

From metering and monitoring to advanced energy management

Integrated right-tech steam solutions

Steam across industries - advanced energy management



Steam

As a sustainable, efficient and ecological utility.

At Endress+Hauser we understand the daily challenges and demands placed upon Energy and Utility Managers across the spectrum of steam generation, distribution and consumption activities. Our global team is committed to working with our partners to overcome these complexities and particularly those that challenge a safe, economic and sustainable source of steam energy production and delivery.

In meeting these challenges, the core of our business is designed to enable customers access to Endress+Hauser global competence with superior expertise in steam system solutions.

By partnering with us, Energy Managers, Utility Managers and Engineers are guaranteed best-in-class quality, reliability with direct access to in-house expertise and shared industry know-how.

Our range of integrated steam solutions are designed to deliver reliable and cost-effective measurement solutions from a single source that comply with international regulatory standards across all industries and boiler technologies.

Having understood your requirements for safe design, we have built a comprehensive portfolio of measurement instrumentation, services and solutions around this.

Additionally we are able to share our expertise with unrivaled confidence as we provide accessible global technical support throughout the entire life cycle of your Endress+Hauser products and solutions.





The universal value of a sustainable utility

Meeting the growing demands of steam generation, supply and distribution.



At Endress+Hauser we recognize the intrinsic value of steam and the growing interest in it as a sustainable, efficient and ecological utility for a diverse group of industries.

Steam remains one of the most important industrial cost drivers. The effective cost of steam depends on the path it follows from the boiler to the point of consumption. A “systems approach” to steam management typically begins with an analysis of the entire boiler unit, including the effects of blowdown, parasitic steam consumption and deaeration.

Investing in accurate and reliable measuring and monitoring equipment has the potential to yield data that can lead to savings within the entire steam process, reducing both CAPEX and OPEX.

Steam is one of the most important cost drivers in the industry.

Integrated solutions for today's steam needs

Interest in the true cost of steam is rapidly evolving across all industries because customers recognize the savings potential this utility bears.

With an extensive range of metering, monitoring and steam management products and services, Endress+Hauser is able to unlock the maximum potential of steam applications and offer a partnership for integrated steam boiler management solutions.

When availability, safety, efficiency and compliance count

A deep understanding of your business and industry requirements lies at the heart of our product and service offering.

Uncompromising availability

You expect continuous steam availability 24/7. Our product portfolio ensures an uninterrupted supply.

We are committed to providing worldwide access to our field expertise of steam and are proud of our ability to react and respond to the ongoing needs of our customers and partners.



Improved boiler house and plant safety through optimal design and operation

Our product portfolio ensures boiler safety and supports robust systems with high availability. Our measuring solutions fulfil a number of industry regulatory/safety compliance and environmental protection standards that include:

- EN 12952/12953, BS 2486 – Recommendations for treatment of water for steam boilers and water heaters
- ASME Boiler Water – ASME Guidelines for water quality in modern industrial boilers PED 97/23/EC, IEC 61508



Efficiency through fulfillment and cost/unit consumption

Flow, level, analytics, pressure and temperature are the basis. Using these measured values, boiler efficiency and the cost per unit consumption (e.g. tons of product per ton of steam) can be derived. The ability to analyze and react accordingly provides an opportunity to optimize related costs in generation and delivery.



High quality of feedwater and steam

The quality of steam has a strong influence on the quality of the end product. Endress+Hauser helps you to ensure optimum feedwater quality through the measurement of crucial parameters. On the steam side, the dryness fraction can be measured continuously helping you to reduce the risk of water hammer, determine the true energy of the steam and improve the efficiency of your heating process - the end result being efficient steam production and enhanced productivity.



Feedwater preparation

At Endress+Hauser we are committed to providing our customers with greater control through access to reliable process data and cutting-edge knowledge.

Feedwater preparation is integral to the safety, efficiency and life span of a boiler unit. The feedwater component of the steam loop provides multiple access points to extract key metering and monitoring information.

The quality and supply of make-up and return water have a direct impact on the safety of boilers. Accounting for up to 90% of the total expenditures, consumables are the main cost drivers associated with the daily operation of a boiler unit. This is a compelling argument for boiler operators and managers to investigate process monitoring solutions that reduce the operating costs related to consumables. The re-use of condensate makes sense from an energy stand-point: typically 10 to 15% of the energy added in the boiler is still contained in the condensate. It is good practice in several applications to monitor the quality of this return water in order to check e.g. for leaks in plate heat exchangers.

Ensuring the highest quality of feedwater is a highly recommended step in the steam generation process. Maintaining optimal production and supply of steam generation and distribution can be enhanced through better management of feedwater preparation. Taking advantage of solutions to maximize the quality and supply of feedwater has a direct impact on the overall boiler life span and the amount of water preparation consumables required.



Maximizing feedwater quality will:

- Reduce costs - Optimal proportional dosing of chemicals into the boiler minimizes internal boiler corrosion as well as excess chemical consumption and costly blowdowns.
- Lead to boiler shut down and no production if feedwater quality is not right.
- Reduce blowdown costs – Optimizing the overall quality of feedwater dramatically reduces the need for manual and unscheduled blowdowns of accumulated salt, sediments and corrosive particles and results in significant improvements in energy loss and time.
- Improve safety by preventing overflow and lack of feedwater - Preventing the overflow of condensate within the hotwell by including level switches provides an intervention that alerts the operator to suboptimal feedwater levels.
- Increase boiler life span – Improving boiler life span and efficiency is a very achievable goal with the solutions now readily available for measuring and monitoring feedwater preparation.

the quality of the feedwater and steam directly impacts productivity.



You need to measure it to know

Using real-time data to drive decision-making in feedwater preparation.

Flow – Boiler feedwater flow is measured to determine blowdown losses and boiler efficiency. A feedwater meter can also be used for proportional dosing of chemicals into the boiler in order to minimize corrosion and the need for excessive blowdown, both of which lead to energy losses. In performing 3-element control using a feedwater meter, a long lifetime of the boiler can be assured. Moreover, the use of a freshwater meter is often a legal requirement. Its addition to a feedwater system is also useful in determining the amount of condensate.

Endress+Hauser provides a range of solutions for feedwater levels, steam measurement and fresh water measurement using measuring principles that are virtually independent of pressure, density, temperature and viscosity and that minimize boiler corrosion and deposition.

Endress+Hauser provides solutions for the verification of flow devices and their re-calibration including documentation that help you to comply with environmental and energy management standards like ISO 14001 and ISO 50001.

Level – Level switches are important to make sure that enough feedwater is in the hotwell or in the deaerator. Additionally, the overflow of these containers can be avoided using these switches. Improved control can be achieved by continuous level measurement.

Temperature – Monitoring feedwater temperature is important for avoiding thermal shock and crack formation in the pressure vessel. Temperature and pressure also define density and enthalpy of the steam.

Analysis – Boiler feedwater requires specific conditioning to reduce levels of dissolved oxygen and mineral salts. Through proper conditioning, the pH value of feedwater can be adjusted to acceptable levels for inhibiting corrosion and sedimentation. Dissolved oxygen in boiler feedwater, in particular, will cause serious corrosion damage in steam systems by attaching to the walls of metal piping and other metallic equipment and forming oxides. Dissolved carbon dioxide combines with water to form carbonic acid that causes further corrosion.

