

Non-intrusive Natural Gas Flow Measurement

Upstream – Midstream – Downstream

Production

- Gas at the Separator Outlet
- Wellhead Gas Flow Measurement
- Gas Injection & Lift
- Gas Treatment

Transportation

- Compressor Stations
- Pipeline Flow & Integrity Monitoring

Storage

- Underground Storage – Gas Injection and Withdrawal
- Gas Dehydration
- LNG Plants
- Storage Terminals
- Check Metering

Distribution

- Medium Pressure Networks
- Odoriser Stations



The superior solution

Non-intrusive ultrasonic gas flow measurement with FLUXUS® G

Accurate – Reliable – Robust – Safe

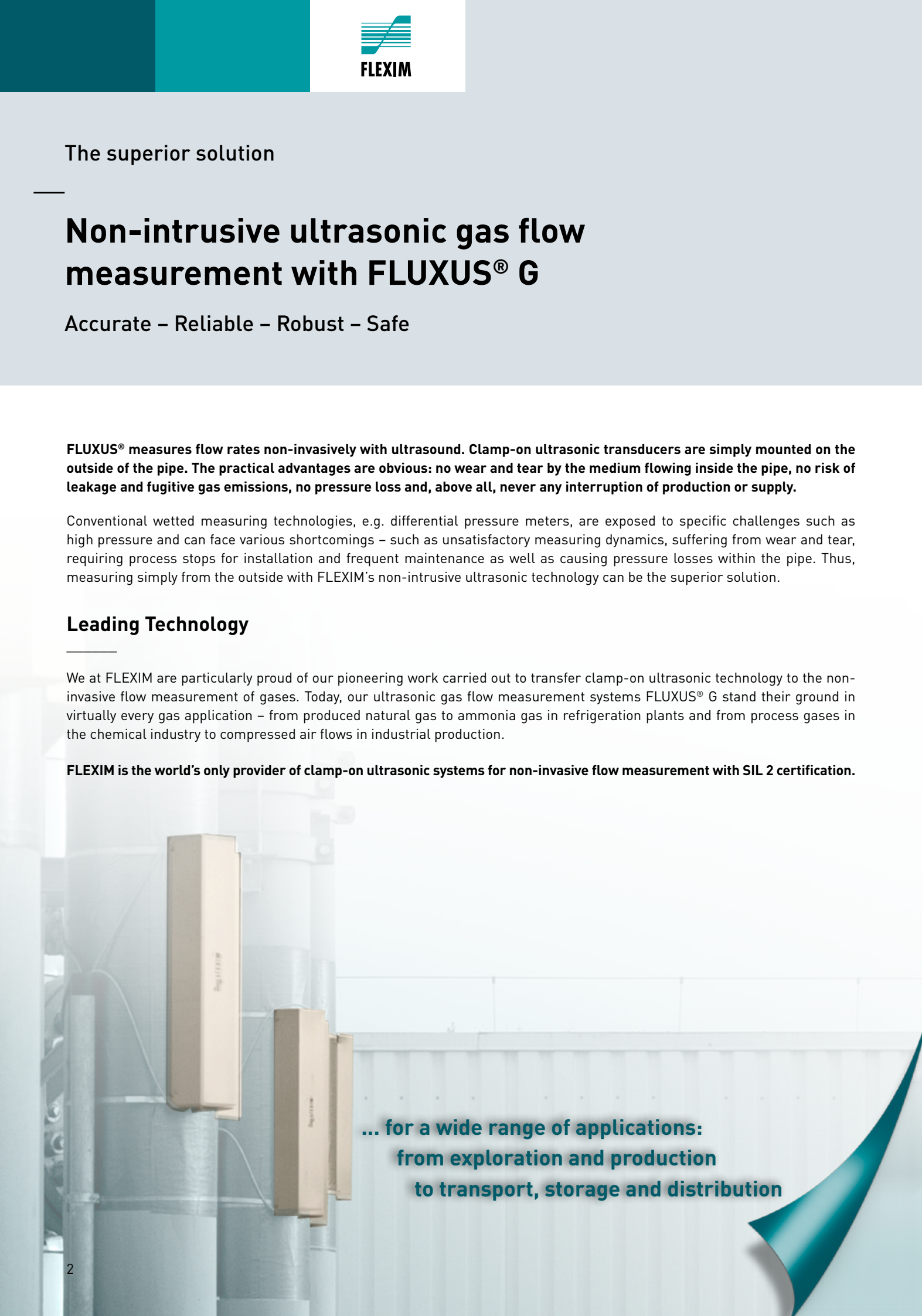
FLUXUS® measures flow rates non-invasively with ultrasound. Clamp-on ultrasonic transducers are simply mounted on the outside of the pipe. The practical advantages are obvious: no wear and tear by the medium flowing inside the pipe, no risk of leakage and fugitive gas emissions, no pressure loss and, above all, never any interruption of production or supply.

