

Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



Solutions

Level measurement in steam boilers

As per EN 12952/12953

High level water (HW)

Low level water (LW)

Continuous level measurement (range)

Steam boilers

Steam boilers are used to create steam that has a higher steam pressure than at atmospheric conditions. The boiling temperature and energy content of the steam also increase in addition to the pressure.

There are primarily two types of steam boiler:

- Water-tube boilers
- Shell boilers

Steam boilers are found in nearly all areas of industry.

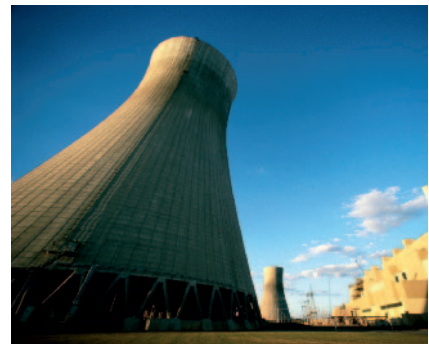
The use of steam as an energy carrier is particularly common in power stations, refineries and chemical plants. Steam boilers are also vital to the food industry, textile industry and many other industry sectors.



Refineries



Chemical plants



Power stations

Level measurement in steam boilers

Given the extreme process conditions, level measurement in steam boilers enforces strict requirements on process measuring technology.

Depending on the type of boiler used and how the boiler works, typical process parameter values can be as high as 300 °C and 100 bar, and are often significantly higher.

The density of a liquid changes with the temperature. This distorts the value returned by traditional measurement methods that depend on the density - such as displacers, float gages or differential pressure transmitters - and the value displayed is too low.

The Levelflex M FMP45 guided radar measuring system complies with IEC 61508/61511 (SIL 2) and has steam boiler approval according to EN12952/12953.

When used as a minimum limiter for low level water (LW), and as a maximum limiter for high level water (HW), the "guided radar" measurement method permits accurate and reliable point level detection in the steam boiler since it is not affected by changes in density.

Furthermore, the same instrument can be used for continuous control (water level controller) and as a visual indicator (water level indicator).



Legal framework

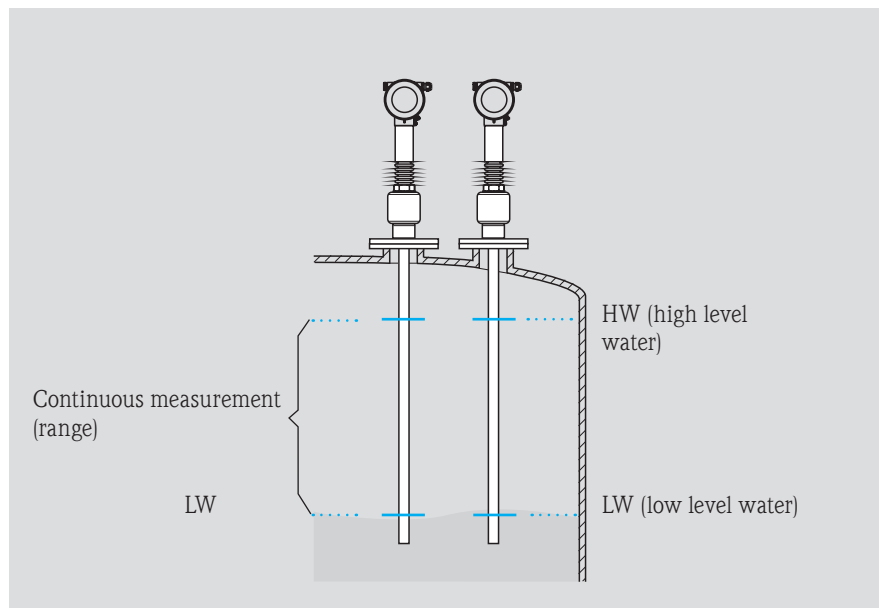
The European standards for steam boilers appeared for the first time in September 2007 and are legally binding in the European Union. The standards in question are EN12952 (for water-tube boilers) and EN12953 (for shell boilers). They replace previous standards such as TRD 604 (German Technical Regulations for Steam Boilers).

The level can be measured in steam boilers with guided radar instruments. For this purpose, Endress+Hauser obtained approval for the Levelflex M FMP45 and the RMA422 transmitter power supply unit.

The guided radar instruments can be installed as a coaxial version freely in the tank, or as a rod version installed in the stilling well or the bypass.

The limiting device must be redundant in accordance with EN12952/12953. 1oo2 architecture.
In the event of strict requirements in terms of system availability: 2oo3 architecture.

