

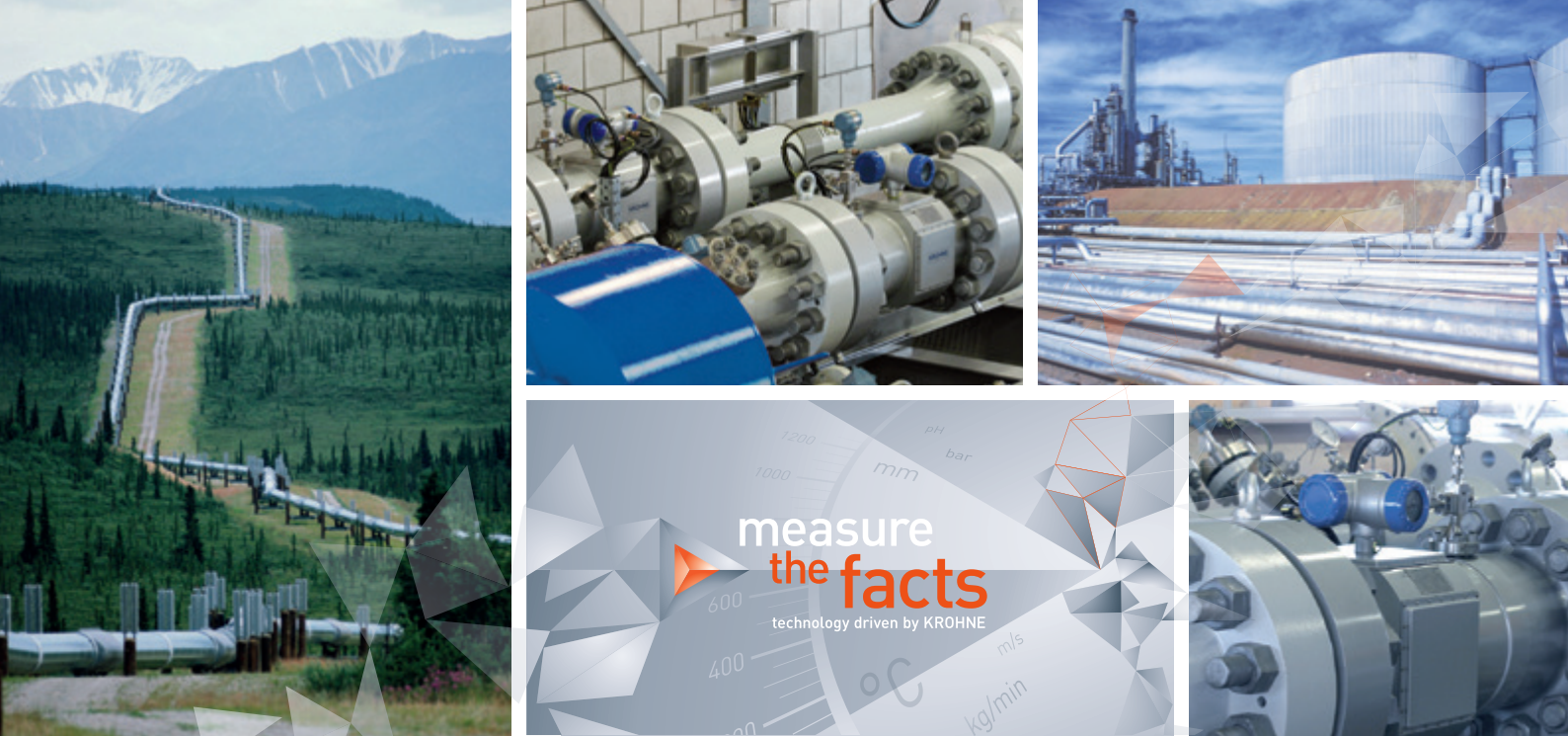
▶ ALTOSONIC V12

Ultrasonic gas flowmeter for custody transfer



KROHNE
Oil & Gas

- 12-path ultrasonic gas flowmeter for custody transfer (OIML R137 class 0.5)
- Complete product series for widest application range
- Swirl immunity and minimal straight inlet due to swirl compensation in each measuring plane
- Dedicated diagnostic path for deposits, dirt or changes in surface roughness
- KROHNE Care: web-based, extended diagnostics system for continuous meter health check



KROHNE – Measure the facts

Welcome to KROHNE. As a leader in process measuring technology, we are comfortable working in a wide variety of industries worldwide. The name KROHNE has stood for **innovative and reliable solutions since 1921**. The company now offers a whole spectrum of field instruments for **flow, level, temperature and pressure measurement as well as process analysis**. Our portfolio is completed by comprehensive services and consulting.

Over the past twenty years **ultrasonic gas flowmeters** have become one of the leading technologies for **custody transfer and allocation measurement of natural gas**. Ultrasonic meters offer a number of benefits as they combine a low pressure drop and no moving parts with high accuracy and repeatability and extensive diagnostics. The **ALTOSONIC V12** is designed to achieve a superior performance even under the toughest conditions in the field.

