Flow measurement for liquids, gases and steam

Products and services at a glance
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.

While Endress+Hauser works closely with universities and research institutes, they also cooperate 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 and regional representatives establishes and maintains the group’s powerful presence in all the world’s markets.

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.

Flow measurement – more important than ever!

Plant safety, constant product quality, process optimization and environmental protection are just some of the 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.

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
- Metering pulsating flow
- Concentration measurement in two-phase fluids
- Measuring viscosity in-line
- Advanced diagnostics

You can find flow-metering technology from Endress+Hauser in just about every industry sector and application:
- Chemicals and petrochemicals
- Petroleum (oil and gas)
- Fueling with gas
- Pharmaceuticals
- Food production
- Breweries
- Dairy
- Water-supply systems
- Wastewater treatment
- Pulp and paper
- Ship building
- Automotive
- Cement
- Mining
- Power plants
- Filling and dosing
- Custody transfer

Whether your needs are for a single intelligent meter with communication interface, or a complete solution for a higher order process control system, you can be sure we are not promoting “one size fits all” – instead, we will offer you a made-to-measure solution tailored to the specifics of your industry, your application, and your requirements.
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 and day out.

There is no single, across-the-board technology suitable for all these applications, so Endress+Hauser will be happy to advise you on the flowmeter best suited for your process needs.

Liquid applications
- Liquids in general (example: water)
- Very low flow rates (< .01 gpm)
- Very high flow rates (> 440,000 gpm)
- Non-conductive liquids
- Viscous liquids (> 50 cP)
- Cryogenic fluids (example: liquid O₂)
- Food and beverages (example: milk, beer)

Gas/steam applications
- Gas flow in general (example: air flow)
- Low flow rates (< .7 ft³/min) (< 0 l/min)
- High flow rates
- Steam

Special applications
- Suspended solids
- Liquid/gas mixtures (water/air)
- Corrosive liquids (acids, alkalis)
- Corrosive gas flows (example: HC3 vapor)
- Applications in mining (ore slurry)
- Bidirectional metering (forward/reverse)
- Measurement from outside without process interruption
- Custody transfer

Ranges of application
- Nominal diameters
- Process pressure
- Process temperature

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| Liquid applications | ✓ | ✓ | ✓ | ✓ | ✓ |
| Gas/steam applications | ✓ | ✓ | ✓ | ✓ | ✓ |
| Special applications | ✓ | ✓ | ✓ | ✓ | ✓ |
| Ranges of application | ✓ | ✓ | ✓ | ✓ | ✓ |

suitable  not suitable  conditionally suitable (depending on application, meter design/materials). Please contact Endress+Hauser!
The Proline device concept
The industry-optimized product line for metering flow

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. Versions for high-temperature and hygienic applications are more examples of the wide range of application possibilities.

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, see for yourself:
- Standardized modules and components minimize costs for spares
- Time-saving by easily replaceable components
- Multi-option control with local display or configuration software (such as Fieldtool®), locally through the service interface or by digital communication from a control center
- Better plant availability on account of self-diagnosis functions, data backup (HistoROM S-DAT & T-DAT) and standardized spare parts concept
- “Quick Setups” and standardized configuration routines for user convenience

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Versatile transmitters
Choose the most suitable transmitter for your application:
- 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 and meters for fluids with high solids content
- Field, wall or stainless-steel housings in compact and remote versions
- Variety of input and output configurations (current, pulse, frequency, current input or relay outputs; status input)
- With/without digital communication
- With world-wide accepted Ex-approvals

Easily comprehensible local display
All Proline transmitters have an easily comprehensible display for operation and for showing brief messages and measured values:
- Backlight 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 push-buttons 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)

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.

Safe data management
All device data programmed in the factory or on-site is stored safely in replaceable non-volatile data memory modules:
- HistoROM S-DAT®: Data memory for sensor calibration data. Enables fast and safe sensor replacement
- HistoROM T-DAT®: Data memory for stored device parameters. Increases plant availability by fast recovery of device parameters
- F-Chip®: Special software upgrades for process optimization (filling and dosing, advanced diagnostics, density/concentration functions, viscosity measurement, electrode cleaning)

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. In other words, you buy exactly what you need!