Level measurement in steam boilers is a critical measurement for plant operators in the process industry. Device failure, which results in a safety-oriented shutdown of the steam boiler, is a very costly affair. For this reason, Endress+Hauser recommends the 2oo3 architecture if instrument availability is a top priority. Please refer to the information in the center of the brochure for more details on the instrument architecture.



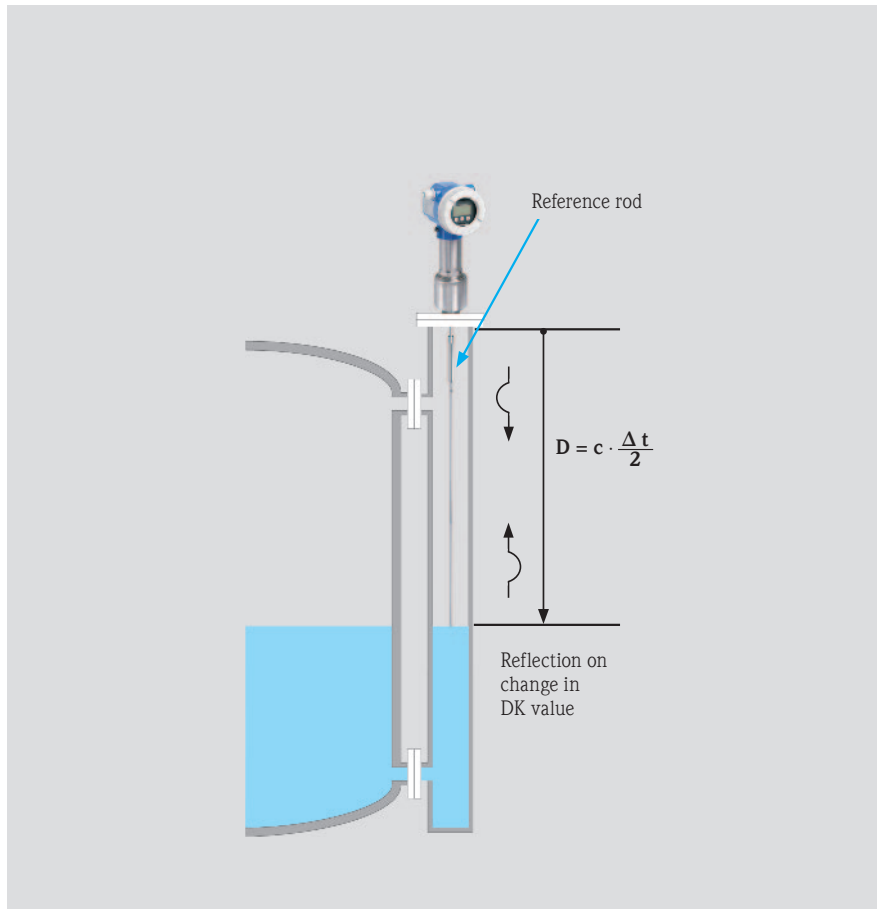
Example of a redundant steam boiler architecture with a guided radar Levelflex M FMP45 unit

Guided radar in steam boilers

Reliable, high-precision level measurement with Levelflex M FMP45

The microwave pulses are guided along the rod towards the medium surface. The change in DK (change in the dielectric constant from the atmosphere to the medium surface) causes the high-frequency microwave pulses to be reflected to the receiver. With the propagation velocity known, the level is determined from the transit time of the pulses. Due to the properties of the microwave pulses, they are practically unaffected by medium and process properties such as:

- Changes in density
- Conductivity
- Change in medium (DK value >1.4)
- Steam
- Gas overlay
- Fluctuations in temperature



Gas phase compensation

Generally speaking, the propagation speed of microwaves is not affected by temperature, pressure and gas layering. Under certain circumstances, however, the DK value of the gas phase changes significantly with polar media such as water, solutions, ammonia etc.

This physical effect reduces the propagation velocity of the microwave signals in the gas-steam mixture above the liquid to be measured. This results in the fact that the probe displays the level lower as it is.

Defined reference reflection combined with a special software algorithm automatically correct the level value measured, thereby providing correct measurement results. This ensures that an accurate and reliable measured value is provided in all gas phases even if:

- Temperature: -200 to +400 °C
- Pressure: -1 to +400 bar

The gas phase compensation function can be used for rod probes in the bypass / stilling well or for coaxial probes.