A number of international standards provide guidance on water chemistry requirements for optimal operation. Included among these are BS 2486 (Recommendations for treatment of water for steam boilers and water heaters) and ASME (Consensus Operating Practices for Control of Feedwater/Boiler Water Chemistry in Modern Industrial Boilers).

Controlled and proportional dosing of chemicals into the boiler – reducing under or overdosing – contributes to minimizing internal boiler corrosion as well as excess chemical consumption and costly blowdowns.

Minimizing sedimentation improves the heat exchange rate, which is directly linked to lower fuel expenditure and a reduced need for expensive boiler blowdowns.



...properly adjusted water levels represent safety and preventive maintenance that can support years of reliable operation.



Fuel combustion & exhaust

Advances in combustion technology continue to challenge current standards and the daily operation of many steam production facilities. At Endress+Hauser, we meet our customers' changing needs with right-tech solutions engineered to provide highly available, safe and efficient metering and monitoring of fuel combustion and exhaust management within the steam production loop.

...proven and tested solutions that accurately measure how effectively the heat content of a fuel is transformed into usable energy.

Boiler efficiency remains a high priority. If the boiler is burning fuel suboptimally or heat is lost through the surrounding system, the end result is excessive waste and potential violations of emission standards.

In terms of fuel combustion and exhaust, boiler efficiency can mean different things to different people. Commonly, however, it refers to the "thermal" or "fuel-to-steam" efficiency. Most often, the term is used to describe combustion efficiency. The stack temperature and flue gas oxygen (or carbon dioxide) concentrations are regarded as primary indicators of combustion efficiency.

Whether your focus is on combustion efficiency, thermal efficiency or fuel-to-steam efficiency, we have a range of proven and tested solutions that accurately measure how effectively the heat content of a fuel is transformed into usable energy. Our range of monitoring solutions complies with ASME Performance Test Codes (PTC 4-1998) and regulatory standards.

Control what is measured

Flow – Choosing the right instrumentation to meet regulatory emission requirements for fuel and exhaust flow measurement and their multiple process variables is a challenge. Measuring flow devices with high accuracy and multivariable diagnostic information can be helpful in fulfilling these requirements.

Pressure – Pressure is an important control parameter for both liquid and gaseous fuels. If the pressure is too low, the boiler doesn't receive enough natural gas, and in liquid applications, low pressure may lead to cavitation.

Incoming combustion air temperature – This temperature is used for the calculation of the boiler's indirect efficiency. Increasing this temperature helps to improve the boiler efficiency.

Exhaust temperature – A boiler's exhaust temperature is a function of the boiler design, firing rate and fluid temperature. If the exhaust temperature rises independently of these factors it indicates a deterioration in the heat transfer inside the boiler. Temperature probes with enduring stability are required to perform a trend analysis of the stack temperature.

A rapid increase in exhaust temperature indicates a burner-side problem. A slow increase indicates scale formation on the waterside, which can result in expensive repairs or, in extreme cases, a catastrophic failure.

Exhaust temperature is also used in the calculation of indirect efficiencies. A 20°C change in exhaust temperature approximates to a 1% change in the indirect efficiency of the boiler.



Steam Generation

Optimized steam production is of utmost importance due to changing process and consumption needs.

The boiler is the heart of every steam system.

The main targets of steam boilers are

- A readily available supply of steam at the desired pressure and temperature
- An efficient performance at the lowest possible costs
- A safe operation at all times of use
- A continual compliance with relevant norms and regulations

Efficient plant operation is dependent on a number of factors including sufficient supply of steam available at the correct temperature. If steam is not supplied efficiently, costs may explode leading to a poor competitive position. If steam is not produced safely, the health and safety of the boiler operators are potentially at risk. If the boiler is not complying with national regulations and international norms, authorities may close down the boiler house leading to a loss of production.

In order to ensure continuous and regular supply of steam, appropriate boiler controls are required. When techniques for measuring the continuous flow during steam generation are introduced, as an example Vortex, substantial efficiency gains are possible. Vortex meters have become indeed the preferred flow metering technology for steam measurement because of their robustness and reliability.

If you don't measure it, you can't control it

- Reduce costs by controlled dosing of chemicals into the feedwater preparation
- Improve boiler lifespan, efficiency and availability through three-element control: measuring level, steam and feedwater flow
- Access to temperature and enthalpy information
- Provide real-time conductivity information
- Provide high repeatability and temperature output at an attractive price
- Use IAPWS-IF97 standard for all Endress+Hauser flow measurement and flow computers

The Prowirl 200 exemplifies our commitment to right-tech solutions and engineering innovation by taking the tried-and-tested vortex principles of measurement one step further with the ability to detect wet steam or even measure the dryness fraction.

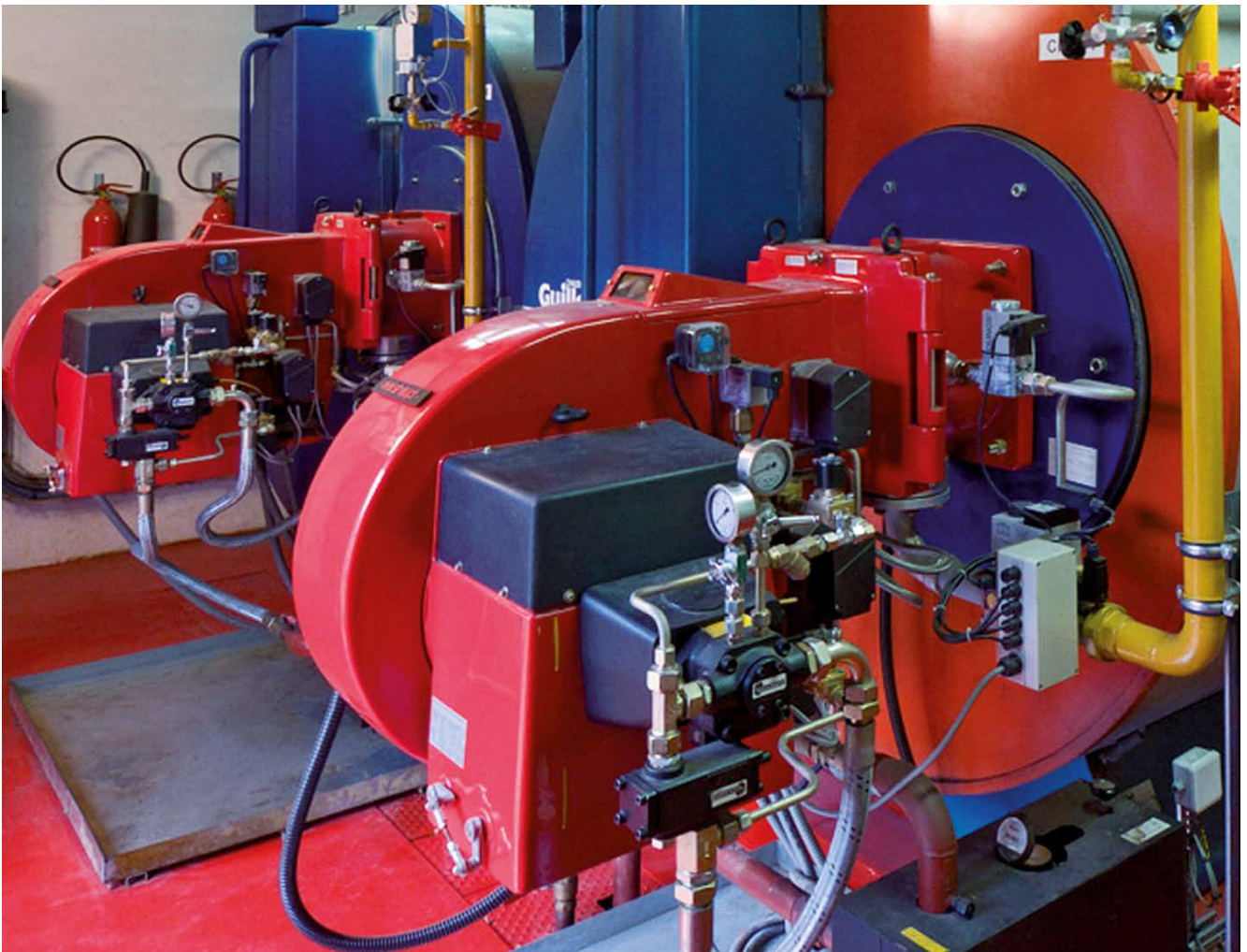
Our flow metering products and solutions are engineered to improve overall availability and efficiency. With Heartbeat Technology™, they offer an innovative verification concept that helps to reduce downtime because of longer calibration intervals.