Permanent self-diagnosis
All Proline Flowmeters have continuous 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 ).
- Fieldtool® for on-site configuration and commissioning
- Fieldcheck® for testing and verification of 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 (multi-variable sensors)
- Measuring principle is independent of the physical fluid properties
- Very high measuring accuracy (typically ±0.1% r.r.)
- Not affected by flow profile, density or viscosity
- No inlet/outlet runs necessary
- Immune against pipeline stress and vibrations due to robust design and TMB™ technology
- 3-A and EHEDG, FDA, CIP/SIP cleanable

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

Viscosity measurement – a new dimension
The ability to measure several process variables all at the same time opens up completely new application fields. Mass flow, density and temperature (the primary measured variables) can be used to derive other variables such as volume flow, solid contents, concentrations, and complex density functions.

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

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

Promass 80
- Transmitters for all standard applications
- Two-line, backlight display
- Push-button controls

Promass 83/84
- With extended functionality suitable for special applications
- Four-line, backlight display
- “Touch Control” operation from outside
- Measures pulsating flow
- FlexROM™ (DAT): Data memory for device parameters
- Custody transfer (NTEP, AGA, API) with the Promass 84

Sensors
The Promass sensors cover a wide range of requirements. The choice of materials, process connections, hygienic versions and accessories is correspondingly broad.

Accuracy: typically ±0.1% r.r. (mass flow, liquids)

Promass A
- For very low flow rates and high pressures
- 1/24” to 5/32” (DN 1 to 4), up to 5,800 psi (PN 40)
- Tube material: Stainless steel, Alloy C-22

Promass H
- Single-tube system especially for chemically aggressive fluids
- 3/8” to 2” (DN 8 to 50)
- Tube material: Zirconium

Promass M
- For high pressures up to 5,076 psi (350 bar)
- 3/8” to 3” (DN 8 to 80)
- Tube material: Titanium
- Also for custody transfer

Promass F
- For universal use
- 3/8” to 10” (DN 8 to 250)
- Tube material: Stainless steel, Alloy C-22
- High-temperature version up to 660°F (350°C)
- Also for custody transfer

Promass E
- Cost-effective sensor for low-end applications
- 3/8” to 2” (DN 8 to 50)
- Tube material: Stainless steel

Promass S
- For universal use
- 3/8” to 10” (DN 8 to 250)
- Tube material: Stainless steel, Alloy C-22
- High-temperature version up to 660°F (350°C)
- Also for custody transfer

Promass F – 10” (DN 250) (compact)
- 0 to 80,840 lb/min (0 to 2,200,000 kg/h)

Promass F – 1” (DN 25) (compact)
- High-temperature version

Proven in >100,000 installations
Electromagnetic flowmeters
Universally usable throughout industry for nominal diameters 1/12” to 78”

This method has been in use around the world for over 50 years, as witnessed by the popularity of these meters that continue unabated in virtually all sectors of industries. Magnets can be used to measure all electrically conductive liquids (> 1 µS/cm) with or without solids (for example water, wastewater, sludge, slurries, pastes, acids, alkalis, juices, fruit pulp and more).

Measuring principle
Faraday’s law of induction states that a conductor moving in a magnetic field induces an electrical voltage. With a magnet, 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.

Advantages at a glance
• The principle is virtually independent of pressure, density, temperature and viscosity
• Even fluids with entrained solids can be metered
• Large nominal-diameter range available (1/12” to 78”)
• Free pipe cross-section (CIP/SIP cleaning, piggable)
• No moving parts
• Minimum outlay for maintenance and upkeep
• No pressure losses
• Very high turn-down up to 1000:1
• High degree of measuring dependability and reproducibility, good long-term stability

In the industrial environment, sectors that utilize this measuring principle include: water/wastewater, chemical, pharmaceutical, pulp and paper, foodstuffs, and many more. Magnets are often robust enough to be used in mining.