ALTOSONIC V12 – Better by design

Since the introduction of **the world's first 12-chord meter**, the ALTOSONIC V12 has become new industry standard. The flowmeter was the first to achieve the OIML R137 Class 0.5 requirements. The unique combination of the path configuration and diagnostic features makes the ALTOSONIC V12 the compelling choice for long-term accurate, stable and reliable measurement.

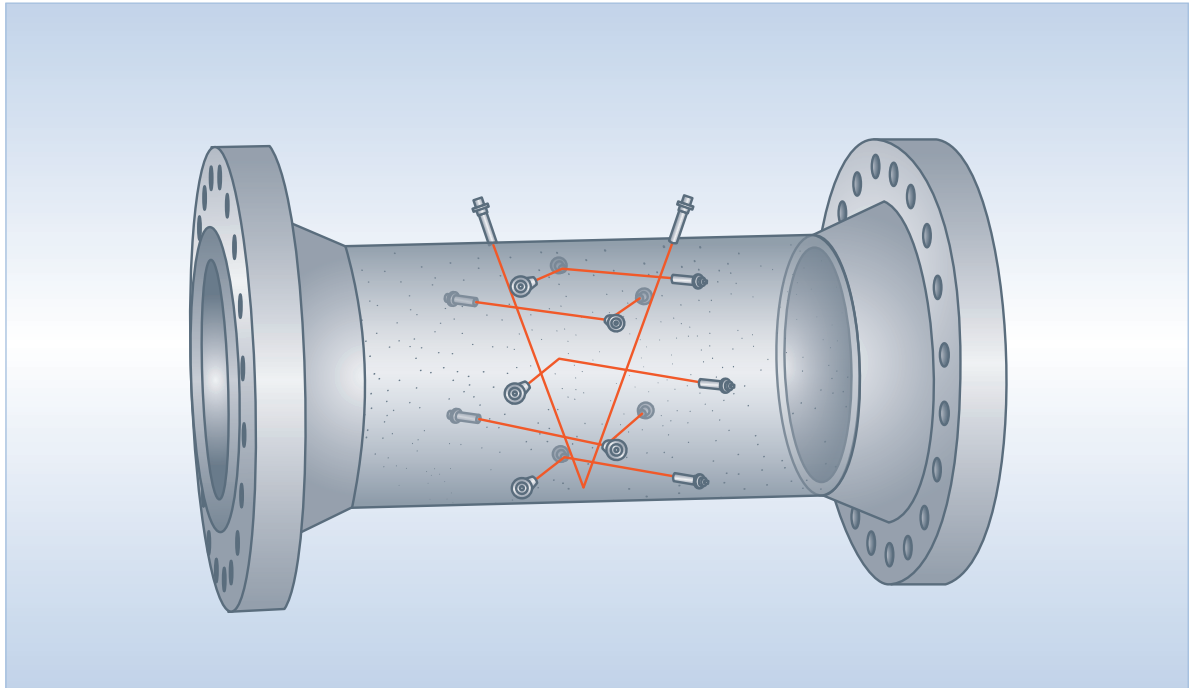
The **ultrasonic gas flowmeter ALTOSONIC V12** has low ownership cost, a small footprint and reduces the risk of contaminating the internal surface. This maintain a reliable measurement and high accuracy in the field.



Typical applications:

- Natural gas transmission pipeline
- Metering & regulation stations
- Liquefaction and regasification
- Border stations
- Underground gas storage
- On- and offshore exploration

ALTOSONIC V12 – The Power of Reflection



12-chords with a single reflection

ALTOSONIC V12 measures the flow in the meter using **10 horizontal ultrasonic measuring chords**. In addition the meter has **2 vertical chords to detect bottom fouling**. The chords are arranged in pairs joined by a single reflection, creating a reflecting path.

The single reflection makes the ALTOSONIC V12 immune to swirl and cross flows caused by installation conditions. Pipe wall contamination can also be detected by reflection paths, while Automatic Gain Correction (AGC) ensures that flow measurement continues without interruption.

The ultrasonic paths have a unique positioning in **5 measuring planes**, close to the wall as well as across the exact centre of the tube. This makes the meter immune to changing process conditions and flow profile distortions and extremely robust to changing Reynolds numbers.

