WGS wet gas measurement solution

Highly flexible and economical solution for well performance optimisation

KROHNE Solutions

- Flexible, modifiable and modular system for a scalable solution
- Independent, fast and continuous update of well compositions and process conditions
- No radioactive source, resulting in low OPEX
- System designed according to ISO5167, ISO11583 and API guidelines

KROHNE – Pushing limits for your standard and advanced measurement applications

KROHNE is a global manufacturer and provider of instrumentation, complete measurement solutions and complementary services in numerous industries. KROHNE stands for innovation and highest quality and is one of the market leader in the process industry.

KROHNE Solutions provides **engineered turn-key solutions** for process control and automation – worldwide. Our portfolio ranges from single flow computers to complete skids, and from instrument management software to metering and full monitoring solutions, such as our wet gas measurement solution (WGS) for reliable and fully automated system operation. Our 360-degree full service concept guarantees smooth and continuous operation in the field. From the first consultation to commissioning, we take responsibility for the entire project lifecycle.

Our specialists are dedicated to guaranteeing benefits for our customers **across the entire value chain.** KROHNE supplies solutions that **improve sustainability and efficiency** in various segments, even when it comes to demanding applications in the field of renewable energies like hydrogen and carbon capture, and traditional industries such as chemical, oil & gas, power generation, marine and water & wastewater.

WGS wet gas measurement solution – Highest flexibility and economical benefits at your disposal

The WGS 1000 / 2000 / 3000 wet gas systems are designed to measure unprocessed gas directly from single-stream and complex multi-wells. The solutions are suitable for (remote) reservoir and wellhead monitoring applications, both onshore and offshore, and fulfil the need for **continuous well and reservoir performance monitoring** in daily production.

- Flexible, modifiable and modular system for a scalable solution
- Fast and continuous update of well compositions and process conditions
  - Customisable system to meet your specific project requirements
  - PVT calculation for superior accuracy of ±1...3%
- No radioactive source, resulting in low OPEX
- System designed according to ISO5167, ISO11583, and API guidelines
- Real-time well performance verification for a faster decision-making process
- Comprehensive calculation blocks, resulting in a flexible solution

Typical applications:

- Upstream and midstream
- Green and brown field performance monitoring
- FPSO/FSO/MOPU for integrated oil and gas production
- Redevelopment of mature oil fields with IOR/EOR implementation (gas-lifted wells, gas injector wells)
- Replacement of bulky and obsolete test separators
- Production (re)allocation and optimisation
- Well testing capability using shared testing line and manifold

Meeting all wet gas measurement requirements

Limited investment recovery period

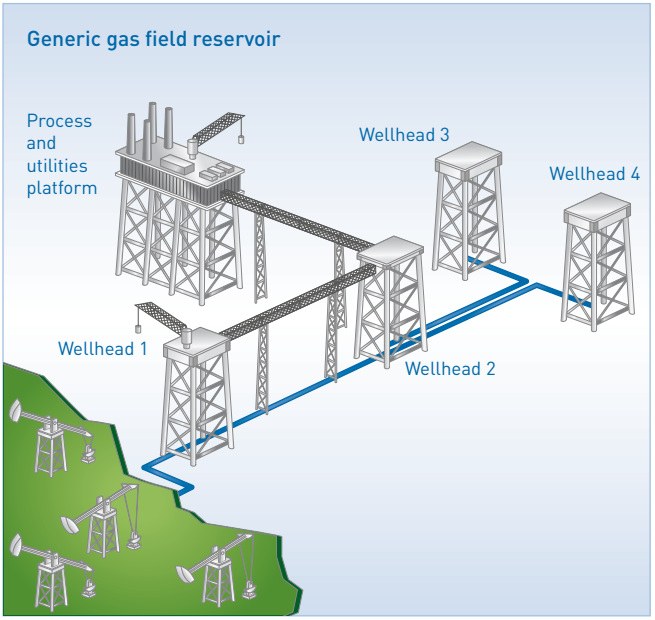
Production or risk-sharing contracts today have shorter validity periods, making an investment recovery phase feel like a race. With **accurate, reliable and automated measurements,** we help maximise the production of natural gas as quickly as possible.

