



Wet Gas Meter Solutions



Flow

Coriolis, Ultrasonic Clamp-On, Vortex, Electromagnetic, DP Flowmeters



Temperature

Explosion-Proof Temperature Transmitter



Pressure

Pressure Transmitter



Level

Guided Wave Radar, Explosion Proof Ultrasonic, Radar, Submersible, Pressure Based Level Transmitters



Validation

Flow Computer, Flo-Mass



Solution

Wet Gas Meter

TECHNOLOGY SOLUTIONS

Tek-Trol is a technology-driven company providing consistent advanced measurement, automation and control solutions.

TekTrol offers process measurement along with control products and solutions for Flow Level, Temperature, Pressure and Level Applications. We provide our customers a complete range of products and solutions for markets covering: Dairy, Water, Wastewater, Boiler instrumentation-and-controls, District Heating and Cooling, Power Plant and Nuclear, Oil and Gas, Paper, Sugar and many more.

.....
TekTrol is proud to be recognized for our industry knowledge, innovative solutions, reliable products, and global presence.

WET GAS METER SOLUTIONS

Applications of wet-gas metering have increased in recent years, particularly in allocation, monitoring of production, and in the move towards fiscal metering for newly developed marginal and large gas fields. The Tektrol WGM range of meters is uniquely positioned to provide the operator with the optimum solution for wet-gas flow measurement which is significantly more complicated than measuring the single phase gas flow.



Wet gas flow is defined as a gas flow that contains a small amount of liquid. Wet gas metering is important in various applications, e.g.:

- Gas and condensate flow custody transfer.
- Allocation purposes where individual well production requires monitoring for overall production control and efficiency.
- Identifying water breakthrough for chemical inhibitor injection control and flow assurance.

Wet gas flow is an adverse flow condition for all flow meters. It incorporates a wide range of flow conditions, and different operators require different wet gas meter capabilities. No one wet gas meter design is optimum for all wet gas conditions and operator requirements. Hence, TekTrol has a portfolio of wet gas meter products, including:

- DP meters with wet gas correction factors in the flow computer. For a known liquid content this system meters the gas flowrate.
- DP meters with a downstream pressure tap where the Pressure Loss Rayio (PLR)

is used to predict the liquid loading for use in the wet gas correction factor. This product meters the gas and liquid flowrates. For use with low to moderate liquid loadings.

- A vortex and cone hybrid (CoVor™) meter that meters the gas and liquid flowrates. For use with low to moderate liquid loadings.

All products optional available with DP meter diagnostic suite 'Prognosis' that will monitor changes in liquid loading.

- ✓ Operator Friendly
- ✓ Low Maintenance
- ✓ Predict liquid loading value
- ✓ Uses Wet Gas Correction Algorithm
- ✓ Simple and Robust

Knowing what measurements you want will help dictate the type of metering technology that is required.

What measurements are needed or important?

- Gas flow rate only?
- Gas + liquid flow rate?
- Gas + liquid hydrocarbon + water flow rates?

Wet gas metering options

- Single-phase meter
- Two-phase meter
- Three-phase meter

} Which one?



WET GAS METER SYSTEM

Wet gas flow is defined to be any two-phase (liquid and gas) flow where the Lockhart-Martinelli parameter (XLM) is less or equal to 0.3, i.e., $X_{LM} \leq 0.3$. It includes any combination of gaseous and liquid components, i.e., the liquid can be a liquid hydrocarbon, water, or a mix of liquid hydrocarbon and water. Other liquids and substances such as MEG/methanol, the wax may also be present. Lockhart-Martinelli parameter a measure of the 'wetness' of wet gas flow. It is a non-dimensional expression of the relative amount of liquid with the gas.