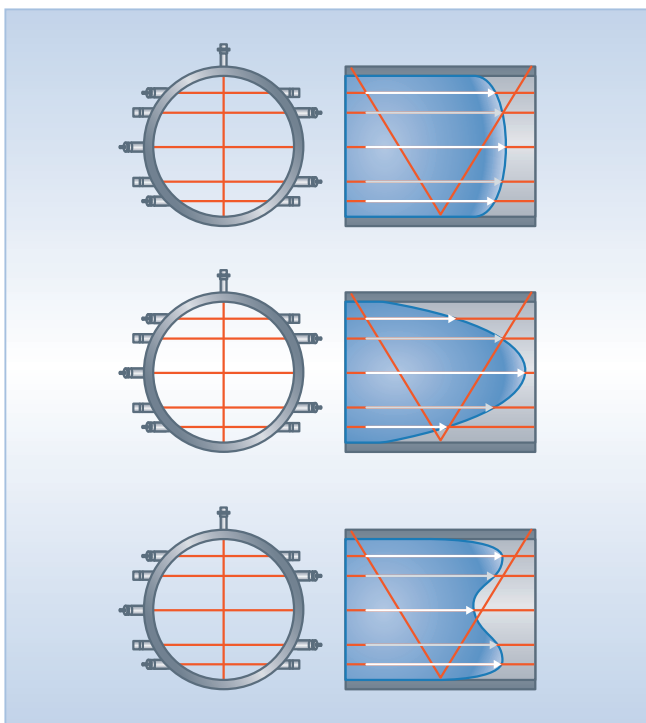
The insensitivity to swirl permits a much shorter inlet length. Whereas conventional meters need 10D and a flow conditioner, an ALTOSONIC V12 needs only half this length.

Dynamic chord substitution

In the rare case of a transducer failure, ALTOSONIC V12 uses dynamic chord substitution. If a chord ever fails, the previously stored velocity ratios between the different chords will be used to **calculate the exact velocity at the position of the failed path**. This functionality ensures that the ALTOSONIC V12 will still **operate within CT limits**.

Flow measurement in five horizontal planes

Compared to a traditional 4-path configuration, a fifth measurement plane through the centre was added to improve the sensitivity in distorted flow profiles. A single reflection in each plane makes ALTOSONIC V12 virtually **immune to swirl and cross-flows**, ensuring short upstream requirements.



Immediate detection of contamination

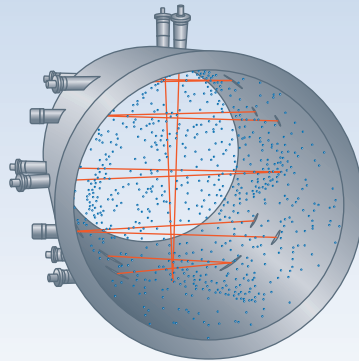
New flowmeters provide excellent accuracies during their initial calibration. The installation conditions during calibration are ideal while the inside of a new meter is free from any contamination.

Once installed in the field, the contamination inside the meter body will affect the meter's accuracy. The reflective technology **detects even small amounts of contamination** on the pipe wall that would remain completely hidden in a direct path design. As the measuring planes become longer, even better accuracies can be achieved. **Significant savings in operation** is the result.

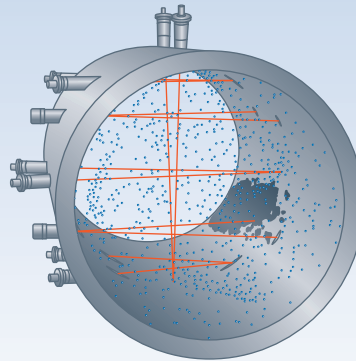
KROHNE now taps into the parameters intrinsic to an ultrasonic flowmeter. The **unique reflective path design** of KROHNE offers even more information compared to traditional ultrasonic flowmeters. Over 1200 parameters are monitored to make sure that the flowmeter will continuously maintain a reliable measurement signal.

Such parameters include the velocity of sound in the gas, Signal to Noise Ratio (SNR), Automatic Gain Control (AGC) and flow profile ratios. Additionally the complete history and trending over a period of up to 10 years in the meter itself, and data downloaded throughout its life, is available. No other meter tells you more.

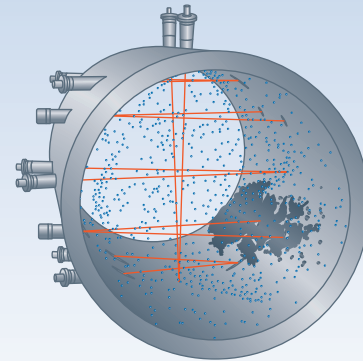
Detection of local fouling, corrosion and pollution long before the measurement is affected due to a single reflection in plane



Normal Warning Alarm

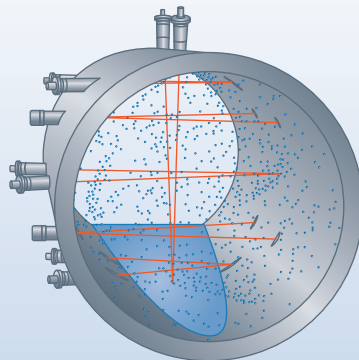


Normal Warning Alarm



Normal Warning Alarm

Detection of bottom fouling due to a fully dedicated ultrasonic chord



Normal Warning Alarm

ALTOSONIC V12 is the first meter to offer an ultrasonic chord that is fully dedicated to bottom fouling detection. More traditional meters can find major blockages, such as a blocked hole in the flow conditioner. The vertical diagnostics chord allows ALTOSONIC V12 to detect very thin layers of contamination at the bottom of the meter.