Smart diagnostics

High risk penalties in cases of underperforming production rates result in contractual pressure. We recognise the need for integrated and smarter solutions to **measure production wells automatically.** The supervisory software enables engineers to **obtain diagnostic data in realtime.** Decisions for optimising production per field can be made much easier.

Accurate production system

Sharing the economic concerns of the industry, KROHNE understands the importance of lowering capital investment (CAPEX) and reducing maintenance operations (OPEX). The wet gas systems are designed to be **cost-effective for long term investment,** providing precise measurement data per well throughout the field life.

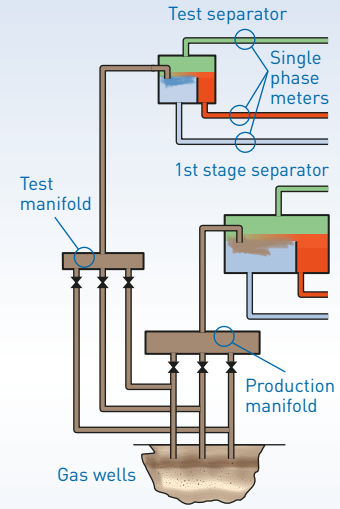


Wet gas reservoir measurement solutions for a variety of applications

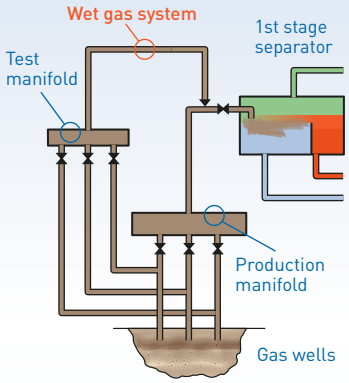
Reservoir fluid is usually produced in multiphases at surface conditions, which consist of hydrocarbon liquid and gas with some produced water, whether in limited or abundant quantity. KROHNE provides complete, integrated solutions for **accurate reservoir fluid measurement,** either in the early phase of new field development or late production life.

The KROHNE wet gas measurement solution is a **cost-effective technology.** It ensures reliable measurement of gas flow within a Gas Volume Fraction (GVF) range of 90...99 % involved in production, processing or reinjection activities.

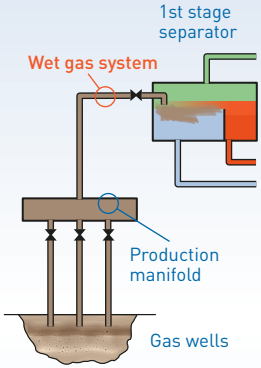
Wet gas measurement points



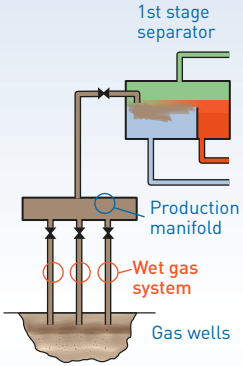
Well testing with test separator



Well testing with WGS solution



Allocation measurement with optimised WGS position



Individual well performance and quality control with multiple WGS

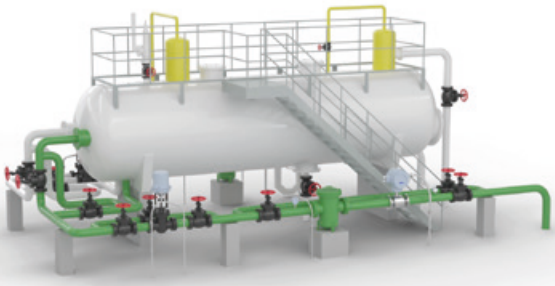
Gas Oil Water

Space-saving and weight reducing

Less weight and less space.