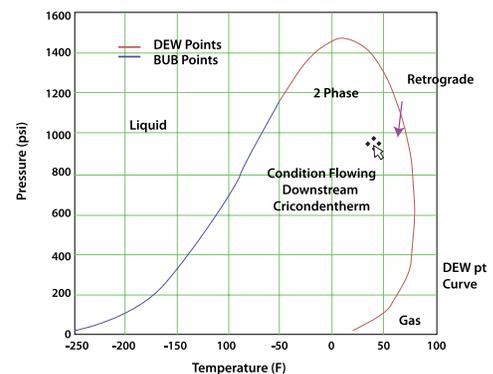
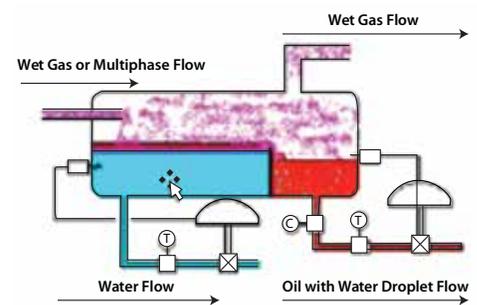
$$X_{LM} = \frac{m_l}{m_g} \sqrt{\frac{\rho_g}{\rho_l}} \quad \text{--- (1)}$$

Where m_g and m_l are the gas and liquid mass flow rates and ρ_g and ρ_l are the gas and liquid densities respectively.

With one single liquid component, a wet gas has one liquid density. With multiphase wet gas flow, there are two (or more) liquid

densities. In this case, the liquid density used to calculate the gas to liquid density ratio and the gas densimetric Froude number is the average liquid density.

The term 'liquid loading' is often used as a qualitative term to describe the relative liquid content of the wet gas flow. Many parameters can be used to quantify the relative amount of liquid relative to a unit quantity of gas. The liquid loading can be predicted by any pair of DP transmitters (orifice, cone, and Venturi meter). The DP prognosis checks the correctness of DP reading. The other products automatically assume any change in PLR as a change in liquid loading. However, Prognosis can identify if a PLR change is due to wet gas flow or a myriad of other issues (e.g., drifting DP transmitter, saturated DP transmitter, eroding plate edge, hydrate impulse line blockage, etc.) The confidential DP diagnostic wet gas DP meter correlation works for a wider range of DP meters, with a much wider wet gas flow range, wider beta range, and is more accurate.



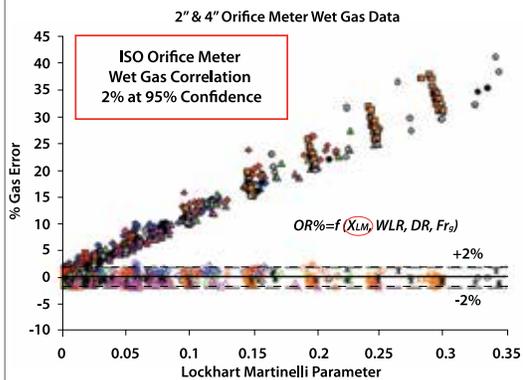
WET GAS RESPONSE

Gas Meters & Wet Gas Flow



Flow Conditions dictate the Flow Pattern and hence the Orifice Meter OR%, i.e.:

$$OR\% = f(X_{LM}, WLR, DR, Fr_g)$$



Wet Gas response of Orifice Meter

Orifice plate flow meters being one of the most widely used flow meters in the natural gas production industry, it is inevitable that they are often used in wet natural gas flow applications. An orifice meter's response to wet gas flow is dependent on the gas to liquid density ratio, DR (i.e., the pressure for given fluids at a set temperature) and the gas densimetric Froude number, Fr_g , i.e., the gas flow rate for given pipe size and fluid properties.

$$DR = \rho_g / \rho_l$$

$$Fr_g = \frac{m_g}{A\sqrt{gD}} \sqrt{\frac{1}{\rho_g(\rho_l - \rho_g)}}$$

The flow pattern dictates the orifice meters response to wet gas flow. This flow pattern depends on many factors, including the meter orientation, gas to liquid density ratio (i.e., pressure), the gas velocity (i.e., gas densimetric Froude number), the relative liquid to gas flow (i.e., the Lockhart-Martinelli parameter) and the liquid properties.

Wet Gas response of Venturi Meter

Natural gas flow metering upstream of the process plant is a challenging but necessary undertaking. Such flows can be wet gas flows (i.e., mixes of gas, water, and oil) and tend to have the water-related issues of scale, salts, and hydrates. In this adverse environment, the Venturi meter is one of the most popular meters, due to it being sturdy, inexpensive, and reliable. A Venturi meter is operated with a wet gas flow for the liquid presence affects the differential pressure read. Venturi meter's response to wet gas flow is dependent on the gas to liquid density ratio (which is effectively a dimensionless representation of the pressure for a set liquid component). It also depends on the gas densimetric Froude number is a non-dimensional gas velocity.