Hart® and Profibus-PA, Fieldbus
• Single power supply 20-260V AC/DC
• FM/CSA CL. I Div.
• F-Chip (software upgrade options): filling and dosing, electrode cleaning
• T-DAT®: Data memory for device parameters
• Signal inputs for temperature or density

Promag 10
• Most economical transmitter for basic applications

Promag 23
• Two-wire transmitter for reduced cost of installation and operating overheads

Promag 53
• With extended functionality suitable for special applications

Promag 55
• HART®, Profibus-PA and Foundation Fieldbus
• Single power supply 20-260V AC/DC
• FM/CSA CL. I Div.
• Four-line, backlit display and “Touch Control” operation
• Pulsering flow function
• F-Chip (software package) solid content flow and advanced diagnostics
• Optional -40°F (-0°C) ambient temperature
• Data management: HistoROM T-DAT®, HistoROM S-DAT®, F-CHIP®

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

Promag H
• For very low flow rates 1/12” to 4” (DN 2 to 100), robust stainless-steel housing
• PFA liner for all applications in the chemical, process and food industry (for high process temperatures / severe temperature shocks, -5°F to 300°F (-20°C to 150°C)
• CIP/SIP (3-A approval /EHEDG and USP certificates)
• Flexible process-connection concept

Promag S
• Nominal diameters 1/2” to 24” (DN 15 to 600)
• Measures fluids with high solids content, abrasive or weakly conductive fluids (for example: cellulose, pulp, ore slurry)
• PFA, PTFE, Polyurethane and natural rubber lining options
• NEMA 4X and NEMA 6P

Promag P
• Nominal diameters 1/2” to 24” (DN 15 to 600) (also for custody transfer)
• PTFE and PFA liners for all applications in the chemical and process industry (PFA is specially for high process temperatures / severe temperature shocks, -40°F to 355°F (-40° to 180°C)

Promag W
• Nominal diameters 1” to 78” (DN 25 to 2000) (also for custody transfer)
• NSF61 drinking water approval
• Polyurethane (PU) liner for cold water and slightly abrasive fluids
• Hard-rubber (HR) liner for all water applications
• Temperature ranges: PL / -5°F to 125°F (-20° to 50°C)
• HR / 32°F to 175°F (0° to 80°C)
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.

Two 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, for example, 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
• Non-contact measurement from outside, ideal for measuring highly aggressive liquids or fluids under high pressure
• With homogeneous fluids, the principle is independent of pressure, temperature, conductivity and viscosity
• Usable for a wide range of nominal diameters (1/2” to 160”)
• Direct meter installation on existing pipes. Retrofitting is also possible
• Commissioning without process interruption
• Non-invasive measurement
• No pipe constrictions, no pressure losses
• No moving parts. Minimum outage 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. This makes them ideal for applications ranging from the water industry to industrial process engineering.

• For pipe diameters up to 160” (4000mm)
• 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 calibration rig, are directly installed in the pipe.

• For pipe diameters up to 78” (2000mm)
• Unobstructed pipe cross-section, no pressure loss
• Short inlet runs
• Robust industrial design to ASME and EN

If the fluid sound velocity or the pipe wall thickness are unknown when commissioning, they can be measured with optional sensors:
• DDU 18 (fluid sound velocity)
• DDU 19 (wall thickness)

Proline Prosonic Flow

Transmitters
The transmitters are available as wall-mount or field housings for safe and hazardous areas. Using the common fieldbus systems, Prosonic Flow integrates easily into higher-order process-control systems. The “Quick Setup” menu allows all the parameters needed for installation and commissioning to be entered, checked and calculated – safely and time-effectively.

Prosonic Flow 92F
Two-wire transmitter
• Multi-beam
• Easy installation and system integration with 2-wire loop power
• HART® and Digital communication
• Short, straight inlet requirement (5xD)
• High accuracy: 0.5% with optional 0.3%
• Non-invasive with no pressure drop
• Maintenance-free
• Hazardous area protection for gas and dust available through FM (intrinsically safety or explosion proof)

Prosonic Flow 91
For basic applications
• Two-line, backlit display
• Push-button controls

For measuring from outside (clamp-on sensors)

Prosonic Flow W
For standard applications:
• -5° to 75°F (-20° to 80°C)
• For diameters 2” to 160” (DN 50 to 4000)