Conventional wetted measuring technologies, e.g. differential pressure meters, are exposed to specific challenges such as high pressure and can face various shortcomings – such as unsatisfactory measuring dynamics, suffering from wear and tear, requiring process stops for installation and frequent maintenance as well as causing pressure losses within the pipe. Thus, measuring simply from the outside with FLEXIM's non-intrusive ultrasonic technology can be the superior solution.

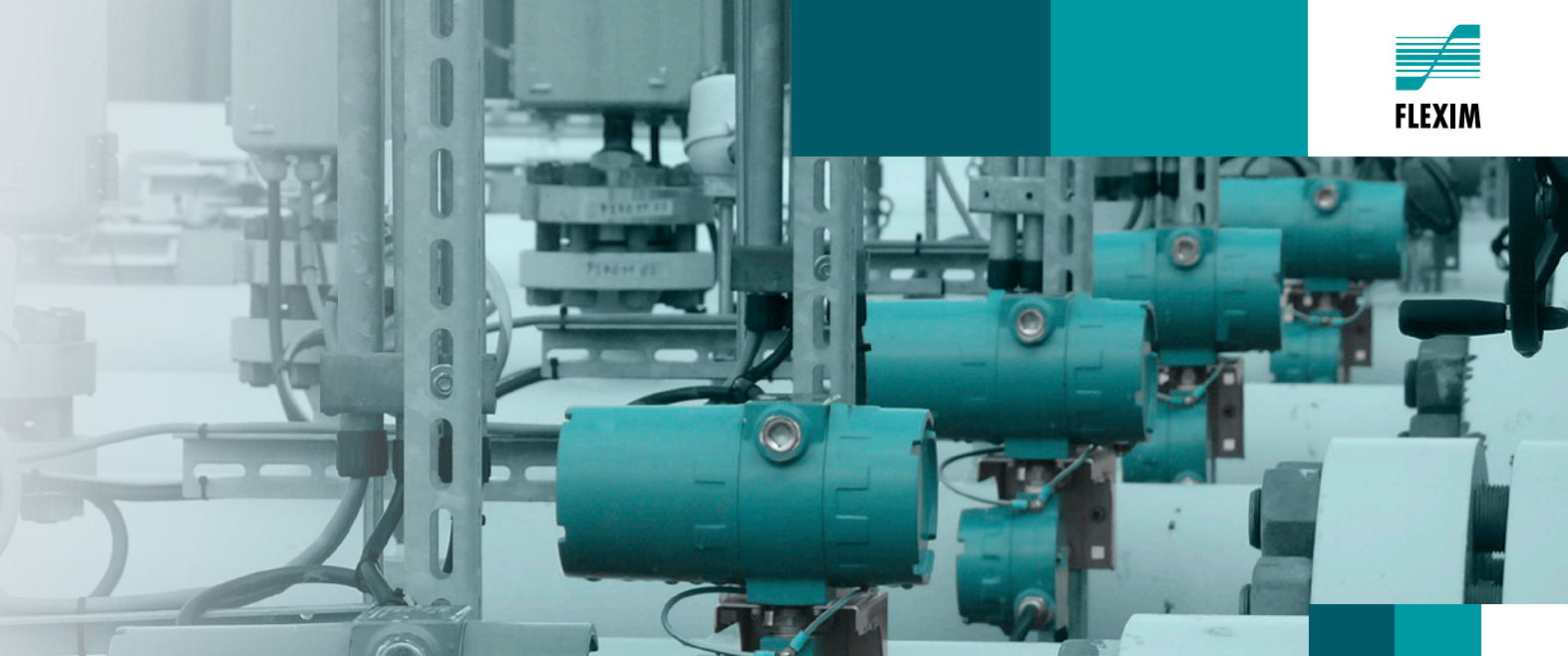
Leading Technology

We at FLEXIM are particularly proud of our pioneering work carried out to transfer clamp-on ultrasonic technology to the non-invasive flow measurement of gases. Today, our ultrasonic gas flow measurement systems FLUXUS® G stand their ground in virtually every gas application – from produced natural gas to ammonia gas in refrigeration plants and from process gases in the chemical industry to compressed air flows in industrial production.

FLEXIM is the world's only provider of clamp-on ultrasonic systems for non-invasive flow measurement with SIL 2 certification.

The background of the lower half of the page is a photograph of industrial pipes. Two orange-colored FLUXUS G ultrasonic transducers are clamped onto the pipes. The text is overlaid on the right side of this image.

**... for a wide range of applications:
from exploration and production
to transport, storage and distribution**



External Excellence and Efficiency

FLEXIM's non-invasive gas flow measurement with FLUXUS® G combines the excellent bidirectional measuring performance of wetted ultrasonic measuring systems with the advantages of clamp-on measuring technology. Measuring from the outside does not only mean measuring from the safe side. The advantages of non-invasive clamp-on gas flow measurement pay off over the entire lifecycle. As the clamp-on transducers are installed during ongoing operation, the installation costs are significantly lower than with wetted devices. The acoustic measuring equipment is not subjected to wear and tear which means it is practically maintenance-free. Internal pipeline pig inspections do not require any modification on the measuring system installed outside.

Non-invasive gas flow measurement with FLEXIM means:

- No process interruption for installation, neither for later inspections or modifications
- **Highly cost effective:**
 - minimal installation and maintenance costs
 - long life time
 - independence of line sizes
 - no need for process interruptions