Flow – By measuring flow within the boiler unit, acquired data can be used directly to enhance the overall efficiency of the boiler. Monitoring direct boiler heat conversion and efficiency results in fewer expensive and unscheduled blowdowns. By applying flow instrumentation strategies to optimize the dosing of chemicals into feedwater, the life span, efficiency and availability of the boiler can be directly improved, while also reducing costs. Our range of flow measurement instrumentation includes solutions that can detect wet steam and measure its dryness fraction, this being one of the most important parameters for helping to increase safety and improve overall steam production efficiency.

Today, modern flow technologies such as vortex, ultrasonic and Coriolis, offer a reliable alternative to traditional flow technologies like positive displacement (PD), turbine, variable area (VA) and differential pressure (DP) – once the only solution available. At Endress+Hauser, we have a range of proven and tested solutions that accurately measure how effectively the heat content of a fuel is transformed into usable energy. Our range of monitoring solutions complies with ASME Performance Test Codes (PTC 4-1998) and regulatory standards.

Level – Significant damage to boiler equipment can result from unresolved long-term level problems. Solutions configured to customer needs according to the safety level required are a key consideration for many Energy and Utility Managers. Improved level monitoring and control help to increase safety and availability by reducing the risk of boiler shutdowns.

Endress+Hauser provides both switches and continuous level measurement devices developed according to IEC 61508 (SIL).



Pressure – Accurate and reliable measurement of boiler pressure is a safety requirement. Enhancing pressure measurement by increasing boiler life span can be achieved by avoiding short-cycling, increasing the boiler’s overall safety. Furthermore, pressure is required for accurately compensating for mass and energy.

Temperature – Pressure and temperature compensation are the two factors that lead to effective savings. On the boiler itself, availability of a Safety Integrity Level (SIL) transmitter for thermometers ensures compliance with safety regulations. Endress+Hauser temperature probes, such as the StrongSens vibration and water hammer resistant sensor, ensure long-term stable temperature measurement. StrongSens technology is an example of measurement instrumentation that provides direct cost savings as the frequency of sensor replacement can be reduced. Therefore, the overall downtime resulting from unscheduled maintenance and replacement can be minimized.

Analysis – Boilers need to be free of turbidity and sediments. They require specific conditioning to reduce levels of dissolved oxygen and mineral salts. The pH value of feedwater can be adjusted to acceptable levels for inhibiting corrosion and sedimentation through proper treatment. Dissolved oxygen causes serious corrosion in

steam systems by attacking the walls of metal piping and other metallic equipment and forming oxides. Dissolved carbon dioxide combines with water to form carbonic acid that causes further corrosion.

A number of international standards have been established providing guidance on water chemistry requirements for optimal operation including the British Standard: BS 2486 and ASME.

Components – Flow computers help to convert volume flow information into compensated mass or energy flow. Additionally digital recorders help to track important information like level, fuel flow or the boiler efficiency over time, while surge arresters help to protect the equipment from power surges.

Steam distribution

A dynamic and changing closed loop environment.

Steam distribution systems regulate the delivery of steam and respond to changing temperature and pressure requirements. Steam cannot be pumped, it flows from high to low pressure. Measurements in distribution lines are often done for internal billing or custody transfer.

There is no custody transfer standard for steam (e.g. from the OIML).

For distribution, steam is sometimes superheated in order to avoid condensation losses. For compensation, both pressure and temperature measurements are required. When distributed, steam first loses superheat and then turns into wet steam. Often, relatively high turn-downs are required because of seasonal differences in demand.

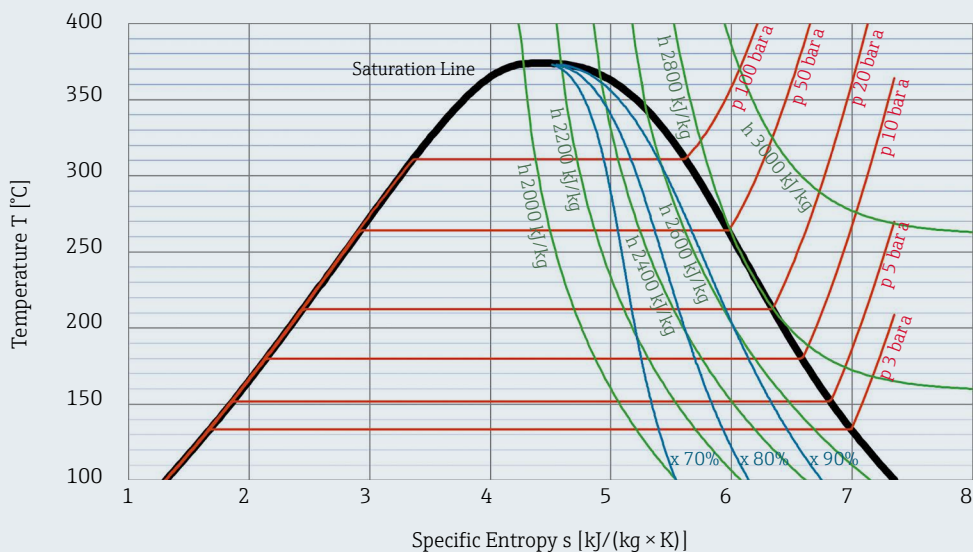
Key challenges of steam distribution

One of the key challenges facing Energy and Utility Managers is the reality that steam has to be transported from the boiler house to the different points of end-use with a minimum loss of energy. Energy losses and the risk of water hammer can be reduced by avoiding dead legs in distribution networks, long distribution pipes, and by reducing poor or non-existing insulation of piping. Balancing steam distribution systems requires a great degree of skill and know-how. Often it is not known if warm water, steam or a mix of the two is in the pipe and what the energy content is. For steam to be effectively distributed across the system, a number of key factors need to be considered.