Venturi meters with wet gas flows have a positive bias or over-reading on their gas flow rate prediction. While the uncorrected prediction of gas mass flow rate (i.e., the apparent gas mass flow) is usually higher than the actual gas mass flow rate of the wet gas flow.



WET GAS ORIFICE METER SYSTEM

Orifice meters have a remarkably reproducible wet gas flow performance.

- Orifice meters in wet gas service will over-read the gas flow.
- Use of a wet-gas correlation corrects the meter's gas flow prediction.
- The liquid flow information is obtained from one of:

- User keypad entry
- ISO TR 11583 PLR based prediction of liquid loading (X_{LM}), $X_{LM}=f(PLR)$
- Commercial enhanced $X_{LM}=f(PLR)$ relationship

FEATURE

Sizes / Flange

Size: 2" to 48", up to schedule 120, Flanges: #150 - #2500.

Meter Run Compliant

AGA 3 / API 14.3 / ISO 5167-2 orifice meter run compliant.

Designs Available

Dual Chamber, Single Chamber.

Wet Gas Operating Range

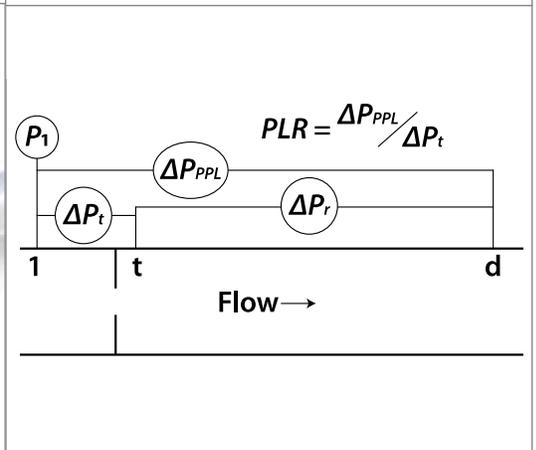
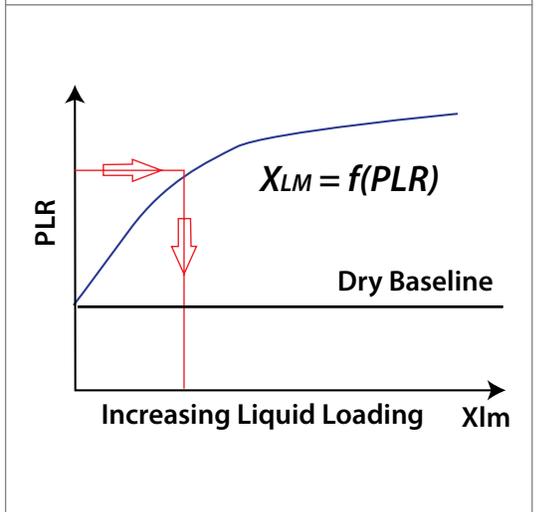
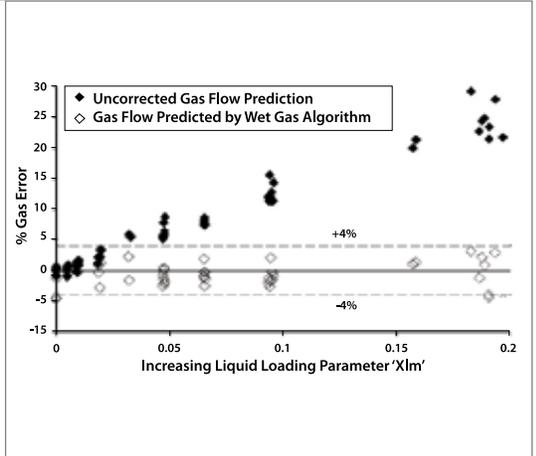
Liquid Loading 'X_{LM}' ≤ 0.2 (≈ GVF ≥ 95%)
 150psi (10 Bar) ≤ Pressure ≤ 2500psi (83 Bar)