Gas phase	Temperature		Pressure							
	°C	°F	1 bar 14.5 psi	2 bar 29 psi	5 bar 72.5 psi	10 bar 145 psi	20 bar 290 psi	50 bar 725 psi	100 bar 1450 psi	200 bar 2900 psi
Steam (water vapor)	100	212	0.26 %							
	120	248	0.23 %	0.50 %						
	152	306	0.20 %	0.42 %	1.14 %					
	180	356	0.17 %	0.37 %	0.99 %	2.10 %				
	212	414	0.15 %	0.32 %	0.86 %	1.79 %	3.9 %			
	264	507	0.12 %	0.26 %	0.69 %	1.44 %	3.0 %	9.2 %		
	311	592	0.09 %	0.22 %	0.58 %	1.21 %	2.5 %	7.1 %	19.3 %	
	366	691	0.07 %	0.18 %	0.49 %	1.01 %	2.1 %	5.7 %	13.2 %	76 %

Measuring error in % caused by gas phases in steam without value correction

Gas phase compensation recommended

Typical measured errors

Comparing guided radar to conventional methods

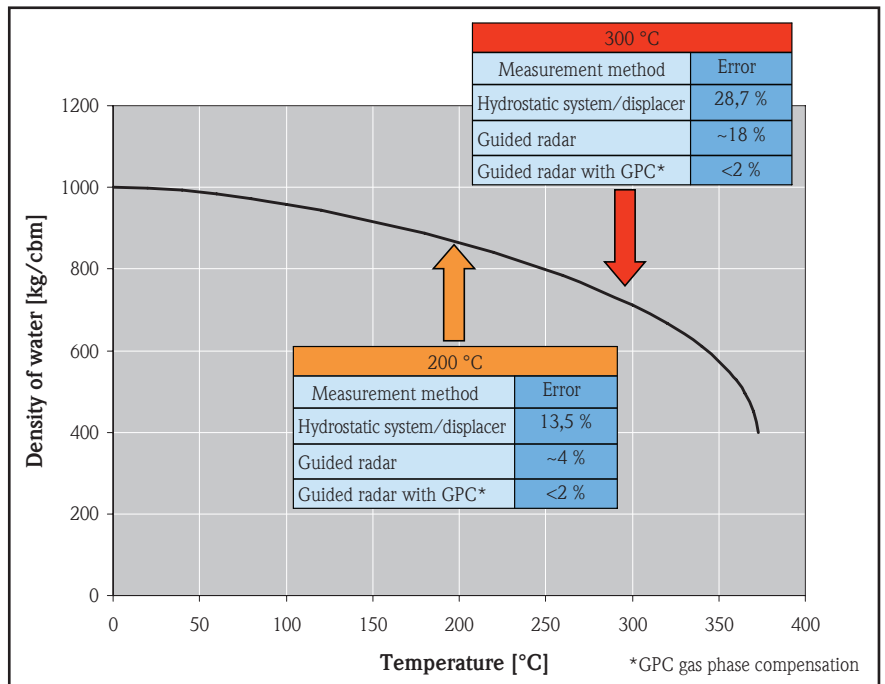
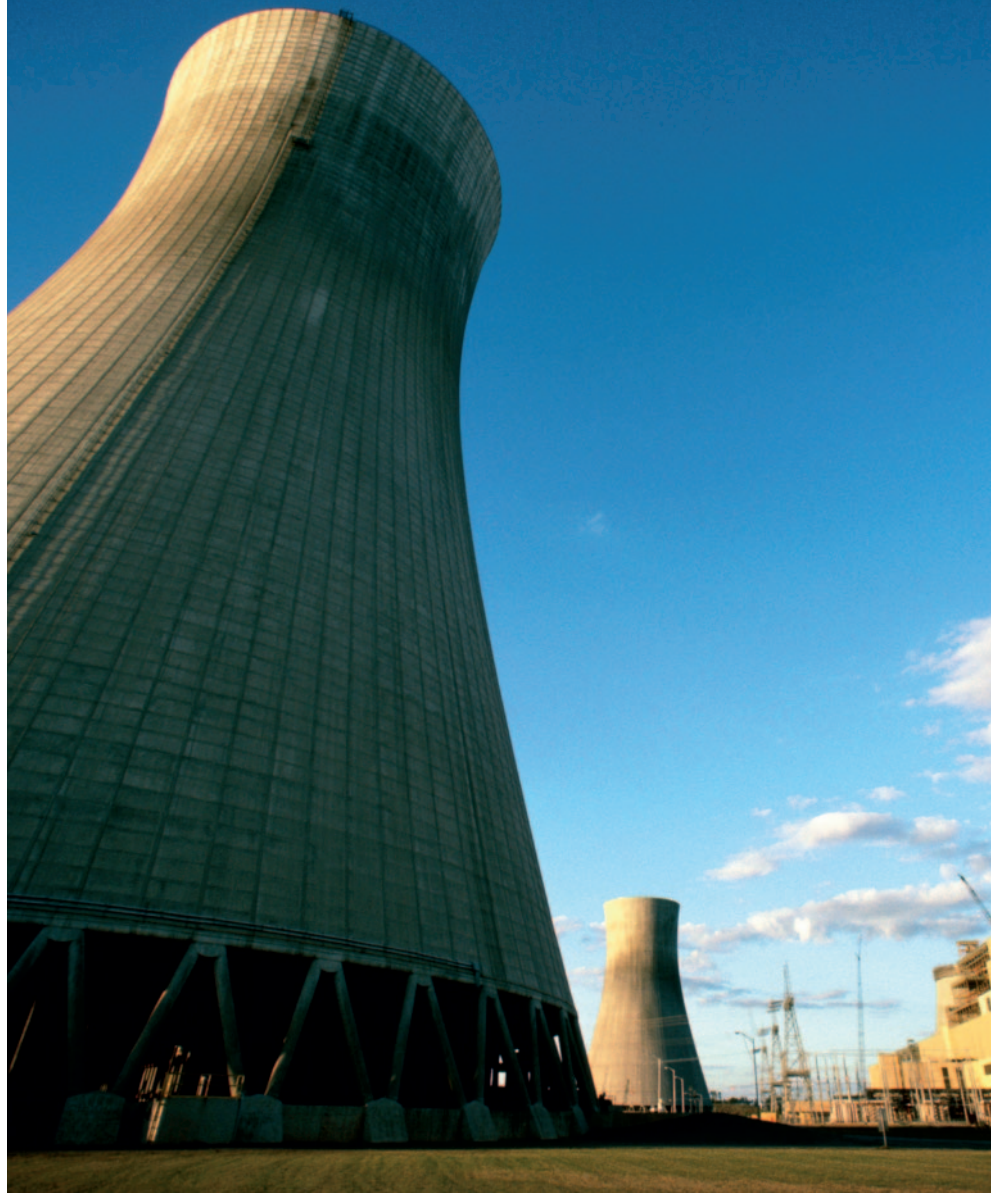
Power station boilers