Good practice in steam distribution

- Ensure that distribution pipes have a minimum slope of 2° to promote effective condensate removal
- Install a condensate trap every 50m to provide an exit for the forming condensate
- Improve efficiency and safety by monitoring steam traps - 10% of steam traps (mechanical devices) fail per year either open (permanent loss of steam reducing efficiency) or closed (condensate is not removed increasing the risk of water hammer)
- Minimize energy losses by providing adequate insulation of pipework
- Increase safety by regularly measuring and monitoring condensate to avoid the risk of water hammer which may destroy the pipeline resulting in a safety concern (safety and life)

T-s Diagram for Steam



Flow – With the presence of undetected wet steam, overall steam quality is severely compromised. The ability to measure the dryness fraction of steam not only provides peace of mind to ensure maximum energy transfer and efficiency, it also plays an integral role in reducing the risk of water hammer and subsequent unscheduled blowdowns. Monitoring and measurement devices offer Energy & Utility Managers highly repeatable and accurate flow data, helping them make critical decisions that improve their daily plant operations. The right choice in flow instrumentation and support services achieve the fulfilment of required documentation as per ISO 14001 and 50001 standards.

Components – Endress+Hauser provide a broad range of components that have become essential within the boiler house environment. These components include flow computers that compensate for separate and stand-alone instrumentation. Through enhanced connectivity and seamless integration with additional buses such as M-Bus or Modbus, they provide calculations as per IAPWS- IF97/ ASME industry requirements. Recording, calculating and the visualisation of key data with industry leading solutions are effortlessly realised when technologies such as Memograph or KPI are chosen.

Pressure – There is no doubt amongst Energy & Utility Managers of the importance of pressure as a control parameter in steam distribution. The ability to detect pressure alterations along the entire system is only possible with absolute sensors where data is provided to avoiding short-cycling. The key benefit is therefore increasing the boiler's overall safety and accuracy by correctly compensating for mass and energy changes.

Energy Measurements Proving Service – Accuracy is an important characteristic of any energy measurement system. Neglecting the measurement uncertainty about the amount of energy consumed at various points within a steam network can lead to incorrect conclusions and actions. In extreme cases this could lead to custody transfer conflicts, unnecessary corrective actions or no corrective actions when they are needed.

Endress+Hauser applied our energy measurement and calibration expertise to this challenge by developing the Energy Measurement Proving Service. Initially focused on superheated and saturated steam this service includes checks of all components of the energy measurement loop, a calculation of the uncertainty of the overall energy measurement and improvement recommendations. Our technical experts perform on-site calibrations and verifications of field devices (energy calculator, flow, pressure and/or temperature) with minimum, if any process interruption.

Energy measurement accuracy is calculated via a validated simulation method which identifies and quantifies ways to improve measurement accuracy. With the accuracy known and proven for each energy measurement loop you and external stakeholders have full confidence on the amount of energy transferred through every energy measuring point in your steam network.

If you don't measure it, you can't control it:

- Use Endress+Hauser Prowirl to build the energy balance of your plant
- Use a long-term stable flow measurement to identify problems more easily (e.g. through CUSUM analysis)
- Measure the dryness fraction to reduce the risk of water hammer, identify when steam traps are not working and measure steam mass and energy with highest accuracy
- Measure by cost center to know who is consuming how much
- Verify the accuracy of your steam energy measurement with the Endress+Hauser Energy Measurement Proving Service



Steam consumption

Direct measurement of wet and dry steam utilizing a comprehensive range of measurement principles.

Ideally, steam should be provided as 100% dry saturated steam to most points of end-use. This makes sure energy is passed on to the process at optimum efficiency.

In reality, steam reaches the heat exchanger either superheated (at the outlet of a correctly working pressure reducing valve PRV) or wet (if no PRV is present at all or not working). Wet steam will lead to inefficient heat transfer, but it also increases the risk of water hammer that might even destroy the heat-exchanger.

Main targets in steam consumption

- Uncompromised commitment to overall safety through continuous measurement and monitoring of condensate and the dryness fraction
- Ongoing compliance, adherence and fulfilment of industry standards (IAPWS- IF97/ASME)
- A readily available supply of steam at the desired pressure and temperature
- Balancing consumption efficiency against total production and supply costs

Flow – Advanced flow meters such as Endress+Hauser’s Prowirl F 200 provide the benefit of wet steam detection and measurement of the dryness fraction with a calculation of steam mass and energy as per IAPWS-IF97/ ASME standards. Only by using this product will you know if your steam is really 100% dry or just how wet it really is. Prowirl F 200 is also supported through a dedicated application of realtime health monitoring made possible by “Heartbeat Verification” including the generation of a pdf supporting ISO 14001 and 50001 certifications.

Components – Solutions designed to compensate for separate and stand-alone instrumentation are available through the Endress+Hauser offering. Advanced connectivity and seamless integration with additional buses such as M-Bus or Modbus are possible with industry required calculations (IAPWS- IF97/ASME). The visualisation of key data with industry leading solutions are effortlessly realised when technologies such as Memograph or KPI are chosen.

Pressure – The ability to detect pressure alterations along the entire system is only possible with absolute sensors where data is provided to avoiding short-cycling. The key benefit is therefore increasing the boiler’s overall safety and accuracy by correctly compensating for mass and energy changes.

Energy Measurements Proving Service – Efficiency of a steam network can only be determined when accurate measurement information is available. Steam energy is typically measured indirectly so the measurement accuracy is dependent on all underlying measurement components. Since each component has a different contribution to the overall measurement uncertainty, how can we have confidence the measurement results?