KROHNE's wet gas systems eliminate the need for expensive, bulky test separators which require a large footprint and regular maintenance. Installed upstream of the 1st stage separator, directly on the testing line, or downstream of the wellhead, the wet gas Venturi meter can be **implemented much more quickly than other technologies.**

WGS 1000 / 2000 / 3000



Test separator

	WGS 1000 / 2000 / 3000	Test separator
Footprint	3,100 (L) x 273 OD	6,500 (L) x 2,336 OD
Weight	1,000 kg	40,000 kg

Flexible, modifiable and modular based on standardised hardware

KROHNE has developed a **unique solution for flow and re-allocation measurement of wet gas.** The systems are highly **suitable for reservoir and wellhead monitoring applications** and have been proven to work very well under varying process conditions. They are designed to measure the unprocessed gas directly from the well and can be used for single-stream multiphase metering, extending to complex multi-well reallocation applications.

The WGS 1000 / 2000 / 3000 wet gas systems have **three main product components:**
- Wet gas Venturi meter
- Transmitters for pressure, differential pressure and temperature
- Computational supervisory software

Additional components include valve manifolds, spools, isolation valves and other equipment necessary for complete integration.

The right system for your demands

The **wet gas Venturi meter** is installed directly after the wellhead of the gas-producing wells, before merging into a single stream at the production manifold. In the case of multiple wet gas Venturi meters, they are **connected to a single computational system.**

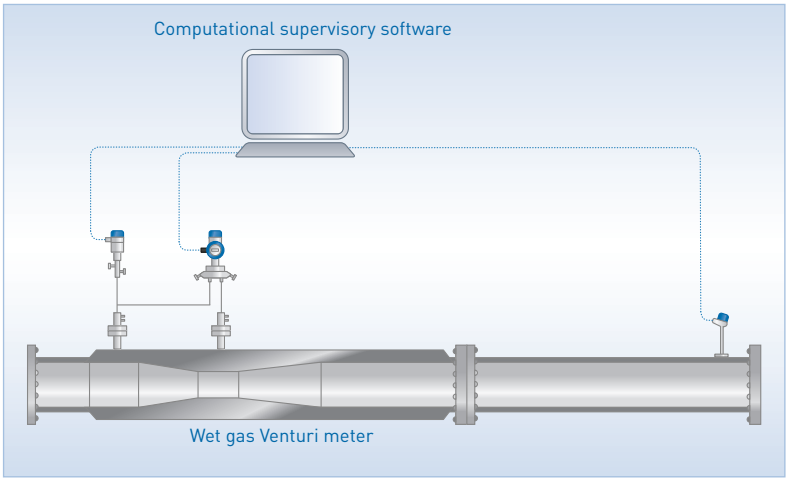
The computational module manages continuous data processing from several wells every second.

This setup is **very cost-effective** and practical **for accurate real-time production allocation** and for field management purposes.

The wet gas system portfolio of KROHNE includes **three different versions.** For full specification details please refer to page 18.

WGS 1000

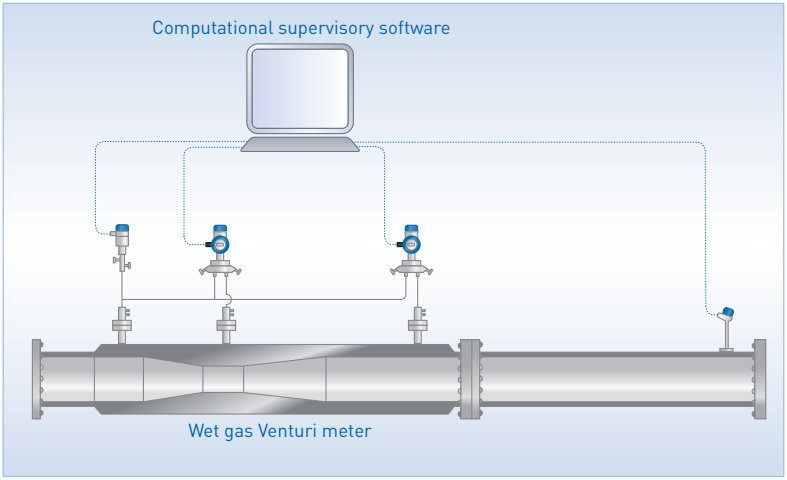
Economic solution with standard functionality for simple applications.
For easy deployment or when existing well testing facilities can be utilised, such as tracer dilution or PVT sampling.