Power station boilers usually operate at temperatures of approximately 300 °C. When using differential pressure transmitters or displacers, a measured error of up to 29% compared to reference operating conditions (without compensation) can occur. The error curve illustrated increases exponentially the higher the temperature in the boiler.

A guided radar system incorporating gas phase compensation (GPC) significantly reduces this error in practice, without the need for complex corrective algorithms in the control system.

Industrial boilers

Industrial boilers operate at around 200 °C. Here, the density of the water is approximately 900 g/dm³. The uncompensated measured error would be 13.5 %. In this scenario, too, the Levelflex M FMP45 returns precise measured values by using a probe with gas phase compensation. When using the gas phase compensation option, the accuracy at reference operating conditions is higher the greater the reference distance and the smaller the measuring range.



Comparison of the theoretical measured errors of displacers (hydrostatic systems) and guided radar

Steam boiler architecture as per EN12952/12953

Guided radar Levelflex M FMP45 combined with safety PLC

Example 1:

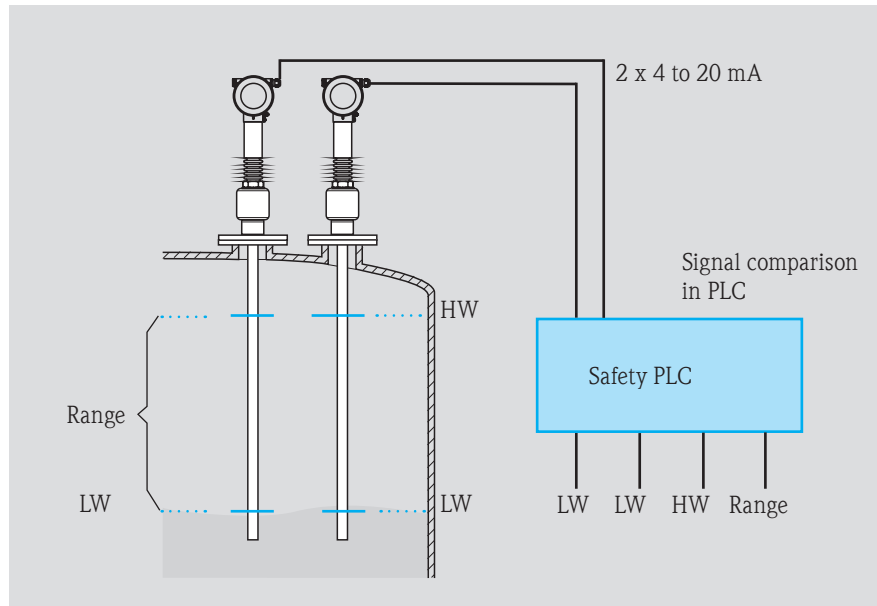
2 x FMP45 units directly connected to a safety PLC (1oo2)