Flow Rate Knowledge

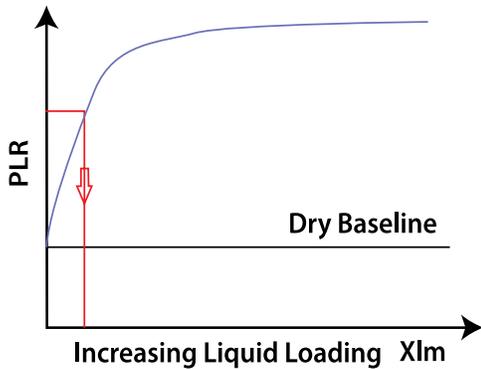
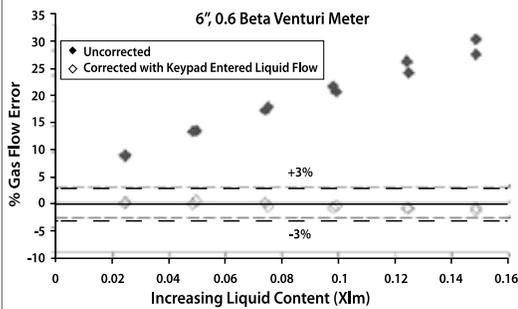
No liquid loading or liquid flow rate knowledge required.

Prediction

Gas flow prediction up to ± 3% accuracy, with liquid loading indicator



WET GAS VENTURI METER SYSTEM



Venturi meter is a simple, sturdy, reliable, and inexpensive device that most popular for single-phase and wet gas flow metering applications. Venturi meter applies wet gas calculation as per ISOTR11538 to identify the wet gas flow. The system monitors a

relative amount of liquid loading in wet gas flow and alerts the operator through visual indication. It also predicts the ratio between Permanent Pressure Loss to Traditional Differential Pressure using Pressure Loss Ratio (PLR).

FEATURE

Sizes / Flange

Size: 2" to 48", all standard schedule, connections and materials.

Meter Run Compliant

ISO 5167-4 / ISO TR 11583 Venturi meter compliant.

Unit

Complete Meter run, Instrumentation, and Flow Computer unit.

Applications

For use with test separator / tracer dilution estimated liquid flow or unknown liquid flow with the range of ISO TR 11583.

Operating range

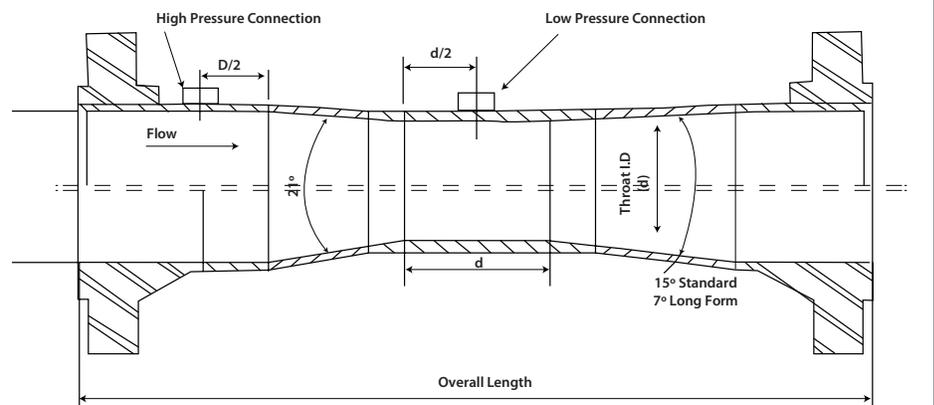
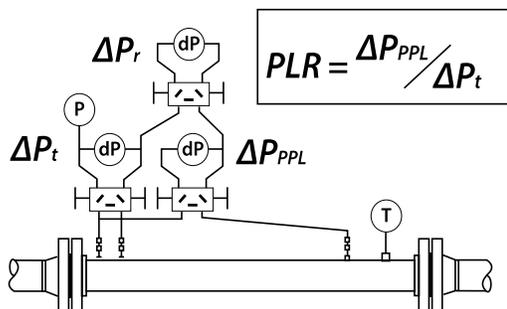
Operating range: As stated by ISO TR 11583

Gas flow prediction

Gas flow prediction up to $\pm 3\%$ accuracy, with liquid flow indicator.

Validation

Option validation system 'Prognosis™'.