..... = Data line ——— = Pressure line

WGS 2000

Industry standard solution with Pressure Loss Ratio (PLR) for liquid fraction monitoring.



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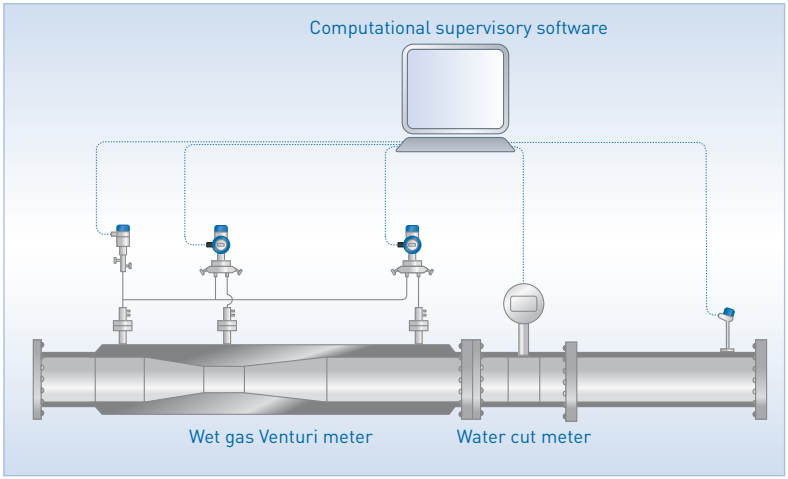
WGS 3000

Advanced solution for water break-through and flow assurance issues by dedicated fraction meter for higher accuracy.



..... = Data line ____ = Pressure line

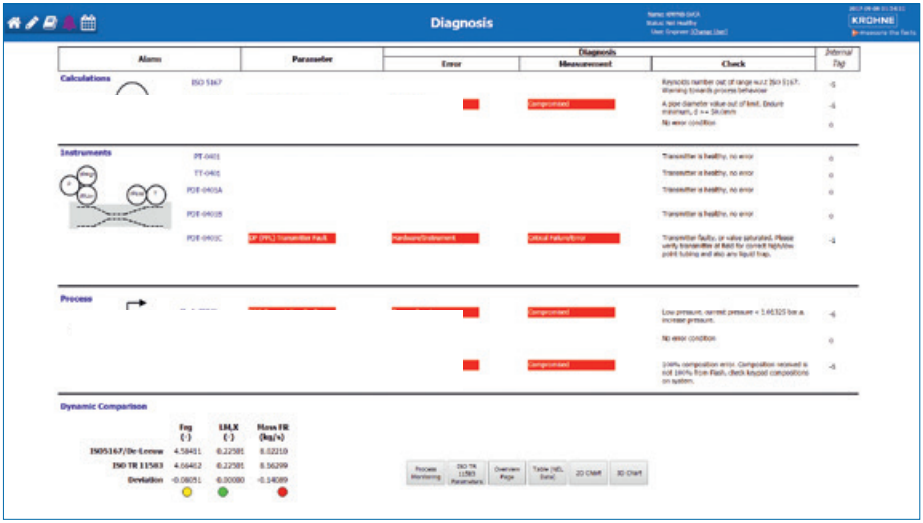
Fast and continuous update of well compositions and process conditions

SynEnergy: system intelligence

The flow computational module is the brains of the wet gas system. Utilising a calculation block application builder as the back-end engineered platform, we can offer the client true flexibility by easily **customising the system for specific project requirements.**

When it comes to system visualisation, monitoring, reporting, allocation and control, we use KROHNE's SynEnergy. The **operator-friendly, high-performance HMI** provides full graphic representation of the application. The supervisory software is web-based and can be accessed remotely.