The following output signals are permitted in accordance with EN 12952/12953:

- 2x LW
- 1x HW

The following output signal is available irrespective of the approval:

- 1x Range



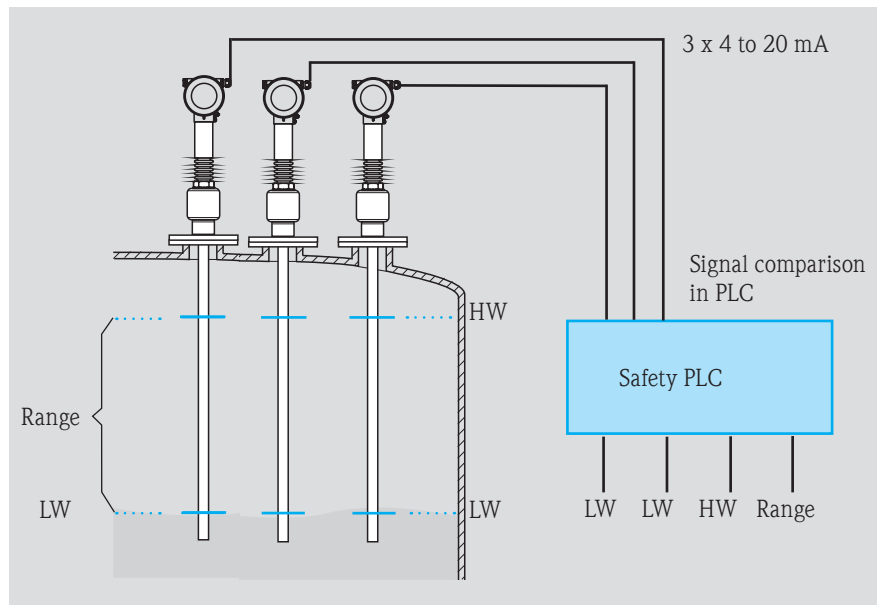
Example 2:

3 x FMP45 units directly connected to a safety PLC (2oo3)

Advantage: greater availability.

This makes it possible to replace a faulty instrument on the fly (e.g. easy shut-off capability for bypass installations). The boiler does not have to be shut down.

Alternatively, in the case of instrumentation in a boiler with 1oo2 voting, the system can continue to be operated until the next scheduled maintenance.



Steam boiler architecture as per EN12952/12953

Guided radar Levelflex M FMP45 combined with RMA422 transmitter power supply unit

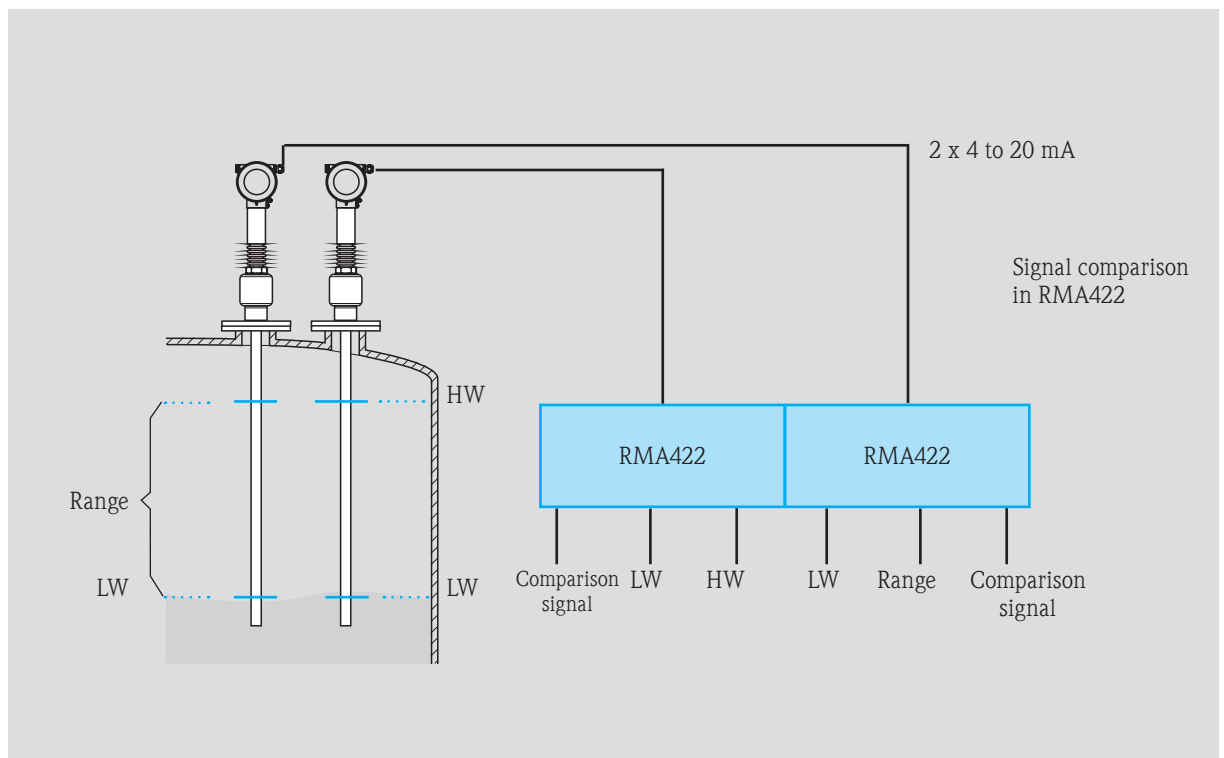
Example 3:

2 x FMP45 + 2 x RMA422 (1oo2)

The following output signals are possible:

- 2x LW
- 2x LW, 1x HW
- 2x LW, 1x Range
- 2x LW, 1x HW, 1x Range

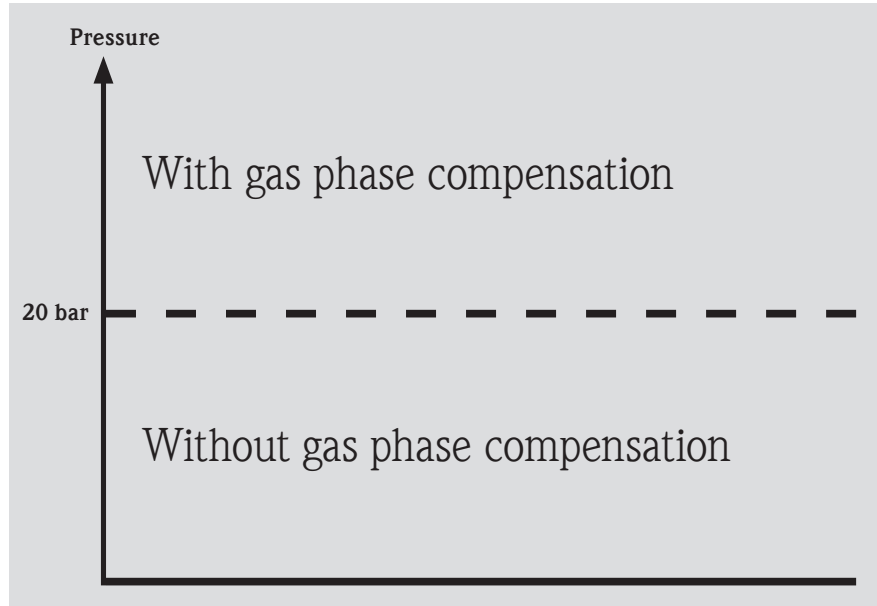
Advantage: No need for an additional safety PLC when comparing signals in the RMA422 with mutual redundancy.



The perfect fit for your application

Always the right measuring technology and correct commissioning

Endress+Hauser recommends using a guided radar instrument with gas phase compensation if the pressure in the steam boiler is greater than 20 bar.



The following information is important for commissioning:

Level measurement with LevelflexM FMP45 installed free in the tank as a coaxial probe:
No commissioning necessary since the instrument is precalibrated before it leaves the factory.

Level measurement with LevelflexM FMP45 supplied as a rod probe in the bypass complete measuring point:
No commissioning necessary since the instrument is precalibrated before it leaves the factory.

Level measurement with LevelflexM FMP45 as a rod probe:
Substitute for conventional measurement methods in bypasses or stilling wells that are already available.
Standard commissioning as explained in the Operating Instructions or with the help of Endress+Hauser Service. Note: Commissioning must be performed by Endress+Hauser Service if the pressure in the boiler is greater than 20 bar: FMP45 with gas phase compensation.

Your benefits

when performing guided radar level measurement with Levelflex M FMP45 in steam boilers compared to conventional measurement methods