The ALTOSONIC V12 family – The right meter for every application



ALTOSONIC V12

12-chord ultrasonic flowmeter designed to offer the highest possible measurement accuracy of natural gas



ALTOSONIC V12 Direct

Direct path configuration to enable flow measurement of natural gas with extremely high concentrations of CO₂



ALTOSONIC V12 Check

Pay & Check meter: Second flow converter using the vertical path for an additional integrated check measurement



ALTOSONIC V12 Twin

Two flowmeters combined with two independent custody transfer measurements within one installation, no additional spool sections or flow conditioners needed

High accuracy in the field

The benefits of OIML R137 Class 0.5

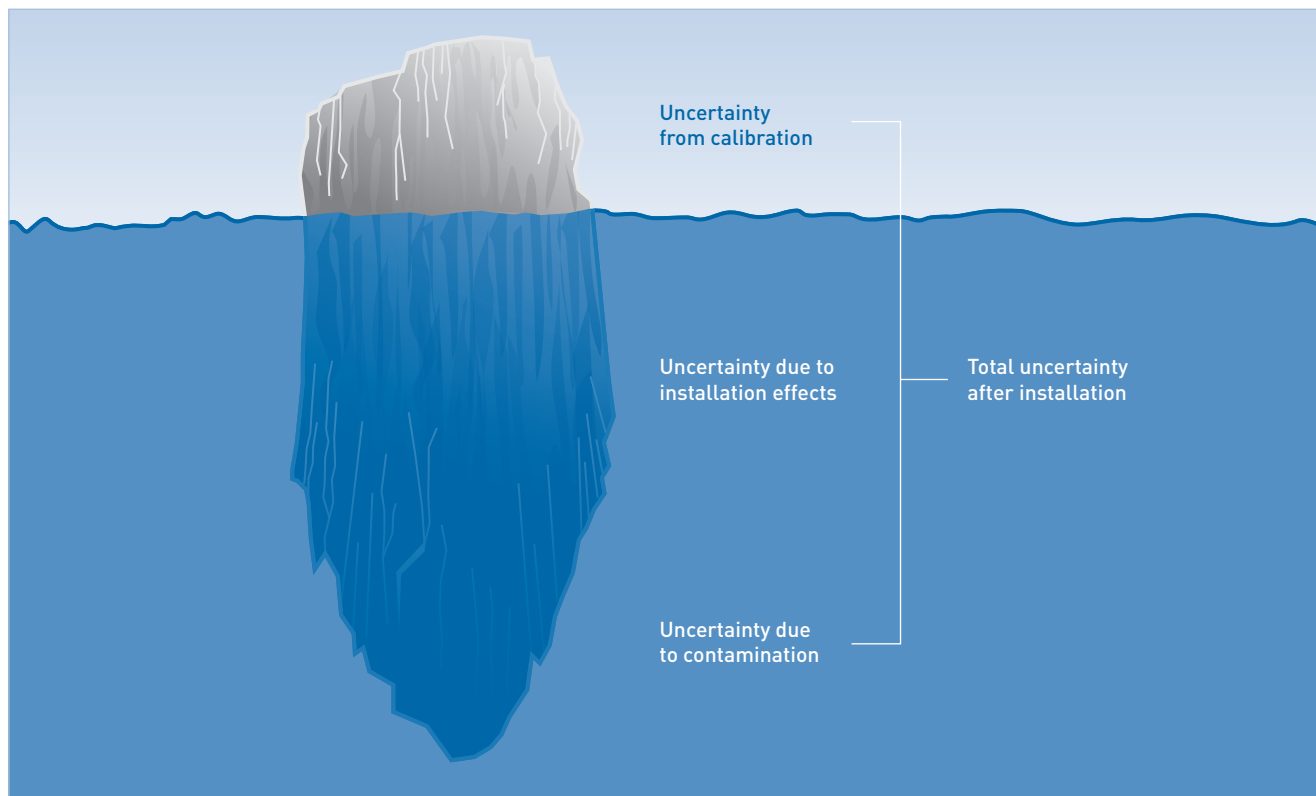
Traditional ultrasonic gas flowmeters are typically custody transfer approved according to AGA 9, ISO 17089 or OIML R137 Class 1. The ALTOSONIC V12 is the first ultrasonic gas flowmeter ever that has been **approved to OIML R137 class 0.5, for both low and high perturbation**. The main difference with certified meters is the improved immunity to installation effects such as swirls and distorted flow profiles.

Ultrasonic gas flowmeters for custody transfer will typically achieve $\pm 0.2\%$ accuracy during high pressure calibration, or even $\pm 0.1\%$ after linearisation of the measurement result. This does not mean however that your accuracy in the field will be $\pm 0.1\%$.

Additional uncertainty due to installation effect

Once a flowmeter is installed in the field, installation effects will cause an additional measurement uncertainty. The maximum allowed additional uncertainty is different for each standard.