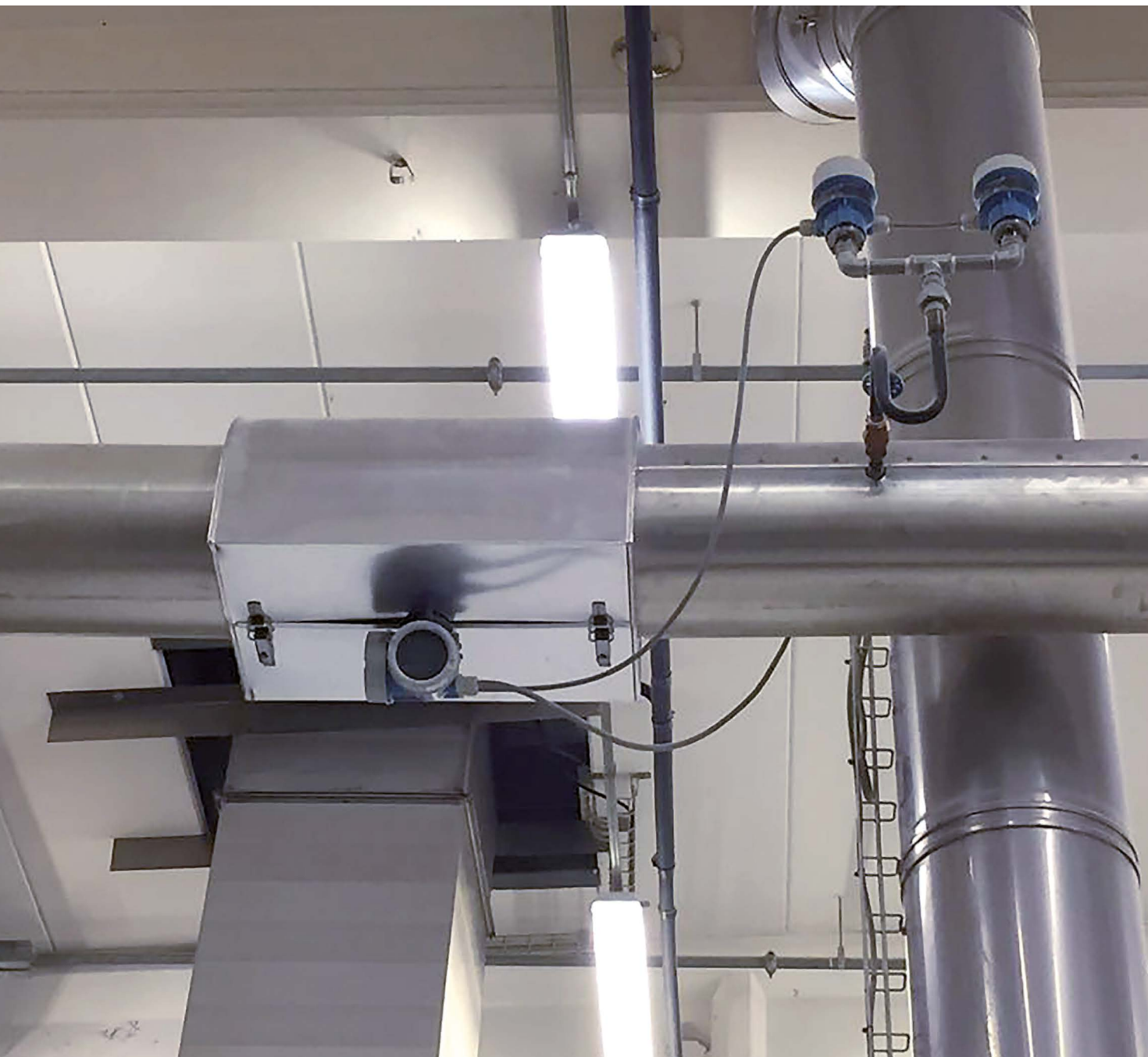
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Energy measurement accuracy is calculated via a validated simulation method which identifies and quantifies ways to improve measurement accuracy. The final report includes an independent statement whether the measuring system complies with pre-defined accuracy requirements. This statement is a key requirement for both internal and external (ISO 50001) checks. With proven accuracy for each energy measurement loop you can be confident about the accuracy of information you rely on to optimize your steam network.

If you don’t measure it, you can’t control it

- Knowledge gain concerning KPIs
- Early identification of problems to improve safety
- Best steam quality ensured to improve efficiency
- Maximum efficiency from heating equipment
- Uptime improvement
- Quality improvements for production
- Proven accuracy for steam measurements





Our technical experts will perform on-site calibrations and verifications of the field devices with minimum or no interruptions of the process.

Steam solutions available

Endress+Hauser – A full spectrum of measurement & monitoring solutions for safe, efficient and available steam.

Flow



Vortex

Vortex meters are extremely robust. These versatile devices have long been in use for measuring liquids, gases and steam in all industries. They are optionally available as multivariable devices with integrated flow computer for energy and heat metering.



Prowirl

Steam generation

- High long-term stability and repeatability
- Lifetime calibration factor
- Mass and energy measurement of wet and superheated steam by an optionally integrated flow computer and temperature sensor
- Reading in external measured values (e.g. pressure, second temperature value)
- Increased safety and efficiency thanks to wet steam detection or measurement
- Advanced verification using Heartbeat Technology™



www.endress.com/prowirlf200



Differential pressure

Thanks to the large wealth of experience, differential-pressure flow metering has been accepted and widely used for over 100 years throughout the world. Some primary elements, e.g. orifices, can be replaced or calibrated at any time under operating conditions, even in pipes with nominal diameters larger than 2 meters.



DP Flow

Steam generation

- Worldwide standards
- Long tradition in metrology, widely accepted
- Robust and application-specific designs (orifice, nozzle, Venturi, Pitot)
- Pitot tube for reduced pressure loss
- Combinable with flow computers for mass, energy and volume measurement of liquids, gases and steam; and for increased turndown (split range)
- High temperature and pressure solutions



www.endress.com/Deltatop-DO62C



Thermal

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 and liquids, this principle the measurement e.g. of natural gas or combustion air at very low rates and process pressures with high accuracy.



t-mass

Fuel combustion & exhaust

- Simultaneous measurement and output of mass flow and fluid temperature (multivariable sensor)
- Negligible pressure loss (<2 mbar)
- Large operable flow range up to 100:1
- Devices certified for hazardous areas are optionally available



www.endress.com/t-mass-65f

Flow



Coriolis

Maximum accuracy is the outstanding feature of this measuring principle for liquids and gases. Another feature is the ability to measure multiple process variables simultaneously: mass flow, volume flow, density, viscosity and temperature. This opens up new perspectives for optimizing and monitoring utilities (e.g. burner control).



Promass

Fuel combustion & exhaust

- Multivariable measurement: several process parameters are simultaneously measured
- High measuring accuracy
- Independent of the fluid's properties
- No inlet/outlet runs necessary
- Approvals for custody transfer (optional)
- Combinable with flow computers for gas and liquid energy metering
- Advanced verification using Heartbeat Technology™



www.endress.com/Promass-E300



Electromagnetic

Electromagnetic meters are used for measuring the fresh water added and in some application also for the feedwater. They offer the advantage of no pressure drop. Short inlet runs and strong measuring dynamics.



Promag

Feedwater preparation

- High degree of measuring reliability and repeatability
- Good long-term stability
- Over 2 million installed devices
- Free pipe cross-section, no pressure loss
- Very high operable flow range
- Advanced verification using Heartbeat Technology™



www.endress.com/Promag-10L



Ultrasonic

Loop-powered in-line ultrasonic flowmeter with innovative minimum inlet run parallel path design. For homogeneous conductive and non-conductive liquids.



Prosonic Flow

Feedwater preparation

- Safe design
- Energy-saving – full bore design ensures minimal pressure loss
- Easy installation and reduced installation costs – loop-powered transmitter
- Maintenance-free – no moving parts
- Safe operation – simplified access & maintenance
- Reliable and accurate data - clear text diagnostic information



www.endress.com/Prosonic-Flow-92F

Steam solutions available

Endress+Hauser – A full spectrum of measurement & monitoring solutions for safe, efficient and available steam.

Level



Guided wave radar

Guided wave radars are used for continuous measurement when it comes to high safety requirements. These devices are not affected by foam which is a potential danger for other level measurement technologies. Best practice is to install these devices in a bypass.