WET GAS CONE METER SYSTEM



Wet gas Cone meter is a hybrid meter with a combination of a vortex and cone DP meter. The Cone Wet Natural Gas Meter measures the wet gas-liquid

loading value (i.e., the Lockhart Martinelli parameter / Gas Volume Fraction) by cross-referencing the vortex and cone DP meter sub-systems.

FEATURE

Sizes / Flange

Sizes: 2" to 48", up to schedule XXS, Flanges #150 - #2500.

System

Complete Meter run, Instrumentation, and Flow Computer unit.

Accuracy

Gas flow prediction up to $\pm 3\%$ accuracy, with liquid flow indicator.

Liquid Loading Range

Liquid Loading 'XLM' ≤ 0.12 (\approx GVF $\geq 95\%$).

Velocity

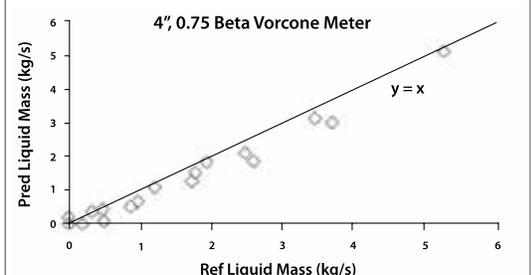
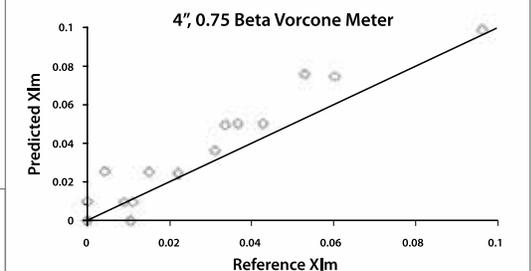
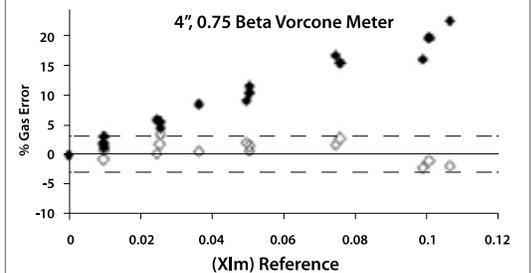
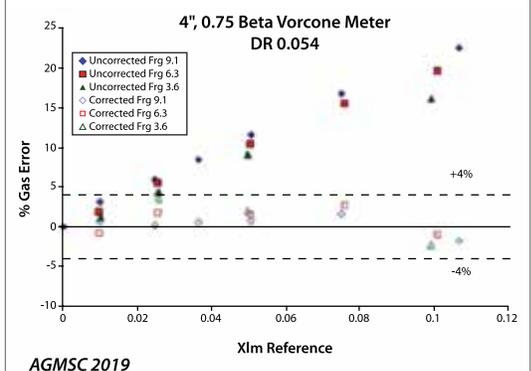
Minimum Inlet Gas Velocity 'Vg' ≥ 15 ft/s (≥ 5 m/s).

Pressure

Pressure ≥ 150 psi (>10 Bar).

Option

Option validation system 'PrognosisTM'.



COVOR WET GAS METER



Tek-Trol's CoVor Wet Gas Meter utilizes two different flow metering technologies in combination, i.e., Vortex and Cone Differential Pressure. This combination allows for the prediction of the fluid density, volumetric flow rate, and mass flow rate without any fluid density information being required from an external source. The ability to predict fluid density allows the meter to provide several valuable measurements with wet gas and steam applications. The CoVor Wet Gas Meter

will provide an accurate total mass flow measurement.

The CoVor Wet Gas Meter is also able to calculate the density of gas mixtures; for example, natural gas is typically a composition of many different gases, each with their own density. With the additional two differential pressure transmitters, the TekValSys DPro, advanced diagnostic software can continually monitor and verify the meter's primary element health and confirm output uncertainty.

FEATURE

Measurement Options

Measures fluid density, volumetric flow rate and mass flow rate along with density of changing gas mixtures.

Advanced Diagnostic

Continuously monitor and verify the flow meter health and reduce output uncertainty using Advanced diagnostic software.

Cost-Effective

Multiple readings from a single installed device reduces initial cost, installation cost and cost-of ownership over the lifetime of the instrument.