	OIML R 137 Class 1.0	AGA 9 ISO 17089	OIML R 137 Class 0.5
A Typical uncertainty after linearisation	$\pm 0.1\%$	$\pm 0.1\%$	$\pm 0.1\%$
B Allowed additional uncertainty due to installation effects	$\pm 0.33\%$	$\pm 0.30\%$	$\pm 0.17\%$
C Flowmeter uncertainty after installation $\sqrt{A^2+B^2}$ excluding effects of possible contamination inside the meter	$\pm 0.34\%$	$\pm 0.32\%$	$\pm 0.20\%$



More than just the tip of the iceberg

Like an iceberg, the main dangers to good metering lie below the surface. Calibration is carried out under ideal conditions which are different from the actual conditions in the field.

After installation in the field the measurement accuracy will be affected by installation effects and contamination inside the meter; neither of these aspects are present during calibration.

ALTOSONIC V12 is designed to be virtually **immune to installation effects** and can show contamination having a thickness of less than a credit card.

Therefore ALTOSONIC V12 can accurately **transfer the quality of the calibration into the field**. The user is thereby assured of extremely low uncertainty in real life situations.

Diagnostic packages

The ALTOSONIC V12 uses diagnostics for performance monitoring. The meter has **two possible diagnostic packages**. The basic system is included as standard.

	Basic system: Condition-based Monitoring	Expert system: KROHNE Care
Velocity of sound comparison per path	•	•
Signal acceptance check per path	•	•
AGC (Automatic Gain Control) check per path	•	•
SNR (Signal to Noise Ratio) per path	•	•
In plane swirl compensation by reflection	•	•
Dedicated path for bottom-fouling detection	•	•
Visualisation of flow profile	•	•
Simple traffic-light structure to indicate meter's health	•	•
Remote access, web-based user interface		•
24/7 monitoring of measurement integrity		•
Easy to print report with overall health indication		•
Interpretation of cause of alarm		•
Storage of data for 10 years in auditable format		•
Automatic trending and tuning of diagnostics parameters		•
Predictive maintenance		•

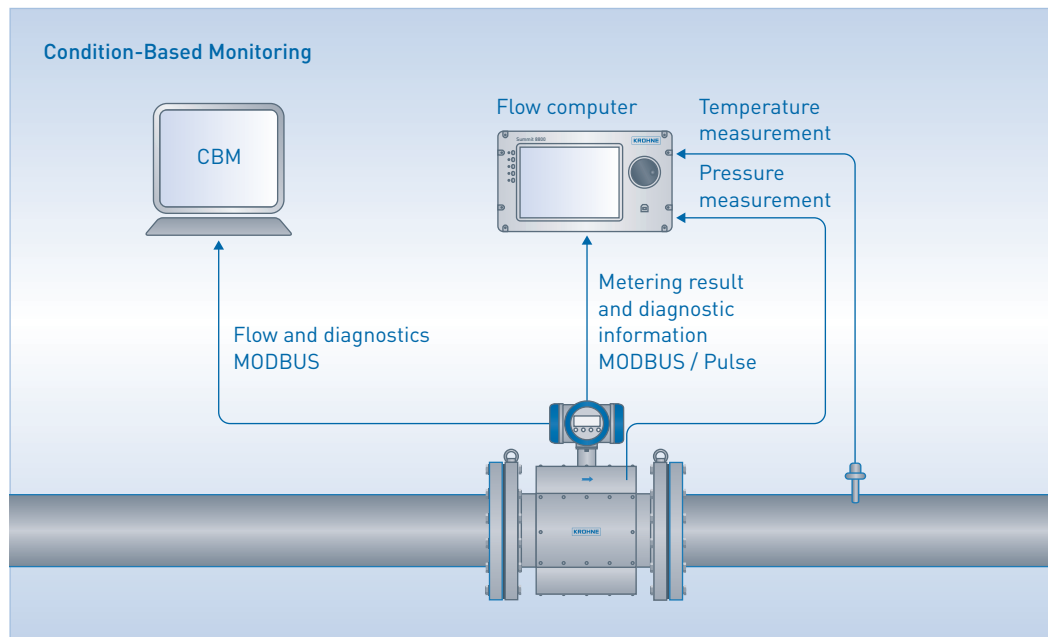
The meter design including the diagnostic package provides the operator with continuous monitoring of measurement integrity. This is the basis for extending the recalibration interval.

Condition-based Monitoring

The simplest way to use standard diagnostics on the ALTOSONIC V12 is to install the monitoring and configuration software tool on a PC and connect it to the MODBUS port of the ALTOSONIC V12. The software is **available as a free download** on the KROHNE website and does not require a specific licence or annual fee.

The ALTOSONIC V12 will automatically give an alarm when the acceptance of the CT accuracy exceeds a predefined threshold. The Condition-based Monitoring system is standard included in the metering package. This package has **all diagnostic features** available such as signal acceptance, flow velocity, Signal to Noise Ratio (SNR), Automatic Gain Control (AGC), speed of sound etc.

