (Prowirl 73)



Tough outside – sensitive inside
The DSC sensor with integrated temperature sensor

Endress+Hauser's unique, patented DSC sensor technology ensures high-precision measured values even under the most arduous conditions. With an installed base of over 100 000 devices, this sensor concept is well proven.
The sensor is highly resistant to:

- external vibrations ■ dirty fluids ■ water hammer
- temperature shocks (> 150 K/s)

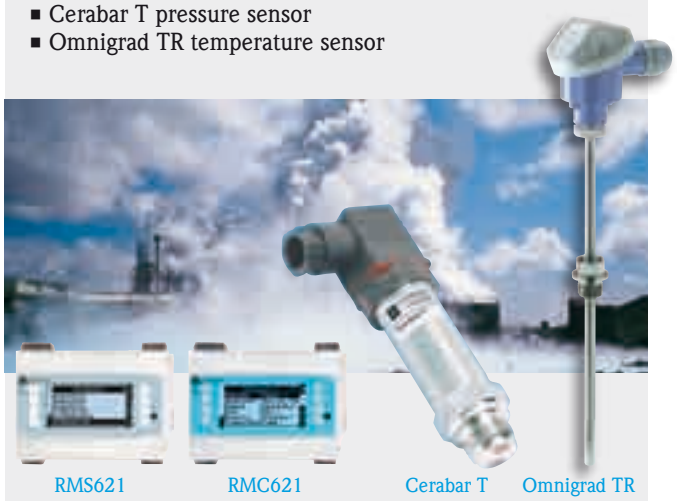


As an option, the DSC sensor is available with an integrated temperature sensor for the direct mass-flow measurement of saturated steam, etc.

Single-source supply for energy balancing

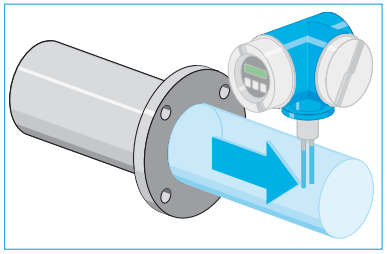
If you have to calculate mass flow or heat of liquids, gases or steam, you'll find that we are single-source suppliers for everything you need along with our Prowirl vortex meters:

- Heat/flow computer (RMS621/RMC621) for connecting up to 3 measuring points
- Cerabar T pressure sensor
- Omnigrad TR temperature sensor



Thermal mass flowmeters

Direct mass flow measurement even at low process pressures



Measuring principle

The principle is that a fluid flowing past a heated temperature sensor removes a known quantity of heat as it passes.

In a thermal flowmeter, the fluid has to pass two PT100 temperature sensors. One sensor obtains a reference value by measuring the actual process temperature. The second sensor is a heating element and it receives precisely as much energy as is needed to compensate for dispersed heat and maintain a defined temperature difference.

The higher the mass flow past the heated temperature sensor, the more heat is dissipated and the more power has to be inputted to the heater element to maintain the temperature difference. Heating current, therefore, is a measure of the mass flow of the gas.

Advantages at a glance

- Direct measurement/display of mass flow of gases and liquids, even at very low flow rates and gas pressures
- High turndown 100:1
- Excellent low-end sensitivity
- No moving parts
- Negligible pressure loss
- Low maintenance

The principle of thermal mass flow measurement has become widely accepted by industry in recent years and is used successfully in many applications:

- Compressed air flow and distribution
- Carbon dioxide for chilling and fermentation
- Argon in steel making
- Nitrogen and oxygen production plants
- Natural gas for burner and boiler feed control
- Aeration air and bio gas in waste water 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.

Proline t-mass, t-trend and t-switch

Transmitters

Proline t-mass 65 is available in both compact and remote versions with 4-wire power supplies. The transmitter is pre-configured at the factory to enable fast commissioning. Push-button programming allows reconfiguration of the gas or mixture, process pressure and end value to be re-scaled at anytime.

t-mass 65

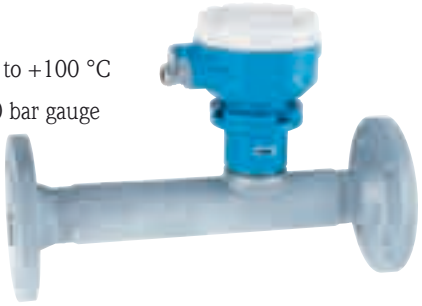
- Multi-variable measurement: flow and temperature display and outputs
- Totalizer
- Status/relay outputs for alarms
- Self-monitoring diagnostics

Sensors

The sensors are made of stainless steel (Alloy C-22 is an option). Numerous process connections (EN (DIN), ANSI, JIS, NPT, BSP) ensure that t-mass fits everywhere. Optional flow conditioner can be provided whenever pipe inlet runs are insufficient.

t-mass F

- Flanged version
- Diameters: DN 15 to 100
- Process temperature: –40 to +100 °C
- Process pressure: up to 40 bar gauge
- Accuracy:
  ±1.5% o.r. (10 to 100% of full scale)
  ±0.15% o.f.s. (1 to 10% of full scale)



t-mass I

- Cost-effective insertion sensor for large diameter pipes or rectangular-section ducts
- Diameters: DN 80 to 1500
- Process temperature: –40 to +130 °C
- Process pressure: up to 20 bar gauge
- Accuracy:
  ±1.0% o.r. ±0.5% o.f.s.