Calculations

AGA-3, ISO5167, V Cone.

Reliable

No moving parts, Non-contact fluid sensor.

Multi-variable options

Multi-variable options available for temperature and pressure measurement.

Remote Electronics Option

Use in harsh environments or locations with limited access.

Mass Flow Equations

Real gas, Ideal gas, AGA 8, API 2540.

HART Protocol

Modbus, BACnet, Power over Ethernet (PoE) communications available.



TEK-FCA 8000A FLOW COMPUTER

Tek-FCA 8000A Flow Computer is used in custody and non-custody applications for liquid and gas and is designed to enhance the performance of differential pressure flow meters. With the help of advanced diagnostics it offers a real-time monitoring system and helps reduce uncertainty in measurement making the process measurement reliable and robust.

The Tek-FCA 8000A Flow Computer is the most powerful flow computer that represents operation, performance, modularity advancements with a wide range of options and configurations that

meet specific application requirements. The single hardware platform reduces spare part requirements, training, and calibration costs. It also allows for a lower overall cost of ownership and meets the requirements of specialized industries. The flow computer supports the extensive alarming capability to enhance operational efficiency and improve the audit trail. Alarms are pre-allocated to meter run for standard values such as pressure, temperature, differential pressure, or frequency as well as meter run flow rates.



FEATURE

Design

Flexible design with power and communication options to meet field instrument needs.

Compliances

Complete Meter run, Instrumentation, and Flow Computer unit.

Data Logging

Real time measurement and Enhanced Data Logging capabilities.

Advanced Diagnostic

Continuously monitor and verify the flow meter health and reduce output uncertainty using Advanced diagnostic software.

Operator Friendly

Easy to use with multiple differential pressure like Orifice, Venturi, Flow Nozzle, Wedge, Cone.

Field Configuration

Simple and easily interface with the device using push buttons.

Flow Units

Volumetric or Mass flow measurement of Liquid, Gases and Steam.

Calculations

AGA-3, ISO5167, V Cone

Mass Flow Equations

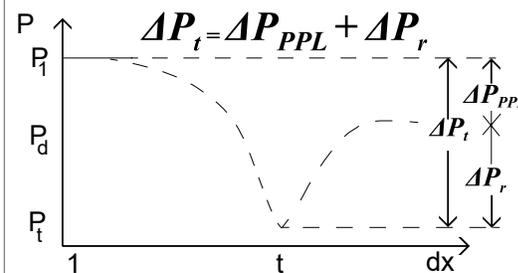
Real gas, Ideal gas, AGA 8, API 2540

Measurement Options

Steam Quality and Density of Gas Mixture measurement.

Low Power

Cost Effective, Low Power field mount flow computer.



Tek-Trol LLC

96 Tek Drive Crystal Lake, IL 60014 USA

Tel: 847 857 6076, 847 655 7428

Fax: 847 655 6147

Email: tektrol@tek-trol.com

Tek-Trol LLC

796 Tek Drive Crystal Lake, IL 60014, USA

Sales: +1 847-655-7428

Tek-Trol Solutions BV

Florijnstraat 18, 4879 AH Etten-Leur,

Netherlands

Sales: +31 76-2031908

Tek-Trol Middle East FZE

SAIF Zone, Y1-067, PO BOX No. 21125,

Sharjah, UAE

Sales: +971-6526-8344

Support: +1 847-857-6076

Email: tektrol@tek-trol.com

www.tek-trol.com

Tek-Trol LLC is a wholly-owned subsidiary of Tekmation Group. The Tek-Trol & Tekmation name and logo are registered trademarks of Tek-Trol LLC & Tekmation LLC. All other logos and registered trademarks are the property of their respective companies. The data of this publication are presented for instructive purposes only. While Tek-Trol has made every effort to ensure their accuracy, we shall not be liable for errors in the stated capacities, dimensions, typographic errors, etc. Products, features, designs and technical data contained in this document are subject to modification by us without prior notice. Illustrations are not obligatory. We reserve the right to correct or improve the designs or features of products at any time. All sales are governed by Tek-Trol terms and conditions, which are available upon request. Responsibility for proper selection, use and maintenance of any Tek-Trol product remains solely with the purchaser and end-user.