Typical screen illustrating key parameters and Pressure Loss Recovery (PLR) graph.

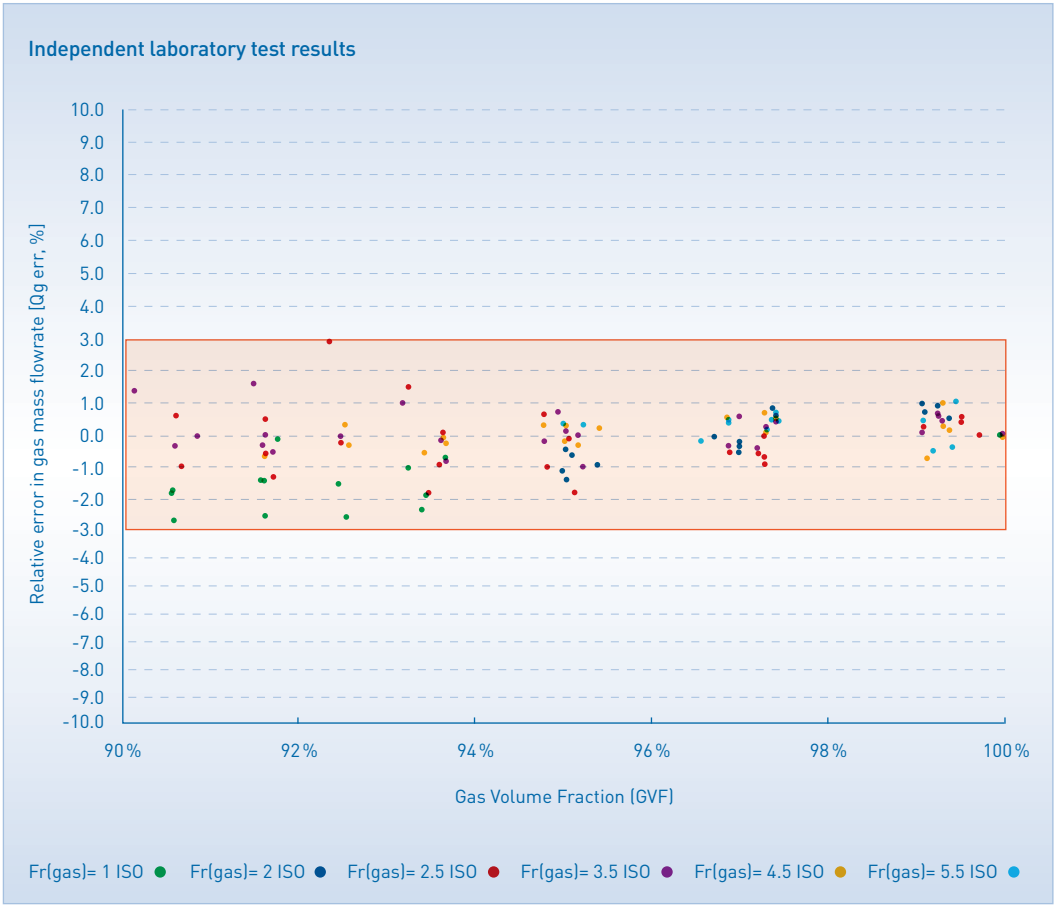


Typical diagnostics screen with alarms showing areas of concern within the system, from well to calculation cycle.

Highly accurate even with dynamically changing flow rates

KROHNE's wet gas systems are designed to be adaptable and are constantly evolving in line with new industry practices and technical international standards. This underscores our extraordinary ability to implement proven research and standards.