t-switch and t-trend flow monitors

Monitoring the flow of liquids and gases is reliable and economical with the t-switch and t-trend meters:

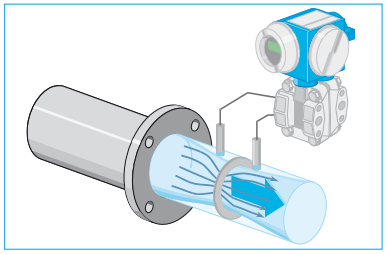
- in pipes from DN 40 to 1000,
- at –40 to +80 °C and up to PN 25,
- e.g. in cooling systems, to prevent pumps running dry, to control ventilation systems, etc.

t-switch: Flow switch (with relay output)

t-trend: Flow monitor (with current output)

Differential-pressure flowmeters

Universally applicable for liquids, gases and steam up to 420 bar and 1000 °C



Measuring principle

A primary element (orifice plate, nozzle, Venturi tube or Pitot tube) creates a pressure difference inside the pipe, which is a direct measure of volume or mass flow. Two impulse lines carry the differential pressure to the transmitter, where it is converted into the corresponding output signals.

Orifice plates, nozzles and Venturi tubes have a circular constriction in the pipe cross-section to create the difference in pressure. Static pressure drops in relation to the associated increase in flow velocity. The difference in pressure upstream and downstream of the constriction is a direct measure of the flow rate.
Pitot tubes have various pressure-tapping holes to measure total head pressure at the leading end and static pressure only at the trailing end. This pressure difference is a direct measure of the flow rate.

Advantages at a glance

- Standardized world-wide (since 1929), traditional metering, high level of acceptance
- Universally suitable for liquids, gases and steam
- For extreme process conditions up to 420 bar and 1000 °C
- Robust primary elements: purely mechanical, no moving parts
- Transmitter can be replaced at any time during operation without interrupting the process (e.g. for maintenance or for modernization)
- Available for a wide range of pipe sizes (DN 10 to 4000). Pitot tubes: up to diameters of 12 meters optionally
- Pitot tubes easily retrofitted

Differential-pressure flowmeters can be used on a broad basis to measure the flow of liquids, gases and steam. The pool of empirical data is large and has been incorporated into numerous standards. Consequently, this method of measurement is accepted around the world and its use is very common. Metering in hot-water and cooling systems and metering steam and condensate at very high temperatures in secondary systems remain primary areas of application even today.

Pitot tubes are a viable alternative to orifice plates where low pressure losses are required and when flow has to be measured in large-diameter pipes (up to several meters).
The transmitters in differential-pressure systems can be replaced at any time without the process having to be interrupted.

Deltatop

Pre-assembled measuring unit

Application-specific configuration

Up to 420 bar / 1000 °C

The Deltatop concept provides customers with an optimum solution tailored to application specifications and process data. This measuring system is available with a wide choice of special process connections made of many different materials. The meters can even be used without difficulty in concrete or glass pipes. Integrated temperature sensors are also part of the range of Endress+Hauser products.

Transmitters

Deltabar transmitter – unified operation concept, fieldbus connection, metallic or ceramic membranes, Quick Setup for easy commissioning etc.

Deltabar M – PMD 55

- Transmitter for standard applications
- Four-line display
- Operation via push buttons

Deltabar S – PMD 70/75

- Transmitter for special applications
- High-temperature version available
- Operation from outside via push buttons
- Housing can be rotated 380°
- Sensors with a high overload resistance

Sensors

The sensors are orifice plates (DO) or Pitot tubes (DP), available in different designs and with a choice of process connections. Accuracy: typically ±1 to 3% o.r.

Compact version

Primary element and transmitter form a single mechanical unit. Every Deltatop flowmeter is completely assembled with a primary element, manifold, condensate chamber (for steam) and a Deltabar transmitter – ready for commissioning:

- For temperatures up to 200 °C (gases, liquids) or 300 °C (steam)
- For process pressures up to 420 bar

DO6XC
- Orifice with corner tapping (to DIN 19205, Design A/B)
- DN 25 to 1000

DO61W
- Orifice with flange tapping (to DIN 19214 Part 1 or ANSI 1636)
- DN 25 to 600

DO65F
- Meter run
- DN 10 to 50

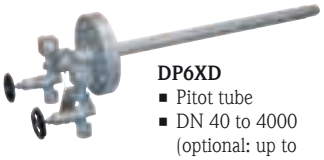
DP6XD
- Pitot tube
- DN 40 to 4000 (optional: up to 12 meters)

Remote version

Impulse lines (installed by customer) connect the primary element and the remotely installed transmitter. Deltatop is a modular flow measuring point consisting of a primary element, shut-off valves, condensate chambers (for steam) and a Deltabar transmitter with the manifold. Deltatop is factory-configured and supplied fully pre-assembled.

- For temperatures up to 500 °C (with standard materials) or 1000 °C (with special materials)
- For process pressures up to 420 bar

DO61W
- Orifice with flange tapping (to DIN 19214 Part 1 or ANSI 1636)
- DN 25 to 600



DP6XD
- Pitot tube
- DN 40 to 4000 (optional: up to 12 meters)

DO6XC
- Orifice with corner tapping (to DIN 19205, Design A/B)
- DN 25 to 1000

DO65F
- Meter run
- DN 10 to 50

DO64P
- Orifice plate (replaceable)
- DN 25 to 1000

Accessories

For the remote version, various accessories and fittings are available with a wide choice of materials and designs.