Prosonic Flow P
For industrial process applications:
• -40° to 340°F (-40° to 170°C)
• Up to 265°F when used with 91 transmitter
• For diameters 2” to 160” (DN 50 to 4000)
• Ex-approvals

Prosonic Flow U
For the pharmaceuticals and semiconductor industries
• For industrial process applications:
• -5° to 175°F (-20° to 80°C)
• Small diameters 1/2” to 4” (DN 15 to 100)

For guaranteed accuracy

Prosonic Flow C (Inline sensor)
• For water/wastewater applications:
• up to 140°F (60°C)
• DIN, ANSI and AWWA process connections
• Nominal diameters 12” to 78” (DN 300 to 2000)
• Guaranteed, traceable accuracy (0.5% o.r.) by factory calibration
• With approval for potable water

Prosonic Flow F (Inline sensor)
For sonically non-conductive pipes
• Economical, safe and highly accurate
• Nominal diameters 1” to 8” (DN 25 to 300)
• EN (DIN/ASME/JIS/ANSI process connections
• Temperature range: -40°F to 300°F (-40°C to 150°C)
• Pressure range: Class 150 to 3000 (PN16 to PN40)

Prosonic Flow W (Insertion sensor)
• For water/wastewater applications:
• -5° to 175°F (-20° to 80°C)
• For diameters 2” to 160” (DN 200 to 4000)
• Optional as two-path version for short inlet runs

Prosonic Flow 93
For pipe diameters up to 160” (DN 00 to 000)
• Four-line, backlit display (“Touch Control”)
• For registering flow at two measuring points or with two ultrasonic paths
• Integrated wall thickness and sound velocity measurement
• Data memory (DAT)
• P-Chip (for software upgrades)

Prosonic Flow 92T
Portable ultrasonic transmitter for temporary metering
• With integrated data logger
• For monitoring processes and for test measurements
• Large, backlit display (with graphics capability)
• Quick Setup for easy operation

Sensors
The flexible installation concept of Proline Prosonic Flow enables retrofitting at any time without extensive on-site preparation. Mounting rails, welding studs or straps ensure that the clamp-on sensors remain firmly secured in exactly the right position on the pipe wall. Precision positioning is the key to accurate measurements and reliable results. Accuracy: typically ±0.5 to 2% o.r.
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, for example, behind a bridge pillar. This phenomenon is commonly known as the Karman 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. The measuring principle is based on the fact that vortices are formed on the downstream side of a bluff 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. This phenomenon is commonly known as the Karman vortex street.

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 factor), no zero-point drift
- No moving parts
- Marginal pressure loss
- Easy to install and commission
- Large turndown: typically 10:1 to 30:1 for gas/steam or 40:1 for liquids
- Large temperature range from -330° to 750°F

Vortex meters are used in many different industries to measure the flow of liquids, gases, and steam. Applications in the chemical and petrochemical 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 and more.

Vortex meters are particularly popular in all industries for metering steam. Vortex meters measure volume flow, but steam systems are generally rated by mass or energy content, so these meters are frequently used in combination with a pressure and/or temperature sensor and a flow computer. A configuration of this nature helps save energy and is ideal for allocating the costs of generation across multiple consumers.

The Prowirl 73 vortex meter combines everything necessary for the direct mass metering of saturated steam: flow computer, temperature and flow metering all in a single device.

Transmitters – The transmitter housings are available either intrinsically safe or explosion proof for hazardous areas, and can operate the entire life of the instrument without calibration. They are suitable for use in hazardous areas and can operate the entire life of the device without calibration. The transmitter housings are available either intrinsically safe or explosion proof for hazardous areas, and can operate the entire life of the instrument without calibration. They are suitable for use in hazardous areas.

Remote version
- Inexpensive version
- Compact version
- Explosion version
- Intrinsically safe

Proline Prowirl

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% of measurement range or ±1% of full scale (steam).