We provide technically advanced solutions with a **superior measurement accuracy of ±1...3 % for gas and ±5 % for liquids.**



Over the past 10 years, we have been sending our wet gas measurement systems to an independent flow measurement laboratory in the UK to test the measurement accuracy.

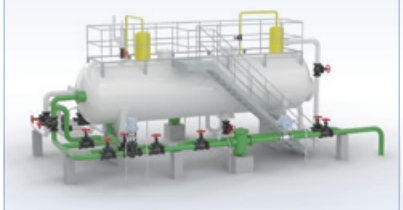
The results show that KROHNE has produced **robust engineered solutions** capable of measuring and correcting wet gas applications within the **Gas Volume Fraction (GVF) range of 90...99 %.** The comprehensive test illustrates various well stream fluids represented by gas densiometric Froude number (Fr).

Highly efficient and safe due to the no radioactive source

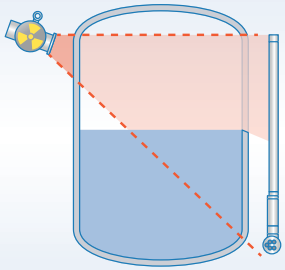
As our system uses **no radioactive source,** resulting in low OPEX, you get an efficient and cost saving operation.

There are no additional yearly costs for permits and screenings or for training special personnel, and radiation-related dangers are generally avoided.

Comparison of wet gas measurement solutions



Test separator with large footprint



Radioactive measurement with increased risks

WGS (Venturi) safe and small footprint

Economic production system

Sharing the economic concerns of the industry, KROHNE understands the importance of lowering capital investment (CAPEX) and reducing maintenance operations (OPEX). The wet gas systems are designed to be cost-effective for long term investment, providing precise measurement data per well throughout the field life.

High stability

KROHNE´s wet gas systems have a low susceptibility to erosion and higher turndown ratio than orifice installations. They can be perfectly integrated into available and existing flowlines and have lower permanent pressure loss.

Designed according to international standards: ISO5167, ISO11583 and API guidelines

Our system meets all of the statutory requirements, meaning you get a perfectly transparent system from the start, with no subsequent surprises such as the necessity for additional software or external services.

The systems are **compliant with ISO 11583** thanks to the combined expertise of KROHNE's system engineers and research divisions.

The advanced and complex computational module of the systems has been designed to optimise each implemented calculation and algorithm. Provided the input is correctly computed in the process modules, this ensures high accuracy at the output.

Development and calculation

Adopting an ISO standard was never enough to achieve the accuracy KROHNE wanted. KROHNE has produced solutions based on years of experience and continuous development and improvements. The systems incorporate **comprehensive calculation blocks,** extending further than just the basic measurement principles of gas using a Venturi. With the liquid phase affecting the true gas measurement, applying the right correction algorithms is vital to achieving an accurate wet gas measurement. KROHNE's wet gas systems are flexible solutions with **various user-defined, over-reading corrections** available.

Further advantages at a glance

High performance and reliability

The wet gas systems utilise high-performance and accurate transmitters to ensure maximum reliability. KROHNE understands the increasing need to **diagnose well conditions** and to **better plan production and allocation.** Measurements are performed close to wellhead conditions.

Proven technology

The systems use technology that have been proven in many applications. The intermediate parameters at the point of measurement are calculated from known reservoir and well compositions. These are then used to generate fraction and density tables for the operation range of the well or reservoir. Our **highly accurate and ultrafast flow computational system** uses the interpolation tables to calculate the dry gas, as well as the hydrocarbon liquid and water fraction.