Shut-off valves

Manifolds

Condensate chambers

Purge unit

Flow measurement for filling applications

When every drop counts

Dosimag

- Electromagnetic flowmeter
- DN 4, DN 8, DN 15
- Measurement of volume flow
- Economical and cost-effective

Dosimass

- Coriolis mass flowmeter
- DN 8, DN 15, DN 25
- Direct measurement of mass flow
- Specially for filling and bottling plants handling different fluids
- Independent of the physical fluid properties

Flowmeters have become increasingly popular for filling and bottling in the course of recent years because given today's requirements, the techniques used in the past (e.g. piston-type bottlers) can no longer sustain competitiveness. Endress+Hauser has responded to this challenge by developing two flowmeters designed specifically for the needs of the filling and bottling industry – Dosimag and Dosimass.

Designed for industrial requirements

Dosimass and Dosimag are both high-precision, maintenance-free filling meters. Dependability and high performance, even under the most demanding conditions, characterize both these flowmeters, making them ideal substitutes for conventional filling systems:

- Compact, space-saving designs
- Wide choice of process connections for optimum integration into existing plants
- 3-A approval and EHEDG-certified
- Measuring technology for quicker and shorter cleaning cycles
- For non-continuous filling processes
- High repeatability
- Capable of metering very small volumes with extremely short filling cycle

Cost efficiency in metering

In practice, cost-efficient metering means: no unnecessary down times, maintenance or upkeep. And this is precisely where Dosimass and Dosimag support you with an optimum device concept:

- Self-monitoring and diagnosis functions
- Maintenance-free, no moving parts in the measuring tube
- SIP and CIP cleaning
- Sterilization temperatures up to 150 °C are possible (max. 60 minutes)
- Self-draining measuring tubes (open cross-section)
- Practical replacement concept for process seals

Cubemass

For low flows

In many sectors of industry, minimal substance quantities have to be precisely measured or added. Cubemass – developed in close collaboration with OEM customers – is the specialist for direct mass and density measurement in such applications.

- Coriolis flowmeter for a reliable mass and density measurement
- DN 1, DN 2, DN 4, DN 6
- High accuracy and repeatability
- Depending on the application, transmitters with different functionalities are available, e.g. with or without display
- Measuring range: from just a few drops to 1000 kilograms an hour
- For liquids of various densities, e.g. additives, corrosion inhibitors, fuels, coolants, surface lacquers or perfumes

Gas filling and gas refueling

Mobile for the future – with clean energy

Clean energy is becoming increasingly important right accross the transport sector and, as a result, the number of fuel stations with dispensers for compressed natural gas (CNG) or liquified petroleum gas (LPG) is growing in countries all over the world. When it comes to billing and paying, of course, measuring accuracy is always essential, no matter where the dispenser is sited. Therefore, the "brain" in every dispenser or tanker truck is a flowmeter that measures the quantity of fuel transferred with the absolute highest accuracy – reliability day in, day out, round the clock. These are the strenghts of CNGmass and LPGmass, the meters specifically designed and built by Endress+Hauser for these applications.

Outstanding performance is the norm for both these Coriolis flowmeters, because no-compromise safety and dependability are invariably the top priorities for gas-refueling applications:

- Excellent measuring accuracy, ensured by our own accredited calibration facilities
- Independent of physical fluid properties
- World-wide accepted Ex-approvals (e.g. ATEX, FM, CSA)
- Various custody-transfer approvals (e.g. PTB, NMi, NTEP, MC as well as MID)
- FieldCare software for time-saving commissioning and operation
- MODBUS communication (RS485) for optimum process control
- High customer acceptance, based on years of experience in the industry

CNGmass

- For use in CNG dispensers
- Direct mass-flow metering
- Diameters: DN 8, DN 15, DN 25
- Max. flow: 150 kg/min
- Process pressure: max. 350 bar
- Process temperature: –50 to +125 °C
- Process connections: internal thread
- MODBUS, pulse/frequency and status output
- High vibration resistance

CNGmass DCI

- For use in CNG dispensers
- Direct mass-flow metering
- Backlit display, easy operation via Touch Control
- Diameters: DN 8, DN 15, DN 25
- Max. flow: 150 kg/min
- Process pressure: max. 350 bar
- Process temperature: –50 to +150 °C
- Process connections: internal thread
- MODBUS, pulse/frequency output, HART, relay, status output
- High vibration resistance

LPGmass

- For use in dispensers and on tanker trucks
- Direct mass-flow or volume-flow metering (either configuration is possible)
- Diameters: DN 8, DN 15, DN 25, DN 40
- Max. flow: 750 kg/min
- Process pressure: max. 40 bar
- Process temperature: –40 to +125 °C
- Process connections: EN (DIN), ANSI, JIS flanges; VCO threaded connections, etc.
- MODBUS, pulse/frequency and status output
- High vibration resistance

Your benefits

- Compact, space-saving design – fits inside any dispenser
- Wide range of measurement, satisfies the operating requirements of all mainstream types of fuel stations

Your benefits

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

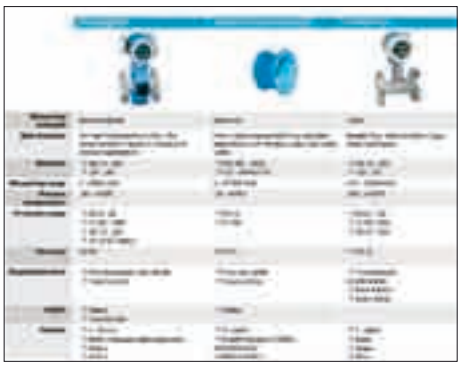
- Integrated temperature compensation
- API tables integrated as standard

Toolset for planning, commissioning, maintenance

For more dependability in operation

Advanced automation and the multiplicity of data to be processed mean that the requirements applicable to modern-day instrumentation are becoming steadily more stringent. The demand is no longer for individual components. Instead, users want system solutions that will provide them with the best possible support from planning through commissioning and parameterization to diagnosis and maintenance. The associated savings in time and money are considerable. Endress+Hauser has integrated these considerations end to end in the development of its flowmeters.