Prowirl F/W
- For process temperatures -330°F (-200°C) to 400°C
- Wide range of nominal diameters from 1/2" to 12" (DN 15 to 300) for liquids
- High-pressure version up to Class 1500
- Flanged (Prowirl F) or wafer (Prowirl W) versions
- Dual sensor for redundant safety requirements/availability (for example: nuclear)
- DIN, ANSI or JIS stainless-steel process connections
- Fitting lengths standardized worldwide
- With integrated temperature measurement for computing mass flow and heat (Prowirl 73)

Prowirl 72
- For standard applications
- Mass flow is computed by entering fixed operating density values or by pressure/temperature-compensated calculation by an external flow computer (RMS 621 or RMC 621)

Prowirl 73
- Features an integral flow computer for extended functionality
- Direct mass-flow metering of saturated steam with temperature compensation (temperature sensor integrated into the sensor). The saturated-steam curves (IAPWS/ASME) stored in the Prowirl 73 ensure highly accurate measurement in conjunction with simple configuration.
- The integral flow computer calculates pressure/temperature-compensated mass flow of gases or superheated steam

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:
- RMS 621 heat computer
- RMC 621 universal flow computer
- Cerabar M pressure sensor
- RTD thermowell temperature sensor

The Prowirl F transmitter can output volume flow and mass flow.

Immersed in over 100,000 installations

The sensor is highly resistant to:
- External vibrations
- Dirty fluids
- Water hammer
- Temperature shocks (> 150 K/s)

The DSC sensor is available with an optional integrated temperature sensor for the direct mass-flow measurement of saturated steam and more.

Vortex flowmeters
Robust and universal – for liquids, gases and steam

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- The integral flow computer calculates pressure/temperature-compensated mass flow of gases or superheated steam

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:
- RMS 621 heat computer
- RMC 621 universal flow computer
- Cerabar M pressure sensor
- RTD thermowell temperature sensor

The Prowirl F transmitter can output volume flow and mass flow.

Immersed in over 100,000 installations

The sensor is highly resistant to:
- External vibrations
- Dirty fluids
- Water hammer
- Temperature shocks (> 150 K/s)

The DSC sensor is available with an optional integrated temperature sensor for the direct mass-flow measurement of saturated steam and more.
Thermal mass flowmeters
Direct mass flow measurement of gases at low process pressures

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

- Compressed-air quantity metering and leak detection
- Low-pressure gas flows (for example, air at ambient pressure)
- Measurement of pure gases (Argon, O₂, N₂, etc.)
- Measurement of natural gas to burners and driers
- CO₂ metering in breweries
- Control applications for gas burners and preheated air
- Air metering for aeration tanks in wastewater treatment plants

Advantages at a glance

- Direct measurement/display of mass flow of gases and liquids
- High turndown up to 100:1
- High measurement sensitivity
- No moving parts
- Negligible pressure loss (< 0.03 psi (<2 mbar))
- Rapid flow response characteristics
- Available for a wide range of nominal diameters (1/2” to 60” (DN 15 to 1500))
- "Gas Engine™" allows user to change the gas composition without the need of recalibration

Whenever high turndown or low pressure losses are important in gas-metering applications, thermal mass flowmeters offer a real alternative to orifice plates and vortex meters.

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 PT 100 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 precisely 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 input to the element to maintain the temperature difference. Heating current, therefore, is a measure of the mass flow of the gas.

Transmitters – Proline t-mass introduces direct mass measurement of gases without the need for density compensation. The proven Proline transmitter platform is introducing features so far unknown to users of thermal dispersion flowmeters. The Proline transmitter concept also features the 5-Dat concept, providing for storage of all sensor relevant information on the sensor in a single chip. This allows for changing sensor or electronics in the field without the need of recalibration.