It is also possible to program standard diagnostics into a flow computer or a DCS system, as long as it is connected to one of the MODBUS ports. These diagnostics are pre programmed as standard in the SUMMIT 8800 flow computer.



KROHNE Care

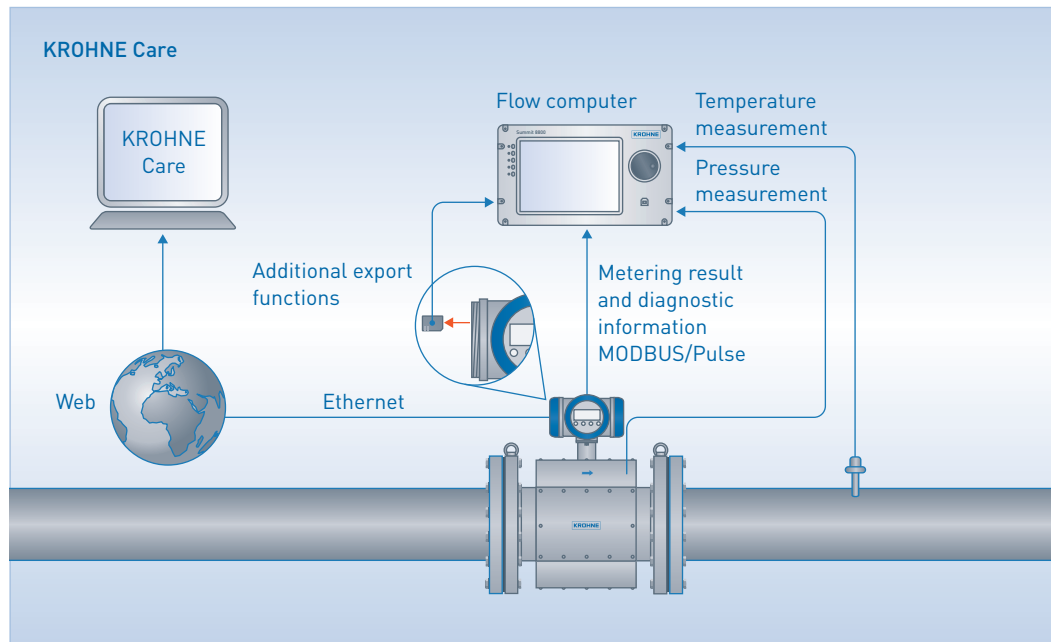
The **web-based expert diagnostic system KROHNE Care** runs 24/7 inside the electronics unit of ALTOSONIC V12. It can be accessed from anywhere in the world with a standard browser without installing additional software.

Based on extensive research a complete model was developed that allows **monitoring of health care** and can **distinguish the different forms of contamination** that can occur inside a meter. The user no longer needs to wonder why parameters such as velocity of sound, Signal to Noise Ratio (SNR) and Automatic Gain Control (AGC) have changed; KROHNE Care simply tells you that there is contamination at the bottom of your meter – in plain language.

With time, this information could justify extending your re-calibration intervals.

Features of KROHNE Care:

- Automatic warning system
- Runs 24/7 inside the ALTOSONIC V12's electronics unit, even when no external PC is connected
- Fully web-based: access from anywhere in the world
- Indication why a warning or alarm is given, no expert knowledge required for data interpretation
- Storage of historic data up to 10 years for long term trending



User interface of diagnostic system

The visualisation of **KROHNE Care** has different levels of expertise, from a simple traffic light structure indicating the meter's overall health to a detailed overview of all critical parameters with their long-term trends.



General overview of the ultrasonic flowmeter, including a master status and a health icon. If the health status is green, correct measurement is assured.



Advanced overview showing individual path status and trending. Also distortions are mapped over time and possible upcoming alarms can be predicted.