- Precise flow measurement over a high measuring range, independent of the flow direction (bidirectional)
- Not subject to wear and tear – virtually maintenance-free (no need for frequent work in hazardous areas)
- No potential for leaks
- No pressure losses, no energy losses
- Highly robust and completely unaffected by solid particles in the gas flow

Unique features of the FLUXUS® G gas flow meters:

- Every measurement system is calibrated in house
- No zeroing necessary
- Integrated temperature compensation according to ANSI/ASME MFC-5.1-2011 regulations guarantee a high zero point and flow measurement stability
- Permanent transducer coupling – no maintenance needed
- Robust stainless steel transducer mountings ensure long term stability even under roughest conditions
- Stainless steel transmitters available for use offshore
- Wet gas capability up to a liquid volume fraction of 5%
- SIL 2 capable
- Portable measuring systems available for temporary measurements

Production

Wellhead Gas Flow Measurement

- Extremely robust: No wear and abrasion of the instrumentation
- No pressure losses
- No leak risk
- Huge turndown ratio and independence from pressure rating
- Ideal solution for sour gas measurements as the measurement system is not in contact with the gas
- Easy retrofitting possibilities facilitate individual wellhead monitoring for optimising production or injection rates
- Measurement system is not susceptible to fouling
- One meter satisfies both high and low pressure operating extremes

Gas at the Separator Outlet


- Consistent, repeatable and accurate gas flow measurement in demanding conditions
- No problem in measuring wet gas with high liquid volume fractions or at high pipe temperatures
- Highly robust measurement system withstanding the harshest environments, including offshore applications

Gas Injection and Gas Lift

- Gas mass flow measurement independent of pipe dimensions, material, wall thickness and internal pressurisation
- No susceptibility to abrasive wear as being installed outside the pipe wall
- High turndown ratio and broad measurement range
- No measurement drift – highly accurate and reliable
- No process interruption for installation
- Easy retrofitting possibilities for optimising injection or lift flow rates

Gas Treatment

- Accurate and reliable flow measurement independent of pressurisation and wall thickness
- Ideal measurement solution for corrosive and toxic sour gas applications as the system is never in direct contact with the gas and no expensive exotic materials of construction are necessary