Levelflex

Steam generation

- Certification according EN 12952/3
- Developed per IEC 61508 SIL2/3
- Increase safety by reducing the risk of boiler shut-downs
- Increase availability by improved level control (Levelflex Bypass: no clogging of impulse piping, measurement not fooled by foam like capacitance probes in the boiler)
- End of probe measurement
- Gas phase compensation above 20bar (increased accuracy)



www.endress.com/Levelflex-FMP54



Vibronic

Point level switches using the vibronic principle are used in applications with high process temperatures up to 280°C and can be used for Safety Instrumented Systems up to SIL2, in homogeneous redundancy up to SIL3. Reliable measurement values, not affected by: changing media properties, flow, turbulences, gas bubbles, foam, vibrations or build-up.



Liquiphant

Steam generation

- With welded gas tight feed through maximum safety in the event of damaged sensor
- Large number of process connections to choose from: universal usage
- No calibration: quick, low-cost start-up
- No mechanically moving parts: no maintenance, no wear, long operating life.
- Monitoring of fork for damage: guaranteed function



www.endress.com/Liquiphant-FTL70

Pressure



Pressure

Digital pressure transmitter with capacitive, oil-free ceramic measuring cell is typically used in process applications for pressure measurement in liquids and gases. Quick Setup with adjustable measuring range allows simple commissioning, reduces costs and saves time.



Cerabar

Feedwater preparation, steam generation, fuel combustion & exhaust

- Best fit for vacuum during shut-down
- Process safety through membrane breakage detection
- Condensation resistant
- Easy menu-guided commissioning via local display, 4 to 20mA with HART, PROFIBUS PA, FOUNDATION Fieldbus
- Process pressure up to SIL2, certified to IEC 61508 and IEC 61511
- Modular concept for easy replacement of display or electronics



www.endress.com/Cerabar-PMC51

Temperature/Recorders/Components



Temperature

Temperature is an important parameter in boiler feedwater at the steam outlet and in the exhaust of the boiler. The temperature thermometer with StrongSens vibration and water hammer resistant sensor will ensure a longterm stable temperature measurement.



Omnigrad

Data Manager / Recorder

The Advanced Data manager is a flexible and powerful system for calculating and organizing process values. Thanks to its intuitive operation adapts quickly and easily to every application. The measured process values are clearly presented on the display and logged safely, limits are monitored and analyzed.



Memograph M RSG 45

Flow and Energy Computer

The Flow and Energy Computers calculate mass and energy flow of 1 – 3 applications. Each input has an individual power supply for the connected sensors and offer a lot of outputs to transfer input values and calculated process values.



RMC 621, RMS 621, RS 33

Steam generation,
fuel combustion & exhaust

- Comply with regulations by continuous checking indirect efficiency
- Increase safety (SIL StrongSens)
- Availability of SIL transmitter for thermometers ensures compliance of safety regulations
- Cost saving for the customer as frequency of sensor replacement and downtime can be reduced



www.endress.com/Omnigrad-TR10

Steam generation

- Memograph M offers additional functions like math channels for calculation of key figures and efficiency, data recording and storage
- Integrated Web server: remote access to device operation and visualization for lower maintenance costs
- Highly improved accuracy compared to compensation in customer's PLC (usage of ISO 5167 standard for real time DP flow calculation and IAPWS Standard, as opposed to use of ideal gas equation).
- Boiler efficiency can be calculated and visualized



www.endress.com/MemographM

Steam generation,
steam consumption

- Calculate and record uni or bidirectional mass flow and heat or delta heat of one application with RS 33
- Calculate uni or bidirectional mass flow, heat or delta heat for up to 3 applications (RMS 621 or RMC 621)
- Up to 8 active 4..20 mA/puls outputs and 9 transmitter power supply (RMS621 or RMC 621)
- Highly improved accuracy compared to compensation in PLC by usage of IAPWS Standard, ISO 5167 for real time DP flow calculation (RS 33, RMS 621, RMC 621) or AGA/SGERG for Natural Gas (RMC 621)



www.endress.com/rms621

Steam solutions available

To avoid serious corrosion in steam systems, boiler feedwater requires specific conditioning using different liquid analysis parameters.



Liquid Analysis



pH

Feedwater preparation

- Robust electrode with long poison diffusion path, requires low maintenance due to large, dirt-repellent PTFE ring diaphragm
- Optional salt ring for low conductivity applications such as boiler feed water and water for injection
- Maximum process safety through non-contact, inductive signal transmission
- Enables predictive maintenance due to storage of sensor and process-specific data
- Reduced operating costs thanks to minimized process downtime and extended sensor lifetime



www.endress.com/CPS11D



Conductivity

Feedwater preparation

- Reliable and accurate measuring values at medium to high conductivities
- Robust design for long durability and low maintenance
- High thermal and mechanical stability
- Logging of sensor-specific data for easy traceability and predictive maintenance
- Maximum process safety via non-contact inductive signal transmission



www.endress.com/CLS15D



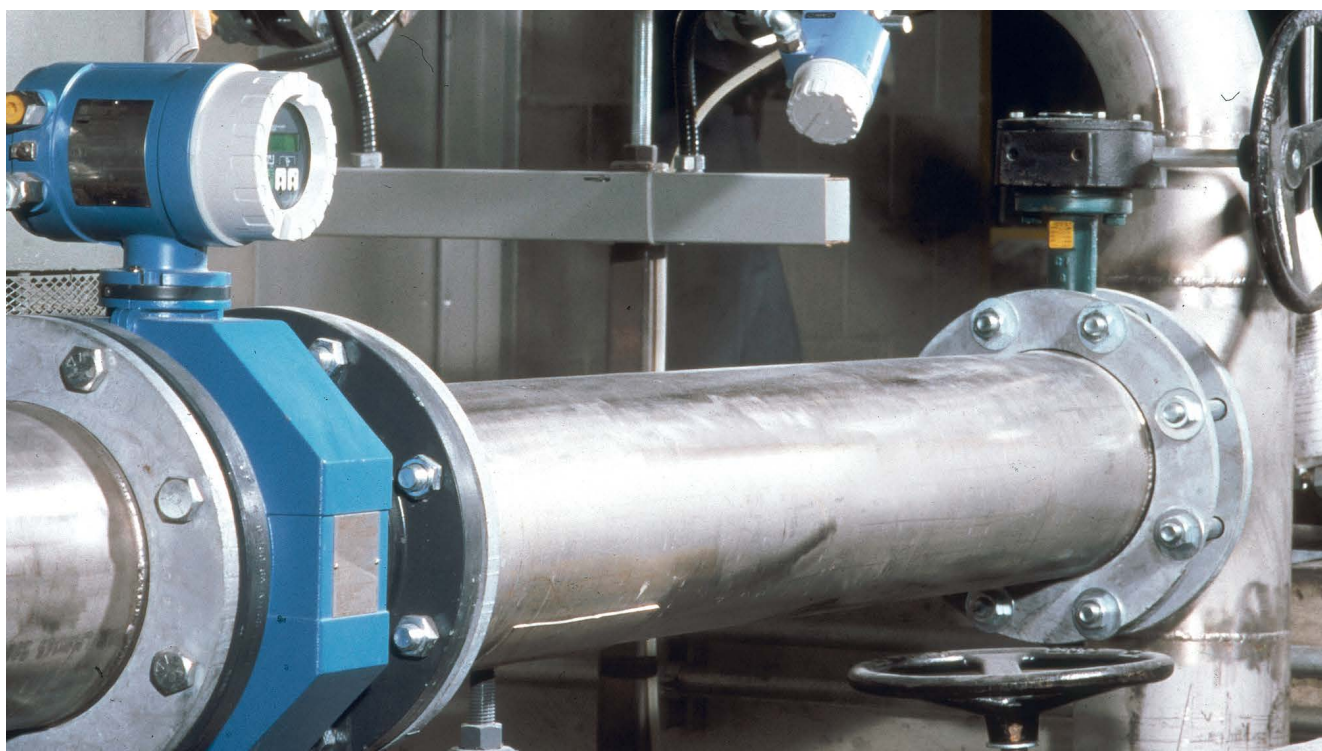
Dissolved Oxygen

Feedwater preparation

- Reliable, long-term stability and linear measurement
- Low-maintenance design
- Maximum process safety via non-contact inductive signal transmission
- Sensor with long-term stability to measure traces of dissolved oxygen