Transmitter family

- Compact and remote versions
- Quick setup
- Simple commissioning by selecting the fluid type
- Integrated Gas Selection Database "Gas Engine™" for on-site gas mixture programming without recalibration (4 single gases or up to 8 component gas mixtures from 23 gases)
- Mass + Temperature output
- Compact explosion protection
- In-situ calibration with reference meter output
- Quick Check menu for diagnostics
- Easy management of repairs in the field
- Reduced repair turnaround and down time

Customer specific factory calibration

- Characteristics of the calibration rig:
  - Calibration with air
  - Repeatable and stable ambient conditions
  - Controlled temperature and humidity
  - Undisturbed, fully developed flow profile
  - Automated positioning of the Device Under Test
  - Revolvers for flanged versions
  - Straight pipe section for insertion versions
  - Master meters: turbines, rotary pistons and sonic nozzles for various flow ranges
  - Measurement uncertainty ±0.25%
  - DIN 17025 and ISO/IEC 17025 accredited

Sensors – The new sensor concept introduced in Proline t-mass 65 features a significantly improved thermal dispersion sensor isolated from external temperature effects by a material with very low thermal conductivity (PEEK). This will guarantee that the meter will not be affected by larger environmental temperature swings, which used to be a problem for thermal flowmeters.

Sensor family

- Nominal diameter flange version: 1/2" to 4" ANSI (DN 15 to 100)
- Wide range of process connections, insertion version 3" to 60" (DN 80 to 1500) (circular or rectangular piping)
- 316L or Alloy C-22 sensor material
- Process pressure range:
  - Flange version: up to 580 psi (40 bar)
  - Insertion version: up to 200 psi (20 bar)
- Process temperature range:
  - Flange version: -40° to 212°F (-40° to 100°C)
  - Insertion version: -40° to 266°F (-40° to 130°C)
- Maximum flow: up to 26,455 lbs/hour
- Maximum measured error:
  - Flange version: ±1.5% o.r. for 0% to 100% o.f.s.
  - ±0.3% o.f.s. for 20% to 1% o.f.s.
- Insertion version: ±1.0% o.r. plus ±0.5% o.f.s.
Differential pressure flowmeters
Universally applicable for liquids, gases and steam up to 5,800 psi and 1,800°F

Measuring principle
A primary element (orifice plate 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 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 to the orifice is proportional to 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. The corresponding pressure difference is proportional to 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 5,800 psi and 1,800°F
• Rugged primary elements: purely mechanical, no moving parts
• Transmitter can be replaced at any time during operation without interrupting the process (for example: for maintenance or upgrade)
• Available for a wide range of pipe sizes (1/8” to 7/8”), Pitot tubes: up to diameters of 40 feet optional
• Pitot tubes easily retrofitted

Differential pressure flowmeters can be used in a variety of applications 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.

For example, metering in hot-water and cooling systems and metering steam and condensate at very high temperatures in secondary systems remain primary areas of application. Pitot tubes are a viable alternative to orifice plates where low pressure issues are required and when flow has to be measured in large-diameter pipes (up to several feet in diameter). The transmitter in differential pressure systems can be replaced at any time without interrupting the process.

Deltabar S
Endress+Hauser can provide you a tailored solution using our world-class Evolution series Deltabar S transmitter with a variety of flow elements produced by suppliers committed to the same quality and reliability you expect from Endress+Hauser. Let our team of sales engineering professionals evaluate your application to determine the proper application of an orifice plate, meter run, integral orifice plate, Pitot tube or Venturi meter. In addition, we can provide RMS/RMC flow computers as well as temperature measurement for calculated mass flow.

Evolution series Deltabar S transmitter
Evolved to a higher-degree of functionality and process safety, the Deltabar S offers significant advantages over other “smart” transmitters for DP flow. Every Deltabar S transmitter conforms to the highest process safety and dependability requirements (SIL 2 conformity according to IEC 61508 standards), and offers an incredibly easy-to-use, flexible user-interface.

• Housing rotates 360° for best placement
• Alternating display mode shows flow, pressure and temperature data
• Measuring units visible on display; user-configurable measuring units available
• Easily readable display for local operation
• Flexible user-interface – configuration via “quick setup menu” and external push-buttons, HART® handheld, PC-based software with HART® modem
• Access to every parameter in the transmitter with the external push-buttons – more than zero and span
• Diagnosis and data-memory functions for analysis, simulation and checking all application parameters related to flow. HistoROM® memory chip stores data
• housed in the transmitter and its use is very common.

Various accessories available in a variety of materials and designs.