W@M – Life Cycle Management
W@M is an information system which provides technical and operative management with complete data flow and archival – from commissioning on through to maintenance and service within a plant, at any time or location. W@M is an open system based on Internet/Intranet technology, and incorporating all software programs, products and services from Endress+Hauser.


Flowmeter selection


Specification of the meter


Check of pressure loss/measured error (example)

Applicator

Proven for more than 20 years
Applicator is a software for selecting and specifing flowmeters and has been used successfully for a number of years. Applicator also incorporates selection functions for all the other Endress+Hauser areas of activity – namely level, pressure, temperature, liquid analysis, etc.
Users, therefore, can access an enormous functionality within the measurement and control industry.
Applicator guides you through all the important parameters for selecting the appropriate flowmeter; simply enter the relevant data and Applicator will choose the appropriate device for your application. By entering the fluid type and other process characteristics such as pressure, temperature and flow rate, Applicator narrows the choice to the ideal measurement technology and meter type. It also calculates the pressure loss and measuring accuracy, and checks the selected process connections using material load curves. Messages and warnings make it easy to select the right meter, help avoid common mistakes, and enable optimization of the measuring point to suit your specific requirements.

Applicator can do a lot more, however:
- Simple and reliable design of measuring points
- Project documentation (recording, archiving, retrieval of design results)
- Extensive databases with information on more than 400 fluids
- Language versions: German, English, French, Spanish, Russian, Chinese and Japanese
- Interface to “Product Configurator” (for ordering processes)
- Definition of special fluids

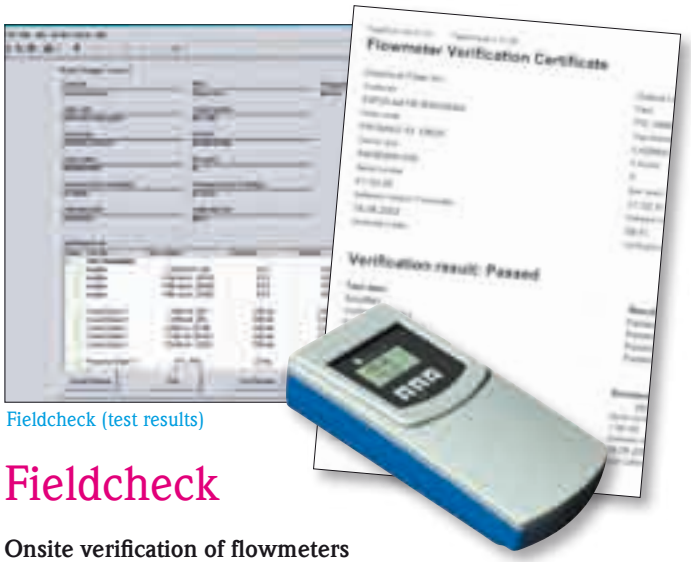
Applicator can be ordered on CD-ROM for local installation on your PC or be accessed online at www.endress.com

The Applicator newsletter at www.applicator.ch can provide you with all the latest updates.

www.endress.com

Configuration and commissioning

Process visualization with Fieldview



Fieldcheck (test results)

FieldCare

Flexible meter support, onsite or by remote control
The modular FieldCare software from Endress+Hauser provide users with an extensive toolset for field support of their measuring points. The functions covered by this software package are:

Basic functions

- Configuration and commissioning of flowmeters using the HART, PROFIBUS DP/PA and service interfaces
- Trouble-shooting
- Measuring point documentation (print, export to other programs)
- Compare parameters of different measuring points (target/as-is comparison function)
- Data backup and archiving (upload/download)

Expansion functions

- **Fieldview** – presenting measured values graphically
  For clear visualization and analysis of measuring data for commissioning, process optimization and diagnosis (continuous line recorder function with integrated data-export and archiving functions).
- **Fieldserv/Fieldflash** – accessing service functions
  For expanded access to service functions by trained personnel.
- **Fieldsafe** – monitoring diagnostics data
  For easy analysis of diagnostic and trend data, e.g. for early detection of deposits or for estimating maintenance requirements.
- **Fieldcheck** – analysing verification results
  For administration and analysis of verification results from the "Fieldcheck" tester/simulator.

Fieldcheck

Onsite verification of flowmeters
Safety in operation and reliability in all aspects of maintenance are essentials for smooth plant operation. The Fieldcheck tester/simulator provides you with the support you need and permits regular onsite checking of your Proline flowmeters. All tests can be performed in-situ without removing the meter from the piping.