www.endress.com/COS22D



Liquid Analysis



Turbidity

Feedwater preparation

- Measuring results like in the lab: Highly accurate and reliable monitoring of your water quality – even at the lowest turbidity
- Smart verification and calibration: Absolutely safe, liquid-free, without Formazin
- Great flexibility, simple handling: One sensor for all measuring points and all installation environments (inline or immersion)
- Improved process control: Individually adaptable sensor response time
- Fast commissioning: Factory calibration and Memosens technology allow plug & play integration into your process



www.endress.com/CUS52D

Memosens

The first connection that you can truly rely on. The mechanically safe, non-contact connection between the sensor and the cable enables the technology to function safely, even under water. As all sensor-related data are stored directly in the sensor head, it is possible to perform predictive maintenance. This has been proven to reduce maintenance costs significantly and to increase sensor operating time. At the same time, process safety is increased and system downtime reduced to a minimum. And as if that wasn't enough, Memosens saves hard cash when it comes to capital costs.



Main benefits

- Non-contact, digital measured value transmission
- EMC safety guaranteed
- Easy calibration in a laboratory
- Industry leading data management
- No more incorrect values
- Memory included

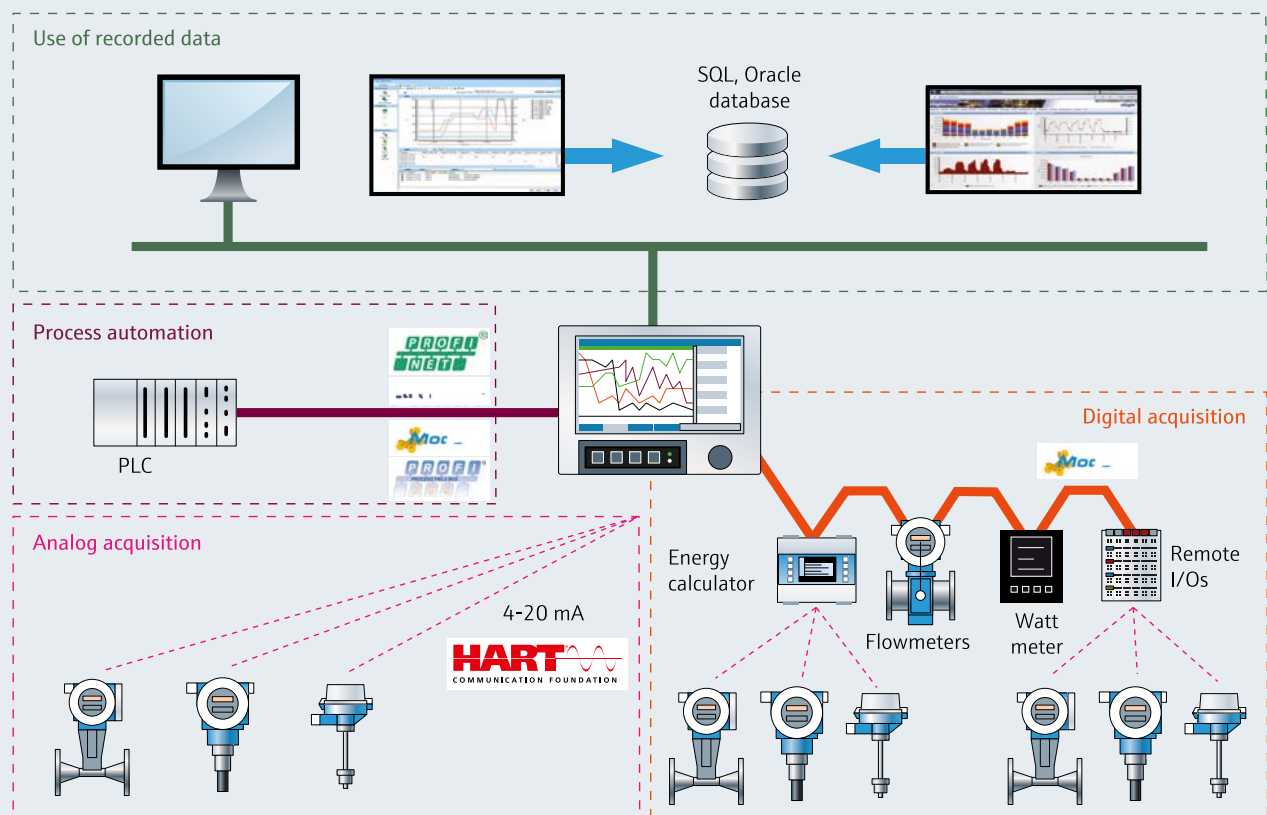
Open communication solutions

Measurements should lead to a decision making.

The ability to automatically extract and analyse data is a crucial step to long term efficiency gains and real time monitoring. The Digital Solutions Projects department boasts certified communication network experts that are able to offer advice on how to ensure an automated data project is a success.

- The values measured are sent back from the field to a Memograph M RSG 45 type recorder/calculator in a number of different ways
 - Standard Modbus type communication protocol
 - Using a purely analog method (4-20 mA)
 - Using the instrument's HART signal (multiparameter)
- Real-time transmission of data to an automated system via industrial communication protocols such as Modbus, Profibus, Ethernet IP, and Profinet
- This acquisition system also allows the process values to be shared with other remote management systems, using standardized databases such as SQL Oracle

Example of the architecture for the EPM solution: energy performance measurement



Display and recording solutions

The estimated savings generated from remote energy management solutions are between 5 and 15 %.



For a successful energy management policy, it is essential that a consumption and energy performance measuring system is put in place. Amongst other benefits, this ensures real-time monitoring of significant energy usage, display of the EnPIs and evaluation of actual energy performance in relation to a reference state.

Memograph M RSG 45 calculator/recorder: the field solution

- Real-time monitoring of consumption and performance of one or more installations
- Customized overview
- Calculation of energy and recording of data
- Option for automatic transfer to higher level systems
- Gateway for centralized maintenance of the measuring instruments.
- Integrated web server for configuration and display

eSight software suite: the solution for Energy Managers

- All energy consumption for one or more sites centralized at a single point
- Online or permanently installed software suite, multi-user access.
- The perfect solution for structuring and applying an energy policy
- A variety of tools for setting targets and objectives, editing reports, managing alarms and identifying ways to save



Real-time monitoring of significant energy usage

Service by your side

Whether you need support for an individual instrument or a managed service contract covering a combination of products, software and solutions, you can rely on Endress+Hauser.