Transportation

Compressor Stations

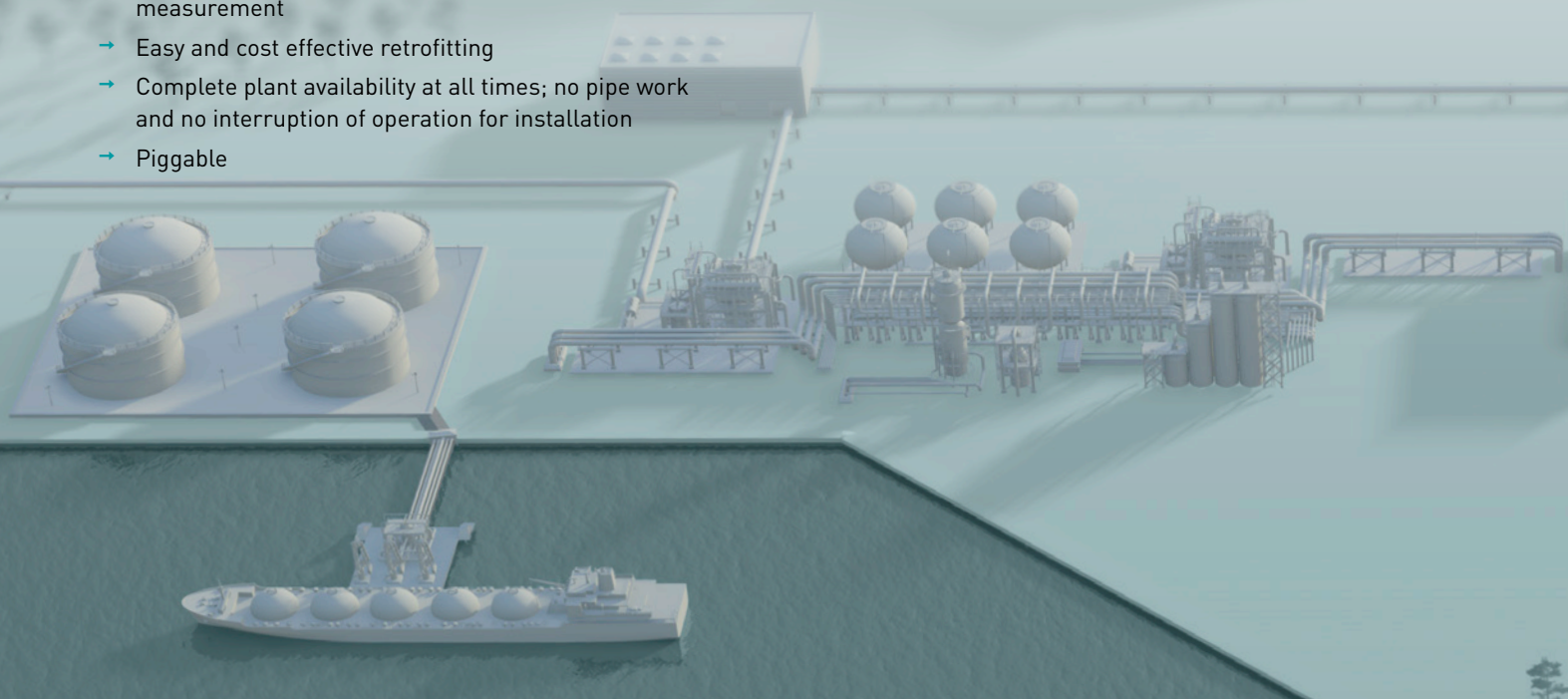
- **Highly cost effective:** much lower CAPEX in comparison to inline instrumentation
- No pressure loss, which means no reduction of efficiency
- **Highly reliable:** Maintenance-free measurement, no moving or vibrating parts, dual-beam redundant measurements
- **Maximum availability:**
 - no pipework modifications and no interruption of operation for installation
 - any failed sensor or meter can be replaced within a few hours

Flow Direction Monitoring

- Non-intrusive determination of flow direction monitoring
- Effective increase in transport network safety, no risk of leakage
- No wetted parts, no wear and tear, no maintenance required
- Maximum operational safety due to robust non-invasive measurement
- Easy and cost effective retrofitting
- Complete plant availability at all times; no pipe work and no interruption of operation for installation
- Piggable