The FieldCare software enables you to transfer the results of tests to a database, print the information, archive it and send it to authorities for certification, for instance. Fieldcheck can prolong the intervals between wet calibrations, or even allow recalibration to be skipped. Whenever ISO 9000 certification necessitates frequent calibration and test cycles, a tester/simulator of this nature offers economically attractive and efficient alternatives. Another possibility is the risk-free verification of a plant's safety concept, e.g. in the case of a pipe closure (blocked pumps).

Advantages at a glance

- Direct, in-situ testing and checking of flowmeters. No need for removal from the piping.
- No time-consuming configuration of the devices under test, because meter data is imported directly
- Simultaneous testing of sensor signal inputs and process outputs (current, frequency, etc.)
- Easily readable plain-text messages in 15 languages
- FieldCare software for reading, evaluating, printing, archiving and exporting test results

Digital communication

Value-adding through more information from the process

Even today, and despite their intrinsic lack of a networkable communication capability, analog signals are still used in most process plants to carry information between measuring devices, actuators and higher-order automation systems. Users, however, want enhanced communication capability and supreme precision from their field devices. This combination of requirements cannot always be achieved by means of a 4...20 mA signal transmission. The fact that each pair of wires can be used for only one signal is a typical constraint. This and other factors severely restrict the informa-tion that can be transmitted from the process.

Most modern field devices, however, have built-in microprocessors that digitize the analog signal incoming from the sensor and pre-process this information before it is even transmitted to the processing environment. In this way, these devices offer users a wealth of information that all too often remains unused.

Modern flowmeters such as those from Endress+Hauser monitor events in their immediate process environment as well as their own performance. This means that they pro-vide the operator with a continuous stream of information about the process being carried on in the plant. This opens up a whole range of possibilities for diagnosis, maintenance and upkeep.

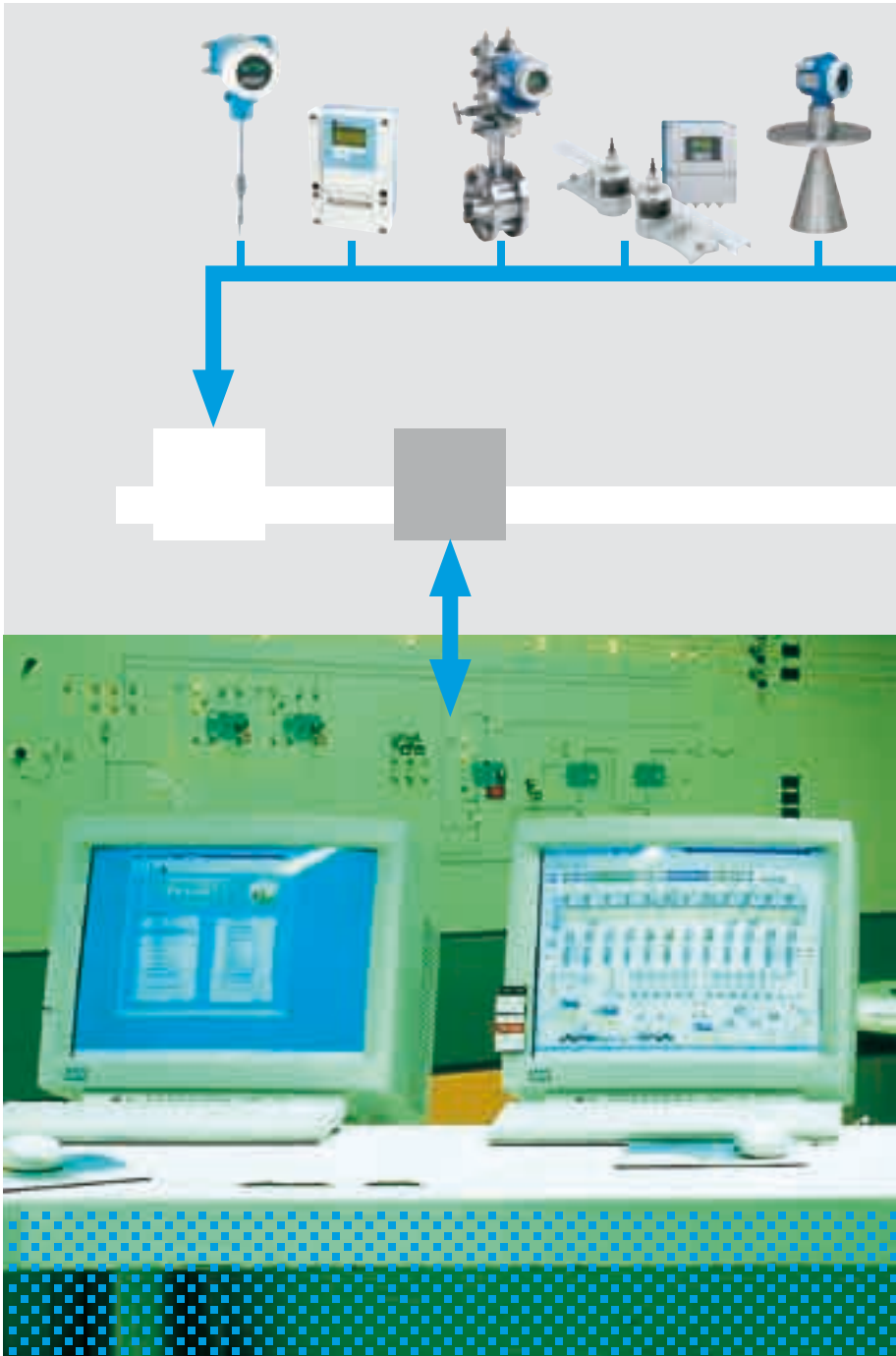
Digital communication by **fieldbus,** however, is the real key to effective transmission and utilization of the process data, measuring and status signals, and device parameters.
The advantages are self-evident:

- Advanced diagnostics and upkeep
- More efficient process management
- Optimized plant availability because of fewer down times
- Maximum process reliability

Additional advantages

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

- Improved productivity of the plant for more flexibility in production
- Access at any time to all essential process data
- Meters can easily be replaced, even in hazardous areas
- Decentralized process control possible
- Fieldbus for intrinsically safe applications in hazardous areas
- Simple installation by two-wire cabling for power supply and data traffic
- Lower cabling costs due to savings on materials and installation
- Space-saving layouts and fewer components, e.g. in control cabinets
- Simplified loop-check for signifi-cantly reduced commissioning costs



Fieldbus technology at Endress+Hauser

Digital communication is essential if plant operators are to extract maximum benefit from the wealth of process information that modern metrology places at their disposal. Consequently, Endress+Hauser relies exclusively on internationally recognized open standards for the digital communication capability of its field devices.
This ensures optimum integration into your plant and guaranteed protection for your investment. The communication systems that have established themselves in the process-automation sector, and which are used by Endress+Hauser, are as follows:

- HART
- 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 trials
- Training courses, seminars
- Customer service

Endress+Hauser's Fieldbus laboratory in Reinach (CH)

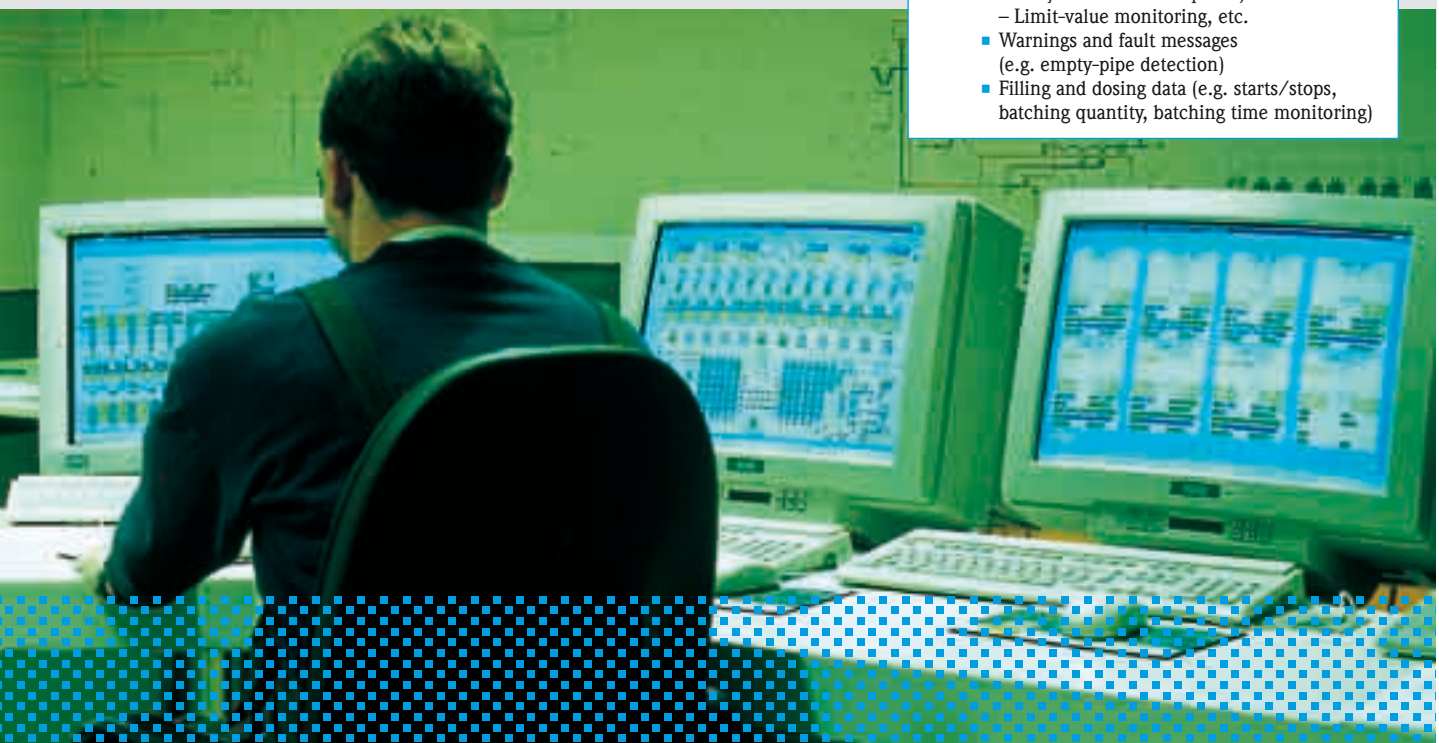
HART COMMUNICATION PROTOCOL · PROFIBUS · FOUNDATION · Modbus-IDA* · EtherNet/IP

Available process information with Proline Promass 83I as an example (Coriolis mass-flow measurement)

Only a few process variables registered and computed by Promass 83I could be transmitted to the automation system by conventional analog communication techniques.
The quantity of process information transmittable by a digital fieldbus, in contrast, is virtually unlimited. This enhances transparency in your process:

- Mass flow
- Volume flow
- Fluid density
- Fluid temperature
- Viscosity
- Totalizer 1
- Totalizer 2
- Totalizer 3
- Standard volume flow
- Density and concentration values (standard density, °Brix, °Baumé, °API, °Balling, °Plato)
- Advanced diagnostic data:
  – Sensor-specific data
  – Trend-analysis data (time series, e.g. for early indication of deposits)
  – Limit-value monitoring, etc.
- Warnings and fault messages (e.g. empty-pipe detection)
- Filling and dosing data (e.g. starts/stops, batching quantity, batching time monitoring)

* available for flowmeters



Global calibration concept

Consistently high measurement quality for all customers around the world

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

These are the reasons why Endress+Hauser subjects all its flowmeters to continuous quality checks throughout production, and tests, calibrates and adjusts them on the most state-of-the-art calibration systems in the world.

We have 30-plus years of experience in developing and building high-tech calibration rigs for correctly and traceably verifying the accuracy of meters. Our maxim is: "Consistently high measurement quality for our customers all around the world." From that baseline we have developed a global calibration concept that offers you, our customer, maximum confidence and maximum security:

- Calibration service in more than 40 countries
- Worldwide accreditation of all flow calibration rigs
- Periodic inspection by national standard authorities
- Complete traceability back to national standards (e.g. PTB, METAS, NPL, NIST, LNE, CN), as laid down in ISO/IEC 17025
- Permanent knowledge transfer through internal and external training
- High-tech calibration rigs – based on a common design platform

Accredited calibration services

In many production facilities, flowmeters are in permanent operation under the severest of conditions. These meters have to be periodically checked or recalibrated depending on the application and the specified accuracy.
Consequently, Endress+Hauser offers its customers a comprehensive calibration service. This service is also available for other-make flowmeters.

Onsite control measurements

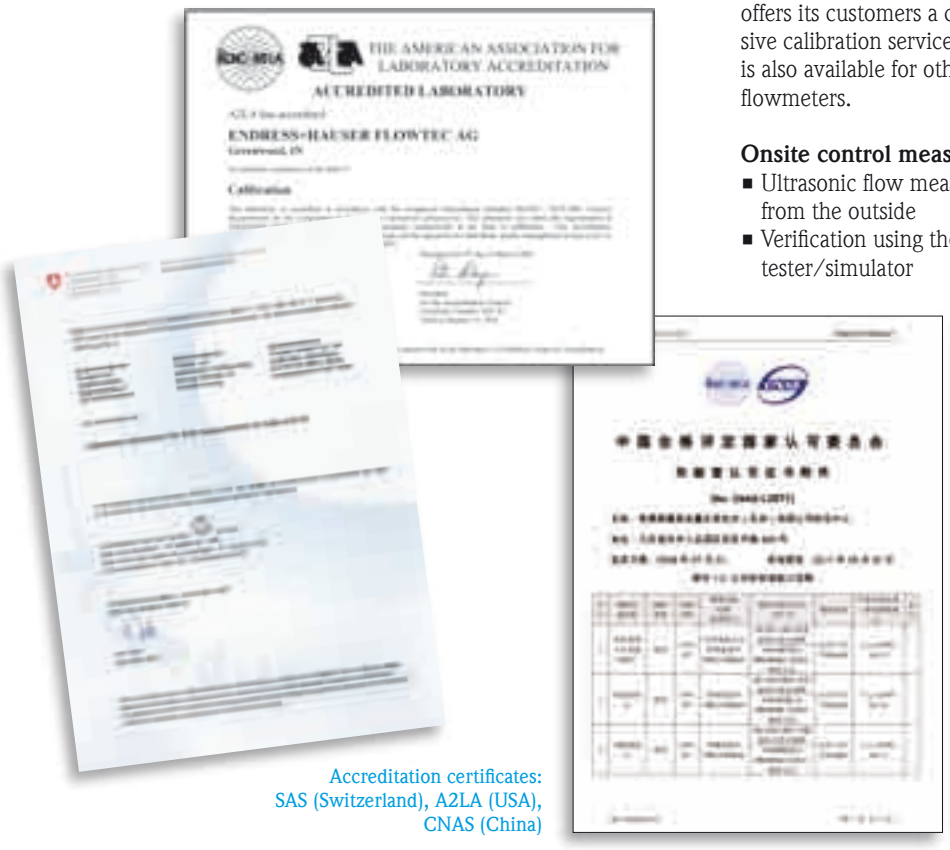
- Ultrasonic flow measurement from the outside
- Verification using the Fieldcheck tester/simulator

Mobile onsite calibration

- Calibration of the meter directly in the piping run
- The transfer master is provided by a mobile calibration system with fully traceable calibrated Coriolis flowmeters

Factory/Workshop calibration

- Control measurement (left as found): As-is drift is measured, but no corrective adjustments are made
- Works calibration with calibration protocol: The device is adjusted to the smallest possible deviation from the calibration system (three standard measuring points)
- Certified calibration: Fully traceable calibration to ISO/IEC 17025 on an accredited calibration rig (three measuring points)



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

Maximum precision under constant measuring conditions

Only stable measuring conditions ensure dependable calibration accuracy. This is particularly true when large flowmeters with nominal diameters up to 2 meters are calibrated. Consequently, the largest calibration facility that Endress+Hauser operates in Cernay (France) has a water tower 28 meters high. The huge tank that this tower supports ensures a uniform supply of water throughout the entire cycle of measurement.