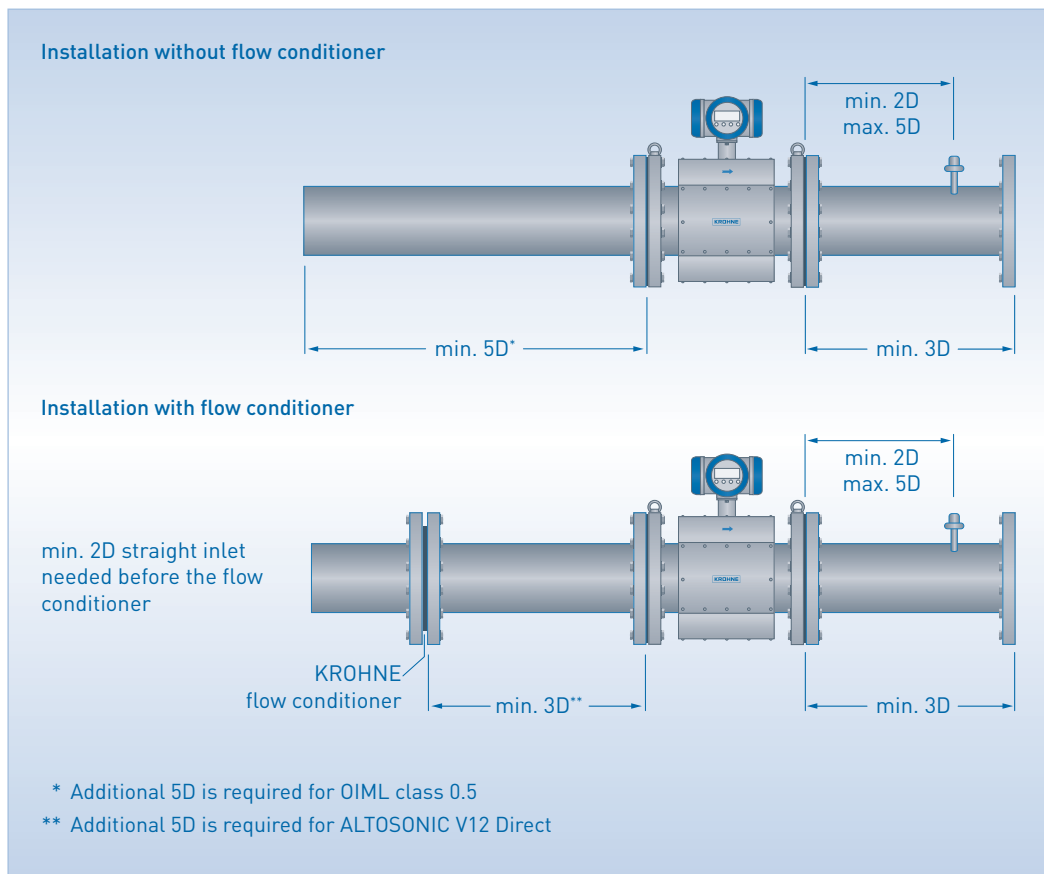


Expert overview, in depth parameters are shown.



Realtime measurement, all parameters can be compared to others.

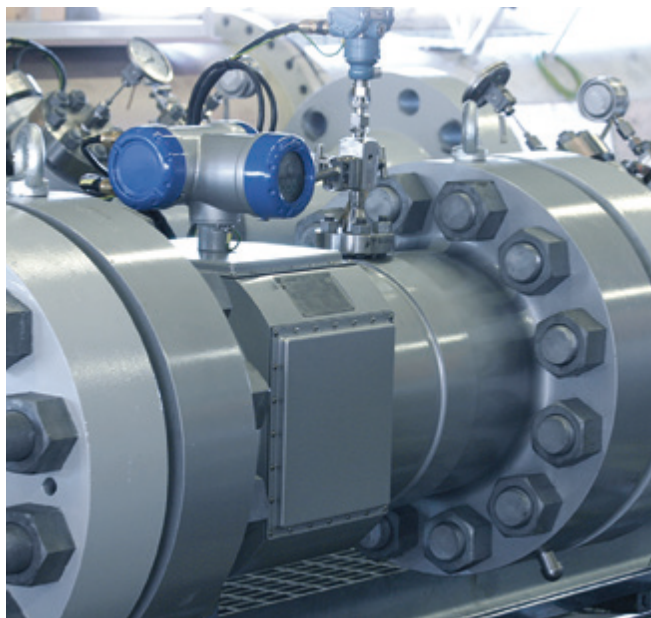
Simple installation



Reduced installation conditions not only minimise the weight and footprint of your installation, but also save on installation and shipping costs, both during new installation as well as during re-calibration.

ALTOSONIC V12 – Better by design

- Complete ultrasonic flowmeter product series for widest application range
- Ensuring minimal inlet requirements
- Continuous monitoring of measurement integrity
- No flow conditioner required, avoiding pressure loss
- Dedicated ultrasonic chords for diagnostics and predictive maintenance



What the standards say

AGA 9 upstream piping requirements



An often heard misunderstanding is that AGA 9 specifies that meters have to be installed with 20D upstream piping and a flow conditioner. This is not the case; AGA 9 (paragraph 5.2.1) states 'Option 2&3: The manufacturer shall specify the length of UL1 (inlet) based on independently certified test data - within the $\pm 0.3\%$ limit'. ALTOSONIC V12 already exceeds this requirement with just 5D inlet piping without flow conditioner to guarantee a deviation of less than 0.17% installation uncertainty.

ISO 17089 upstream piping requirements



Like AGA 9 the ISO 17089 standard advises that an additional error due to installation effects should stay below $\pm 0.3\%$. The perturbation testing in ISO 17089 is, however, far more comprehensive and testing is mandatory, recognising that perturbations such as swirl can have a huge impact on measurement accuracy. If a supplier cannot provide certified test results to all mandatory tests described in ISO, the meter must be installed with a 50D straight inlet length.