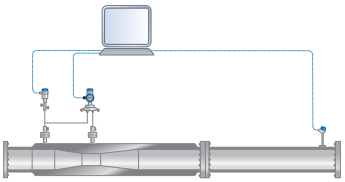
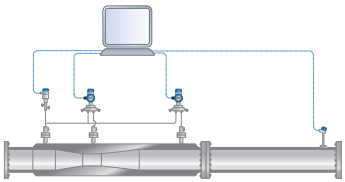
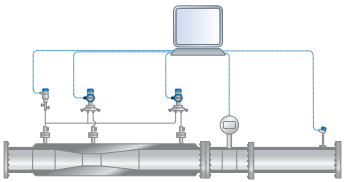
Advantage of reallocation

The **wet gas Venturi meters** in the systems are located directly on each individual well flowline and can be configured for both reallocation and well management. Together with the other data, they provide a **complete mass balance of the overall platform or facility.** Reallocation to each individual well is simple and of great value and of great importance to the operator. This is especially the case when different operating companies are tied into the platform or facility and compliance with Well and Reservoir Facility Management (WRFM) is mandatory.

Zero maintenance with smart system diagnostics

The WGS 1000 / 2000 / 3000 wet gas systems have proven to be **very accurate and effective solutions,** surpassing other technologies with ease. The use of highly sensitive equipment such as online analysers and chromatography is not always the first choice due to reliability issues and high maintenance. The systems provide **continuous validation and smart diagnostic features.** The ability to determine Pressure Loss Recovery (PLR) allows the operator to detect changes in the properties of the gas from the well.

Specifications

	Economic solution with standard functionality for simple applications	Industry standard solution with Pressure Loss Ratio (PLR) for liquid fraction monitoring	Advanced solution for water breakthrough and flow assurance issues using dedicated accurate fraction meter
	WGS 1000	**WGS 2000**	**WGS 3000**
			
Distinctive criteria	• Liquid fraction is obtained from periodical PVT lab test (manual sampling) or tracer dilution test • The most cost-effective option for simple applications	• Liquid fraction is obtained from Pressure Loss Ratio (PLR) liquid monitoring (online readings) • Lower OPEX cost throughout operating life	• Liquid fraction is obtained directly from dedicated water cut meter (online readings) • Best accuracy in measurements
Key components	• Wet gas Venturi meter • Computational supervisory software • 1 x pressure transmitter • 1 x differential pressure transmitter • 1 x temperature transmitter	• Wet gas Venturi meter • Computational supervisory software • 1 x pressure transmitter • 2 x differential pressure transmitter • 1 x temperature transmitter	• Wet gas Venturi meter • Computational supervisory software • Water cut meter • 1 x pressure transmitter • 2 x differential pressure transmitter • 1 x temperature transmitter
Measurement uncertainty	Water: ±20 % Condensate: ±20 % Gas: ±5 %	Water: ±10 % Condensate: ±10 % Gas: ±3...5 %	Water: ±5 % Condensate: ±5 % Gas: ±1...3 %
Compliant upstream length (ISO 5167-4)	5D	11D	13D

Technical data

Recommended installation	Horizontal: 5 to 13D upstream straight length and 5D downstream straight length Vertical: please contact your local KROHNE sales office
Available material	Carbon steel, stainless steel, duplex stainless steel (other material available on request)
Gas Volume Fraction (GVF)	90...99 %
Line size	DN50 (2 inch) to DN300 (12 inch) (larger line size on request)
Pressure rating	ANSI 150lbs to 2500lbs (higher pressure rating on request)
Temperature rating	-40...+120°C (higher temperature rating on request)
Flow computational system	• Integrated software system • Connectivity ports: RS485, TS232, TCP/IP ethernet • Flexible data transfer and communication protocols: Modbus and OPC (other protocols on request) • Automatic and continuous flow computation with over-reading correction • Operator-friendly supervisory interface • Graphical visualisation for easier trending of readings and system-fault diagnostics • Available as a centralised or decentralised system for installation in safe and hazardous areas

Learn more about WGS wet gas measurement solution

Solution page

krohne.link/wgs

Videos

krohne.link/wgs-video-en

Applications

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