- Power stations have to be flexible since renewable energy, such as wind energy, is fed into the power grid. This flexibility can only be controlled with precise measurements in the steam boiler. The FMP45 returns accurate, highly available measured values irrespective of the density, conductivity, temperature and pressure.
- The Levelflex can be adapted flexibly to changing process conditions (changes in the measuring range) without making mechanical modifications to the measuring task. This permits the optimum control and regulation of steam boilers.
- Eliminates the need for complex pressure piping installations to avoid measured errors, as well as the need for compensation curves (control system/ PLC) with conventional measurement methods, such as differential pressure transmitters or displacers.
- Four measurement requirements can be addressed with two FMP45 measuring systems: LW, LW, HW, Range
- No need to install additional stilling wells if measuring in the steam boiler. The ready-calibrated coax version of the Levelflex M FMP45 system provides the solution to this measuring task without any extra costs or the need for additional mechanical installation work.
- If measuring in bypass containers outside the tank, Endress+Hauser supplies the complete system, comprising the bypass container + measuring technology + engineering + documentation + CAD drawing. **The single-source system is ready-mounted and preconfigured for your convenience. All you have to do is attach and connect it, and you can start measuring right away.**
- The Levelflex M can be powered by either a transmitter supply unit (e.g. RMA422) or a PLC/control system since it has a standardized 4 to 20 mA analog signal.
- The Levelflex M is a very robust unit that has already proven its worth in many steam boiler applications.



Levelflex M FMP45 with stable 16 mm rod probe

All the advantages combined in one system:
Guided radar Levelflex M FMP45

Bypass complete measuring point

Benefits that do the talking!

For level measurement in the bypass, Endress+Hauser offers an optimum, time-tested solution with the guided radar instruments. This solution presents many convincing cost advantages for the customer:

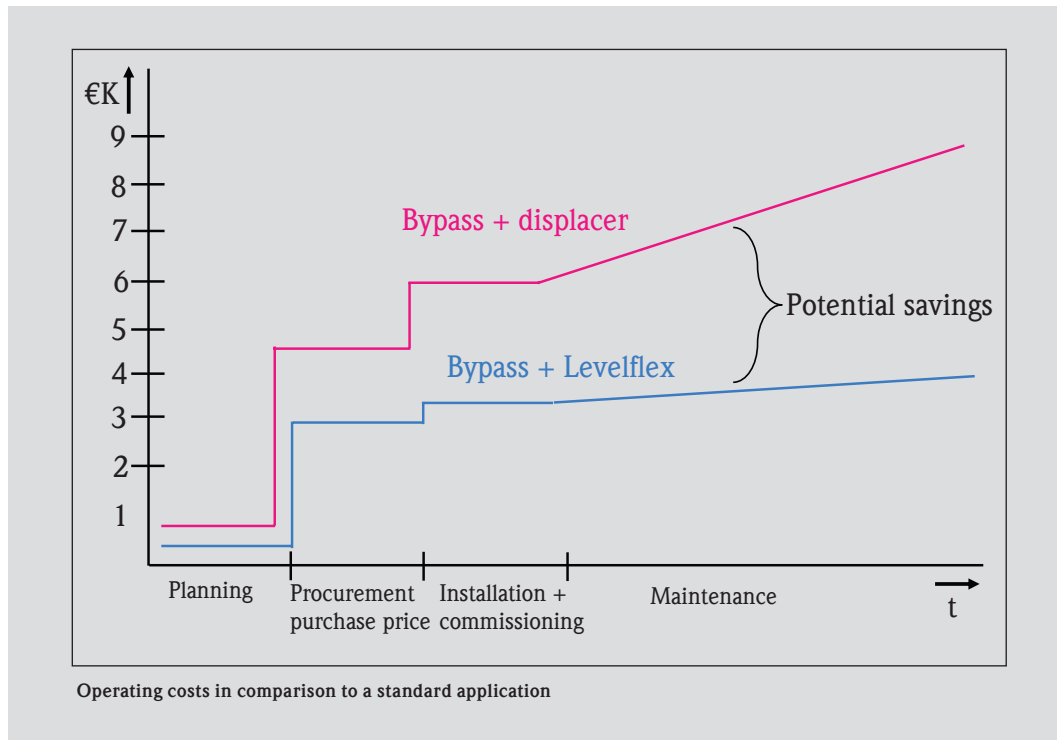
Reducing maintenance costs

The maintenance of a mechanical moving measuring instrument, like that of a displacer, is complex, time-consuming and expensive.

The Levelflex M guided radar device is practically maintenance-free since it has no mechanical moving parts, thereby reducing your plant downtime.

System availability is reduced by problems such as:

- Jamming
- Caking
- Crushed floats



Minimizing freight and mounting costs

The Levelflex M guided radar device can be pre-mounted in the bypass and pre-configured when delivered. This is not possible with displacement systems as mechanical damage cannot be ruled out during transportation – a clear advantage particularly in terms of export shipments.

Time is money

Leave the coordination of your bypass measuring point to the specialists at Endress+Hauser.