Pipeline Flow Monitoring

- Reliable, bidirectional flow measurement at large diameter and thick walled pipes with exceptionally high measuring dynamics
- **Significant cost savings:**
 - Most types of protective coatings can remain on the pipe
 - Cathodic corrosion protection is not affected
- Commissioning without any pipe work and without any pipeline downtime
- No mechanically moving parts, no additional costs for high pressure levels or large nominal widths, no pressure loss
- Piggable
- Long standing experience with IP68 buried solutions





Storage

Underground Gas Storage – Gas Injection and Withdrawal

- Accurate and reliable flow metering at highly pressurised and thick walled steel pipes (up to 35 mm)
- Reliable bidirectional flow measurement over a wide turndown range
- Measurement not affected by high moisture content – absolutely wear resistant, little maintenance work required
- Long-term stability, no calibration intervals required

Gas Dehydration

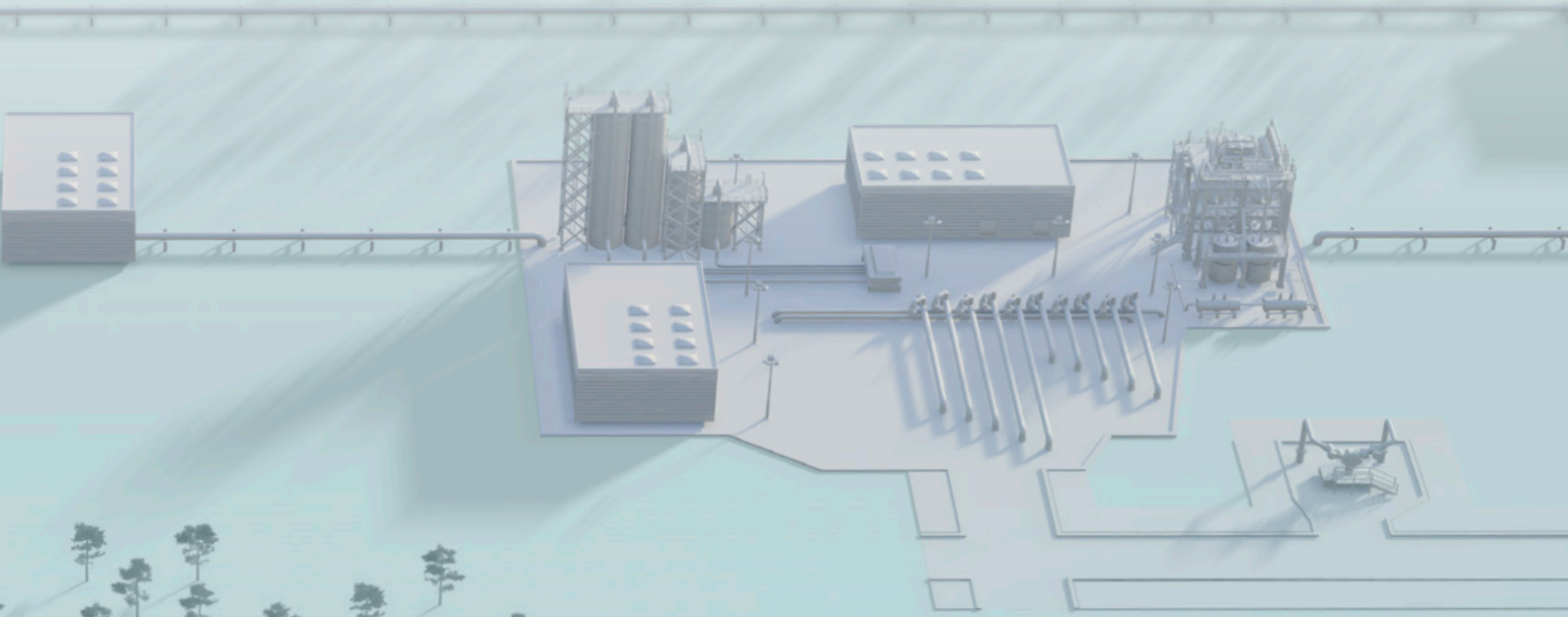
- Consistent, repeatable and accurate gas flow measurement in demanding conditions
- No problem in measuring wet gas with high liquid volume fractions
- Efficient dehydration processes by online flow and concentration measurement of the circulated glycol