OIML R137 upstream piping requirements



OIML R137 (paragraph 12.6) specifies that a meter shall be type-tested with vendor recommended upstream piping against the upstream disturbances as per Annex B. During these tests the shift of the error curve shall not exceed 1/3rd of the accuracy class. This means that meters that have an OIML R137 class 1 approval are allowed to deviate up to 0.33% during type-testing. With its class 0.5 approval ALTOSONIC V12 is only allowed to deviate 0.17%.

Technical data

General	
Measurement functionality	Actual volume flow rate and totalised volume; uni-directional and bi-directional
Applications	Natural gas with a minimum of 75% methane; other applications on request
Nominal diameter	DN100...1600; 4"...64" Other diameters on request
Measurement accuracy	
Accuracy (relative to calibration facility)	$\leq \pm 0.1\%$ of measured value, high-pressure flow calibrated and linearised $\leq \pm 0.2\%$ of measured value, high-pressure flow calibrated $\leq \pm 0.5\%$ of measured value, SOS calibrated
Repeatability	$\leq \pm 0.05\%$
Operating conditions	
Flow range	See flow table
Pressure range	1...450 bar / 15...6525 psi (ASME Class 150...2500)
Ambient temperature	-40...+60°C / -40...+140°F
Process temperature	-20...+70°C / -4...+158°F [-40...+100°C / -40...+212°F optional]
Wet gas content	Typically $\leq 1\%$ LVF, contact KROHNE for detailed sizing
CO ₂ content	Depends on diameter and pressure, contact KROHNE for detailed sizing
Minimum pressure requirement	Depends on diameter, gas composition and CO ₂ concentration; contact KROHNE for detailed sizing
Materials	
Flanges	Low temperature carbon steel A350 LF2, (stainless steel and duplex optional)
Measuring tube	Low temperature carbon steel A350 LF2 ($\leq 14"$) or A333 GR6 ($\geq 16"$), (stainless steel and duplex optional)
Electronics housing	Stainless steel 316
Finish	Outside "on-shore": 1-layer epoxy coating PSX 700 (KROHNE Grey) Outside "off-shore": 3-layer epoxy coating PSX 700 (KROHNE Grey) Inside: corrosion preservative oil film Other finishes available on request

Inputs/ Outputs	Condition-Based Monitoring	KROHNE Care
Power supply	24 VDC / ≤10 W	24 VDC / ≤17 W
Digital output	4x output	4x output plus 1x extra status
Serial	2x MODBUS over RS 485 (individually configurable)	3x MODBUS over RS 485 (individually configurable)
Ethernet		2x ethernet
Analog Output		1x 4...20 mA
Input		1x multidrop (dual) HART
Approvals		
Custody transfer	OIML R137 class 0.5 by NMI MID (Measurement Instrument Directive 2004/22/EC) by NMI Fully compliant with AGA 9 and ISO 17089	
Hazardous Area	ATEX: II 2G Ex d e ma IIB T5 or T4 Gb IECEx: Ex d e ma IIB T5 or T4 Gb CSA: Class I, Div 1 and 2, Groups B,C,D T5 Class II, Div 1 and 2, Groups E,F,G FM: Class I, Div 2, Groups C, D T5 Class I, Zone 1, AEx de ma IIB T5, IP66 Class II/III, Div 1, Groups E, F, G Class I, Div 1, Groups C, D T5 or T4 Class I, Zone 1, IIB T5/T4 (only USA) Class II, Div 1, Groups E, F, G	
Protection	IP66 NEMA 4x	
Verifications		
Standard	<ul style="list-style-type: none">• High pressure hydrostatic pressure test on meter body• Factory Acceptance Test (FAT)• Low pressure leakage test with nitrogen on the complete meter	
Optional	<ul style="list-style-type: none">• High pressure leakage test with nitrogen on the complete meter• High pressure flow calibration	

Flow table

Diameter (")	Qmin (m³/h)	Qmax (m³/h)	Qmin extended (*) (m³/h)	Qmax extended (*) (m³/h)
4	25	1000	10	1150
6	45	2300	16	2600
8	55	4100	20	4500
10	85	6200	25	7000
12	115	8500	35	9000
14	140	9900	45	10500
16	185	12300	60	13000
18	230	15000	75	16000
20	260	17600	90	19000
24	290	23000	130	25000
26	360	25000	180	30000
28	410	28500	210	33800
30	470	32000	230	38900
36	620	41000	300	51400
40	765	51000	380	61000
42	845	56000	420	64500
48	1100	73000	550	80600
56	1500	95000	750	105000
64	1910	120000	950	127250

* Extended Range; Flow rates can have certain restrictions, therefore an application check is always required.

Qt as per ISO 17089 (Vt = 3 m/s < 12" and Vt = 1.5 m/s ≥ 12")

For piping > Sch 80 values might vary slightly
Technical data is provided as an indication;
please ask KROHNE for detailed sizing.

KROHNE – Process instrumentation and Measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process analysis
- Services

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