We'll take care of:

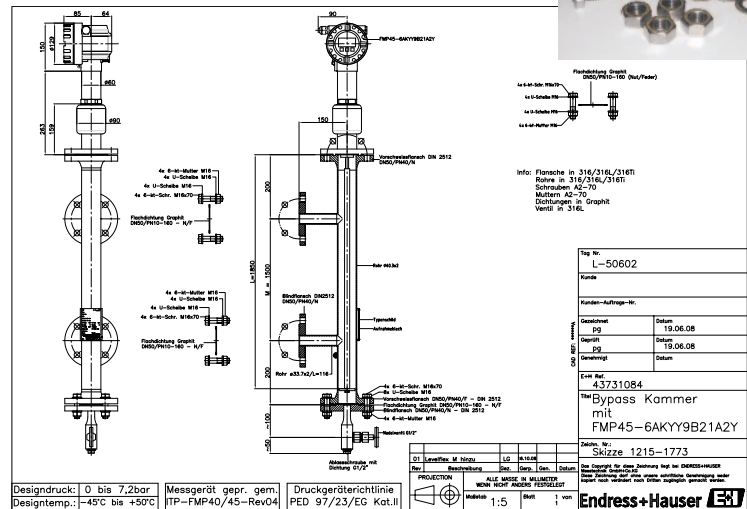
- Bypass measuring point engineering
- CAD drawings
- Procuring screws, nuts, washers, seals and bypasses
- Selecting the measuring technology (e.g. Levelflex M with or without gas phase compensation)
- Mounting, configuring and functional testing
- System calibration including reports
- Complete documentation

Services for the bypass complete measuring point



Mounting/configuration/functional testing:

- Performed for all complete systems including test certificates before delivery



Measuring point engineering:

- Selection of optimum measuring technology and calculation of threaded connectors

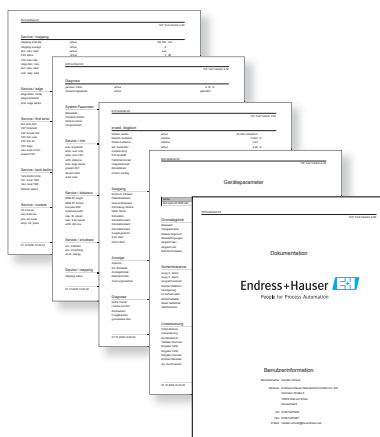
CAD drawing:

- Creation of a CAD drawing of the bypass and measuring device as per customer specifications

System calibration:

- Using water as the test medium, multipoint system calibrations are performed and logged as per customer requirements.

Detailregulierung Systemabhängigprotokoll																																											
<table border="1"> <tr> <td>Projektspezifikation</td> <td>System</td> <td>...</td> <td>...</td> </tr> <tr> <td>Profilbeschreibung</td> <td>...</td> <td>...</td> <td>...</td> </tr> <tr> <td>Einheit</td> <td>...</td> <td>...</td> <td>...</td> </tr> <tr> <td>Skizze</td> <td>...</td> <td>...</td> <td>...</td> </tr> <tr> <td>Kennzeichnung</td> <td>...</td> <td>...</td> <td>...</td> </tr> <tr> <td>Messbereich</td> <td>...</td> <td>...</td> <td>...</td> </tr> <tr> <td>Messbereich</td> <td>...</td> <td>...</td> <td>...</td> </tr> <tr> <td>Messbereich</td> <td>...</td> <td>...</td> <td>...</td> </tr> </table>												Projektspezifikation	System	Profilbeschreibung	Einheit	Skizze	Kennzeichnung	Messbereich	Messbereich	Messbereich
Projektspezifikation	System																																								
Profilbeschreibung																																								
Einheit																																								
Skizze																																								
Kennzeichnung																																								
Messbereich																																								
Messbereich																																								
Messbereich																																								
...																																
...																																



Documentation:

- Complete creation of the documentation e.g. parameter lists of the measuring devices for the complete measuring point

Commissioning in the plant:

- Performed by Endress+Hauser service technician on-site

Acceptance:

- At Endress+Hauser in the factory or on-site in the plant

Endress+Hauser – your specialist for level measurement in steam boilers

Endress+Hauser has been a reliable partner for national and international companies for many years in the area of steam boiler production and the use of steam boilers in the process industry.

Well-known industrial plant manufacturers and plant operators rely on the services Endress+Hauser offers, thereby benefiting from over fifty years' experience in the field of process automation.

Guided radar Levelflex M

The most reliable, cutting-edge technology for level measurement in steam boilers.

Comprehensive service portfolio:

Endress+Hauser's skill and expertise boosts the productivity and efficiency of plant operators and industrial plant manufacturers.

One specific point of contact over the entire project cycle optimizes the flow of information and reduces the time needed to respond to customer queries.

Cost savings thanks to process-oriented plant management.



For more information, visit:
www.de.endress.com/dampfkesselzulassung