Check Metering

- Highly accurate flow measurement redundancy to avoid line downtimes in case a custody transfer meter is temporarily taken out of service for recalibration
- Increase in reliability, meter confidence and plant availability

LNG Terminals

- Reliable non-invasive flow measurement even under extreme conditions (-163 °C) without pressure drops
- **Highly economical:** No extra costs due to special materials, no pipework, one man installation without lifting gear
- Safe equipment due to the non-invasive technology – no gaskets, no leakage points
- Further information can be found in the FLUXUS® Cryo Brochure



Distribution

Medium Pressure Networks

- Simple installation without interruption of the gas supply
- Subsurface, IP68 buried installation possible without any problem. Thus no need for expensive manhole structures
- No mechanical wear or tear of the flow meter
- No leakage risk through the measuring system

Odoriser Stations

- Measurement from the pipe wall outside – no more maintenance issues
- **Constant availability:** no pipework necessary for the installation of the ultrasonic flow measurement system or for maintenance
- Ideal for odoriser dosing measurements at extremely low flow rates (below the range of invasive measuring technologies)
- Standard volume flow rates calculation within the meter (optional)

Related Applications & Flow Surveys

FLEXIM's FLUXUS® non-invasive flow meters cover a wide application range. Our permanent and portable solutions also measure a variety of other liquid and gaseous media such as:

- Liquid Hydrocarbon Products (flow and media detection)
- Brine during leaching processes
- Compressed air
- Nitrogen, etc.

Go for gas!

FLEXIM's FLUXUS® G608 goes where other measuring devices can't. It is the only all purpose portable clamp-on ultrasonic system for flow measurement of gases as well as liquids on the market. Furthermore, it is the only portable clamp-on ultrasonic flow measurement system certified for use in hazardous areas (ATEX, IECEx Zone 2 and FM Class I, Div. 2).



Laboratory Accuracy under Field Conditions

High accuracy and proven laboratory performance under reference conditions is one task. Accuracy under field conditions is quite another thing:

- FLEXIM's transducers automatically compensate for ambient temperature changes – according to ANSI/ASME MFC-5.1-2011. This prevents false measurement readings during temperature swings (day/night).
- FLEXIM's transducers are carefully paired according to their individual properties. This process lays the foundation for superior accuracies over a wide temperature and application range. It also ensures a negligible zero offset and facilitates the measurement of very low flow rates. There is no need for zeroing, or programmed "automatic zero" workarounds.
- FLEXIM's transducers are all individually factory calibrated, with storage of the calibration data on a "Sensprom" chip. The calibrated transmitter automatically reads the individual calibration data, avoiding potential errors and making transducer exchanges easy.
- FLEXIM calibrates pairs of transducers and measuring transmitters independently of one another so that the narrowly defined measurement uncertainties are always observed, regardless of which transducers are used with which transmitter.

For FLEXIM, accuracy is a topic we take very seriously. FLEXIM's specified installed accuracy claims can seem conservative but we firmly believe that clients expect us to overperform rather than disappoint.

Ask us, if you want to learn more about the total measurement uncertainty for your specific application.

Technical facts

Temperature ranges:	-40 °C to +80 °C (for liquefied gases down to -200 °C)
Flow velocity:	0.01 to 35 m/s
Repeatability:	0.15% of reading, ± 0.01 m/s
Accuracy: (if field calibrated):	$\pm 1\% \dots 3\%$ of reading, ± 0.01 m/s (application dependent) $\pm 0.5\%$ of reading, ± 0.01 m/s (liquids and gases)
Pipe sizes (OD):	7 mm to 1600 mm
Protection degree: Hazardous area approvals:	IP65/IP66; Transducers up to IP68 ATEX, IECEx Zone 1 and 2, FM Class I, Div. 1 / 2
Pressurisation:	> 3 bar for gases in steel pipes; plastic pipes no limitation
Communication Protocols:	HART, Modbus RTU, Foundation Fieldbus, Profibus PA, RS485
Quantities of measurement:	Actual and normalized gas volume flow rates, mass flow, flow velocity,

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