Our global service team offers a portfolio of services to ensure optimal performance of your energy measurement systems and their underlying components. More specifically Endress+Hauser can assist you by:

- ensuring energy measurement components have been correctly commissioned and are operating optimally
- checking existing measuring devices to ensure reliable measurement results
- doing routine maintenance to ensure performance and identify potential problems
- determining your steam energy measurement system accuracy (uncertainty)
- proving steam measurement accuracy with full documentary evidence
- centralizing all service records in an easy to access repository
- developing in-house skills and know-how through on-site technical support and training
- providing optimization advice



Endress+Hauser Service


- Technical support
- Diagnostic and repair
- Engineering
- Commissioning
- Calibration
- Maintenance
- Training
- Optimization

W@M-Life Cycle Management

W@M Life Cycle Management enhances your processes with easy access to device information. Up-to-date data allows you to shorten engineering time, increase plant uptime and optimize maintenance.

Improved productivity with information at your fingertips

W@M Life Cycle Management is an open and flexible information platform with online and on-site tools. Instant access to current in-depth data shortens your plant's engineering time, speeds up procurement processes and increases plant uptime. Combined with the right services, W@M Life Cycle Management boosts productivity in every phase, from planning and initial design, engineering, procurement, installation and commissioning, to plant operation, maintenance and servicing.

 More information about W@M
www.endress.com/lifecyclemanagement

W@M Operations - data to optimize maintenance

Optimal maintenance is driven by information. Transfer your device data easily into the operation phase and enrich it with up-to-date asset information to manage your installed base.

Endress+Hauser Operations app allows easy access to up-to-date information on your equipment e.g. order code, availability, spare parts, successor products for old devices and general product information - wherever you are, whenever you need it. Simply enter the serial number or scan the data matrix code on the device to download the information.

Download the free mobile app today. The app is available for iPhone, iPad and Android. Scan the QR Code to download the Operations app from the App Store or Google Play.

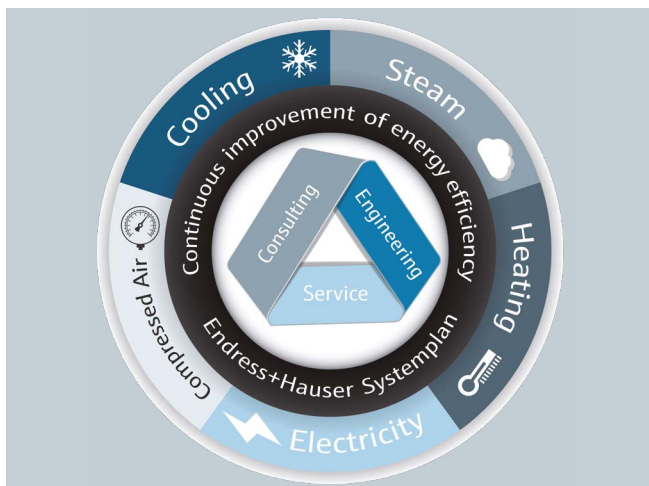


Energy consulting services

Endress+Hauser Systemplan is the engineering competence center for energy management and energy solutions within the Endress+Hauser Group. We specialize in engineering solutions for the smart use of steam, heat, electricity, compressed air and cooling in the process industry.

Our offering includes consultancy in implementing and maintaining ISO 50001 certified management systems and services to improve the energy efficiency at our customers' plants.

Here are some examples of our solutions in steam:



- **System analysis and optimization of steam generation and distribution (and also for other heat carrying media)**

Independent analysis of planned or existing installations from the boiler to the users including economizers and other equipment.

- **Performance check and comparison against state of the art equipment**

Endress+Hauser Systemplan strives for best in class solutions while also taking ecological and economical aspects into account.

- **Load analysis (peak loads and fluctuations) based on energy monitoring data**

Experienced engineers help our customers in minimizing disturbances, leading to smoother system operation.

- **Planning of new installations and re-engineering of existing ones**

Endress+Hauser Systemplan provides independent planning and engineering according to international standards.

- **Optimization of existing systems including heat storage systems and evaluation of flue gas and condensate losses**

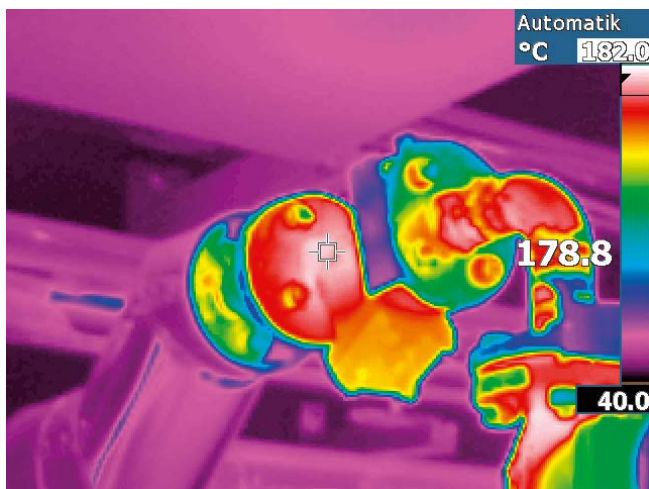
We calculate KPIs in relation to energy usage and savings which could be realized with the implementation of the proposed concepts.

- **Analysis of heat losses in pipes, armatures and flanges with or without insulation**

Endress+Hauser Systemplan determines losses using advanced methods and increases savings by improving insulation.

- **Engineering solutions to use surplus heat to provide cooling**

We analyze existing and planned systems to create concepts and execution plans to use surplus energy sources intelligently.



A global commitment to total quality steam generation, distribution & consumption

All devices manufactured by Endress+Hauser guarantee high measuring accuracy and operational safety 24/7 throughout the entire life cycle of the steam System.

We have sales and customer service centers in over 45 countries. So, whether you are based in Europe, America, Asia, Africa or Australia, we are there for you!

The extensive network of sales and production is coordinated by Endress+Hauser Management AG. The company with headquarters in Reinach, Switzerland, is the receiving point for the management reports from each company and the point from which the cross-departmental tasks and processes are standardized and coordinated. Various support centers enable the Group companies to fulfill their tasks. Endress+Hauser InfoServe in Weil am Rhein, Germany, plays a special role. InfoServe, the Group's IT specialist, runs our data processing center and concentrates unique expertise for software and computer-assisted services and solutions.



We support you by

- Providing first-class field measurement technology for all process variables (flow, analysis, level, pressure, temperature etc.)
- Planning and delivering all common control, visualization and process control systems
- Planning and advising with consultants, engineers and expert technicians on site
- Consulting, designing and engineering
- Managing national and international projects
- Installing, commissioning and configuring
- Inspecting and maintaining (maintenance contracts)
- On site calibrating of factory, controlling measurement
- Repairing services, spare parts
- Individual maintenance concepts (installed base audit)
- Training courses and qualifications
- Worldwide service





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