Accessories
5-valve manifold, ½” process connections
3-valve manifold, ½” process connections
5-valve manifold, flanged process connections
5-valve manifold, flanged process connections
3-valve manifold, ¼” process connections

Pre-assembled measuring unit
Application-specific configuration
Up to 5,800 psi / 1,800°F
Flowmeters have become increasingly popular for filling and bottling over the last few years. Due to today’s requirements, the techniques used in the past (for example: piston-type bottlers) can no longer sustain competitiveness. For example, the PET bottle has become all-pervasive in the beverage industry and has revolutionized the filling and bottling sector. The heat employed in washing causes PET bottles to deform. This change in volume gave rise to the necessity of using modern, high-precision meters for bottling beverages. Daily, these applications are subject to more stringent requirements in terms of hygiene, cleaning and optimum process control.

Endress+Hauser has responded to these challenges by developing Dosimass and Dosimag – two flowmeters designed specifically for the needs of the filling and bottling industry.

"Batchline": Single-source flow measurement for filling and bottling

When every drop counts!

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

- Two meters for all liquids and all sectors of the industry
- 3-A approval and EHEDG-certified
- Simple and safe operating concept (Fieldtool software)
- Maintenance-free, no wear
- Short setup times in multi-product systems for different applications
- Measuring technology for quicker and shorter cleaning cycles

Designed for industrial requirements
Space is always at a premium in line and rotary filling machines, so the meters for these machines have to be compact and light. Dosimass and Dosimag meet these and other requirements:

- Compact, space saving designs
- For non-continuous filling processes
- Wide choice of process connections for optimum integration into existing plants
- Quick conversion and replacement of meters (modular product line, both mechanically and electrically)
- Capable of metering very small volumes with extremely short filling cycles
- High repeatability
- Usable for all filling processes across all sectors of industry

Getting your money’s worth
Highest accuracy in filling and bottling is essential in order to avoid product losses, and this is precisely what Dosimass and Dosimag do best. Dosimass, for example, measures volume or mass flow directly with temperature and density compensation to ensure maximum repeatability.

Even the smallest quantities of certain substances can be very costly, so state-of-the-art flow metering is the key to future savings.

Dosimass
- Coriolis mass flowmeter
- Direct measurement of mass flow
- For filling and bottling plants handling different fluids
- Measuring principle is independent of the physical fluid properties (conductivity, density, pressure, temperature and viscosity)

Dosimag
- Electromagnetic flowmeter (magmeter)
- Measurement of volume flow
- Extremely compact
- Economical and cost-effective

Cost efficiency in metering
In practice, cost-efficient metering means: no unnecessary down times, maintenance or upkeep. 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 300°F (150°C) are possible (max. 60 minutes)
- Self-draining measuring tubes (open cross-section)
- Practical replacement concept for process seals
- Time-saving electronics exchange, without exposing wetted components

Service and support
Plant availability and process dependability are crucial to your organization. Endress+Hauser’s global sales and service network is in place to ensure both and to keep your production from “drying up.” Our service centers offer:

- Specialist application consultants with many years experience in the industry
- Immediate round-the-clock assistance by competent service technicians

Dosimass

Dosimag
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, but users instead want system solutions that provide them with the best possible support. From planning through commissioning, configuration 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. The software tools the company has developed for the individual sensors ensure that users have optimum support throughout their meters' entire life-cycles. The “Tooling” concept has three primary components:

- **Applicator** for easy selection and specification of flowmeters
- **FieldTool**® for flexible device support, either on-site or remotely
- **FieldCheck**® for on-site verification of installed flowmeters

### Toolset for planning, commissioning and maintenance

For more dependability in operation

Applicator®

Applicator is software for selecting and specifying flowmeters and has been used successfully for more than 10 years. Applicator also incorporates selection functions for all other Endress+Hauser areas of activity — level, pressure, temperature, liquid analysis, and more.

Applicator guides you through all the important parameters when searching for the ideal flowmeter. Enter the application limits and Applicator displays the principles and families of meters best suited.

By entering the fluid type and other process characteristics such as pressure, temperature or measuring range, Applicator narrows the choice to the ideal meter type (design), and gives the nominal diameter, pressure loss, measuring accuracy and 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 requirements specifically.