- Constant pressure at the meter being tested
- No pumping pulsations in the flow
- No level measurement overlaying additional measuring uncertainties
- Measurements of any duration are possible, for example to verify the long-term behavior of flowmeters at certain calibration points

Flow rates from a few liters up to six million liters per hour can be measured for calibration, and always with the same, uniformly high level of precision.

"PremiumCal" – The world's best production calibration facility

Ever more manufacturing processes (formulas) – such as those in the life sciences industry – demand maximum accuracy from the measuring equipment being used. The same applies to the measurement of very expensive fluids. For these markets, Endress+Hauser Flowtec AG has once again significantly improved several of its production calibration rigs thanks to large-scale investment. In the nominal diameter range of DN 8 to 250, the Promass 83/84F Coriolis mass flowmeters can now be calibrated to an accuracy level of ±0.05%. And all this on accredited and fully traceable production calibration rigs (acc. to ISO 17025) with previously unattainable maximum measurement uncertainty of ±0.015%! This value corresponds to the contents of a single champagne glass per one thousand liters of water!

Calibration with air

Our air calibration facilities set completely new conceptual and technological standards. Several adapter revolvers enable a rapid and precise positioning of the devices under test into the measurement section (DN 15 to 100). The measurement sections themselves are equipped with a battery of instruments and each section incorporates a fully automated leak tester. Flow rates from 0.05 kg/h up to 10 000 kg/h can be measured with a maximum measured error of only ±0.3%. Reference master meters such as critical-nozzle, rotary-piston and gas turbine meters ensure maximum repeatability.
A special climate control system keeps the air in the calibration room at exactly 24 °C and 40% humidity – day and night. It comes as no surprise, therefore, that this commercial calibration facility measures air flows with one of the highest measuring accuracies in the world!

Service and support the smart way

Always at your service – on 5 continents and round the clock

Endress+Hauser knows that the continuous availability of industrial production facilities is of crucial importance to all our customers. Consequently, our aim is that all devices manufactured by Endress+Hauser should ensure high measuring accuracy and operational safety – round the clock, seven days a week, throughout the entire life cycle of your plant.

And to keep things that way we have established our own sales and service centers in more than 40 countries around the world. So we're always close at hand, no matter whether you are producing in Europe, America, Asia, Africa or Australia. Increase your competitiveness and make use of the many different opportunities offered by Endress+Hauser as a single-source supplier of field instrumentation.

Consulting and planning

Competent technicians, engineers and application consultants come onsite to help you find the technically and economically ideal solution for your application.
When it comes to designing measuring points, we can provide the tried and tested Applicator software, which also features an engineering tool for the administration of measurement and control projects.

Service – maintenance / repair

Need some fast advice on the phone, or support for a maintenance schedule? You decide what we should provide, because our sales and service centers are not only there to help you in emergencies. They also maintain a helpdesk service and make sure you get spare parts and consumables whenever and wherever they are needed. The individual services at your disposal include:

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

Factory witness testing

Customer satisfaction is a keynote issue for Endress+Hauser. So we offer a tailored inspection service on request. You can come to our factory and satisfy yourself that the produced meters are to your specification and complete, and that they leave our works in perfect condition. You can also appoint a representative of your choice to act on your behalf, for example plant engineers, or an inspection agency such as TÜV, Lloyds, SVTI, Bureau Veritas, SGS or equivalent. The tests we conduct at our factory in the presence of our customers include for example:

- Hydrostatic pressure testing
- Visual inspection (specifications, documentation, process connections, materials and acceptance-test certificates, etc.)
- Insulation test for Ex devices
- Check of measuring accuracy
- Metrological audit
- Performance tests
- Verification of analog/digital communication

Installed Base Audit

Installed Base Audit is a service which consists of auditing and analysing an installed base of process instrumentation. The main aim in this is to use appropriate recommendations to develop a maintenance plan that increases system reliability and saves costs.
Other tools used include “Compucal” for the automated administration of calibration/maintenance work as well as “FieldCare” for configuring and analyzing measuring devices.

Documentation

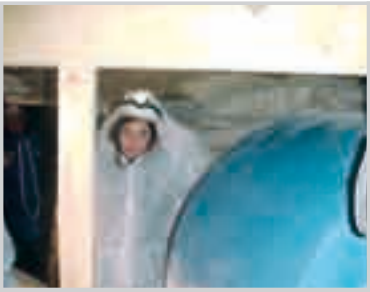
User manuals are available in a number of languages and contain all the information needed for commissioning, operation, installation, safety instructions, connection plans, descriptions of device functions and much more. Endress+Hauser also publishes technical books and basic information on a very wide range of topics associated with industrial instrumentation.

Trade fairs

We exhibit at all the major trade fairs. 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 know-how to you: ■ Industry seminars ■ Service seminars ■ Specialist seminars ■ Workshops ■ Technology forums ■ Introductory seminars ■ Special-interest subjects



People for Process Automation

The knowledge, the commitment, and the experience of the people involved are the drivers that power the development of new products. Their motivation and their keenness to implement their own ideas are what maintain outstanding performance in the long term.
As they appreciate the engineering innovations characteristic of Endress+Hauser's products, customers and users alike perceive the presence of the people behind this progress – the individuals at work in Service, in Sales & Marketing, in Production and in Research & Development.

Endress+Hauser
People for Process Automation

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