Applicator can do a lot more:

- Simple design of measuring point
- Project documentation (recording, archiving, retrieval of design results)
- Extensive databases with information on more than 300 fluids
- German and English language versions (French, Spanish, Russian, Chinese and Japanese are in preparation)
- Conversion functions for physical units

### Configuration and service software

#### FieldCheck®

On-site verification of flowmeters

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

The FieldTool software enables you to transfer the results of tests to a database, print the information, archive it and send it to authorities for certification. 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, for example, in the case of a pipe closure (blocked pumps).

**Advantages at a glance**

- Direct, in-situ testing and checking of all Proline flowmeters
- 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)
- Easily readable, plain-text messages in English and German
- FieldTool software for reading, evaluating, printing, archiving and exporting test results
- Traceable verification

#### Flexible meter support, on-site or by remote control

The modular software packages (FieldCare, ToF Tool-FieldTool Package) from Endress+Hauser provides users with an extensive toolkit for field support of their measuring points. The functions covered by these software packages 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 functions
  - Data backup and archiving
    - Upload/download

- **Expansion modules**
  - **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, for example, for early detection of deposits or for estimating maintenance requirements.
  - **FieldCheck**: analyzing verification results.
    - For administration and analysis of verification results from the “FieldCheck” tester/simulator.

FieldTool software for reading, evaluating, printing, archiving and exporting test results

FieldCheck® (test result)

Configuration with FieldCon

Process visualization with FieldView
Digital communication

Value-adding through more information from the process

- 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, (for example: in control cabinets)
- Simplified loop-check for significantly 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

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:

- Accredited PROFIBUS Competence Center
- Engineering of fieldbus networks
- System-integration trials
- Training courses, seminars
- Customer service

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 superior 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 information 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 provide 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
The advantages of recognized, accredited calibration facilities are:

- Traceability back to national standards (for example: METAS, PTB, LNE, NIST)
- World-wide acceptance
- With official SCS or A LA certificate (ISO/IEC 1705)
- Periodic inspection by the national standard authority

Long-term stability and guaranteed, traceable accuracy are essential aspects of flow metering. They are some of the 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 prior to final testing, adjustment and calibration on state-of-the-art calibration systems. Calibration can also be customer-specific, in other words, within a desired measuring range. A calibration certificate documents the results.

Calibration service and factory witness testing
When quality and customer satisfaction take center stage

At Endress+Hauser, we are proud of the performance and accuracy of our extensive ‘Factory’ calibration facilities. The laboratories are located around the globe ensuring you the best possible service wherever you are. One example is our extensive flow calibration facilities in Switzerland, France, UK, India, China, USA and Japan, which are accredited to ISO 17025 and A2LA, plus they are traceable to national and international standards. No other provider of calibration can offer such support.

Wherever your device is calibrated, on-site or at one of our facilities, we use systems compliant to ISO 9001 Quality Standards. If you show your quality auditors an Endress+Hauser Calibration Certificate, you can be sure of acceptance.

Our services are tailored specifically to your needs, including before and after calibration statements, and can incorporate equipment software updates and repair as necessary.
Endress+Hauser’s product portfolio

**Level**
- Capacitance (RF)
- Conductive
- Mechanical
- Vibration
- Ultrasonic
- Radar
- Guided radar (TDR)
- Hydrostatic

**Pressure**
- Gauge/absolute
- Differential pressure
- Hydrostatic

**Liquid Analysis**
- Conductivity
- pH/ORP
- Chlorine
- Dissolved oxygen
- Turbidity
- Chemical analyzers
- Nitrate/organic sensors
- Sludge level

**Flow**
- Electromagnetic
- Vortex shedding
- Coriolis mass flow
- Ultrasonic
- Open channel
- D/P flow
- Thermal mass flow

**Temperature**
- Temperature transmitters
- RTDs/thermocouples
- Sensors

**Components**
- Displays
- Active barriers
- Process transmitters
- Power supplies

**Service**
- Start-up
- Training
- Calibration
- Maintenance contracts
- Instrument Management Solutions

**Recorders**
- Paperless recorders
- Visual data managers
- Safety data managers

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