
ABB MEASUREMENT & ANALYTICS

Differential pressure flow meters

Applying over 100 years of DP flow expertize to industrial processes



Expertize in technology

More than a century of experience

To operate any process efficiently, it is essential to measure, actuate, record and control. With ABB's measurement products and solutions, you are receiving the best technology combined with the most reliable products available on the market.

ABB offers a broad range of life cycle services for optimum product performance. A global network of measurement products specialists delivers local service and support.

Research and development is a vital source of ABB's technology leadership. It builds on the foundation of existing technologies for new applications, and continues to develop the breakthrough technologies needed to meet the challenges of the future.

ABB and its heritage companies have been leaders in innovation and technology for more than 100 years.

Aztec

Bailey

BETA[®]

BOMEM

Bush Beach Engineering
Limited

**FISCHER
& PORTER**

Hartmann & Braun

K-TEK

Kent

Pressductor[®]

SENSYCON

Schoppe & Faeser

Taylor

TBI-Bailey

TORBAR
FLOWMETERS LTD

TOTALFLOW
MEASUREMENT & CONTROL SYSTEMS





Comprehensive measurement solutions

Serving your industry

- 01 HVAC
- 02 Power and industrial steam
- 03 Food and beverage
- 04 Onshore oil and gas
- 05 Minerals
- 06 Metals
- 07 Chemical and petrochemical
- 08 Pharmaceuticals
- 09 Offshore oil and gas

ABB DP flow products provide world-class measurement solutions for any industry. Latest innovations in DP primaries and transmitters deliver technological solutions to make it easier for you to run your plant efficiently and economically.

This results in products that are easy to configure, easy to integrate, and easy to maintain.

The following are only a few of the industries in which DP flow products find application. They are used on the ground, in the air as well as both on and under the sea. Fluids being measured range from water, air or steam through to heavy oil, slurries and molten sulfur.



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DP flow measurement

Our experience at your service

- 01 OriMaster
- 02 PitotMaster
- 03 WedgeMaster
- 04 IOMaster

Experience and capability count in all industries, especially in the design and manufacture of differential pressure based flow meters. ABB has proven experience and capability in the design, engineering, manufacture and application of a comprehensive range of differential producing flow elements - including the manufacture of some of the most complex DP solutions.

Although it is over 100 years since the first DP devices were used commercially, they still form the largest installed base of all flow measurement technologies, especially in the process, power, chemical and oil and gas sectors. ABB has been supplying DP devices from their commercial beginnings in the late 19th century and have unrivalled experience in the field. In fact engineers from ABB companies invented the Wedge meter and the Dall tube.

ABB's DP flow measurement portfolio:

- Venturi tubes
- Wedge meters
- Averaging pitot tubes
- Integral orifice assemblies
- Orifice plates (incl. restriction and pressure drop)
- Orifice unions, carriers and metering runs
- Flow straighteners/conditioners
- Flow nozzles (including PTC-6)
- Subsea meters
- Wet gas solutions
- Stack gas solutions

ABB's DP flow portfolio ranges from simple orifice plates through to custom-engineered metering systems.



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02



03



04

- 05 Subsea system
- 06 Wet gas system
- 07 Wedge
- 08 Venturi

ABB's DP flow elements and systems provide robust, reliable flow metering in a variety of industries and applications but find particular application in oil and gas (onshore and offshore), petrochemicals, power, metals and HVAC.

Reduce your energy usage

By minimizing pressure losses in your system you can reduce the need for top-up pumping or compression and minimize your environmental impact. ABB averaging pitot tubes offer minimal irrecoverable pressure losses as well as being economical and simple to install in your process.

Match your application requirements

Whether your application involves high or low pressures, aggressive fluids, erosive slurries, viscous liquids or extreme temperatures, ABB can engineer a DP flow solution to suit. From LNG production to furnaces and from seabed applications to unconventional oil recovery, ABB have a flow metering solution.

Reduce your cost of ownership

ABB's compact DP flow meters reduce the cost of ownership in a number of ways. They reduce purchase costs by having a single-source, direct mount assembly instead of multi-sourcing of the orifice, carrier, manifold, transmitter, impulse pipe & fittings and temperature element. In addition there are Installation cost savings by the fitting of a single assembly instead of the on-site mounting and interconnection of many individual components. Maintenance costs are minimized by reducing the number of potential pressure leak points by up to 70%.

Performance is improved due to minimal impulse pipe lengths and optional plugged impulse line detection technology.



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Compact DP flow meters

Delivering simplicity in DP flow metering

ABB supply DP flow solutions that are easy to install and operate with minimal specialist knowledge. ABB compact meters offer real savings in all these areas: cost of ownership, greater reliability, much simpler installation and commissioning and they add real value to DP flow metering.

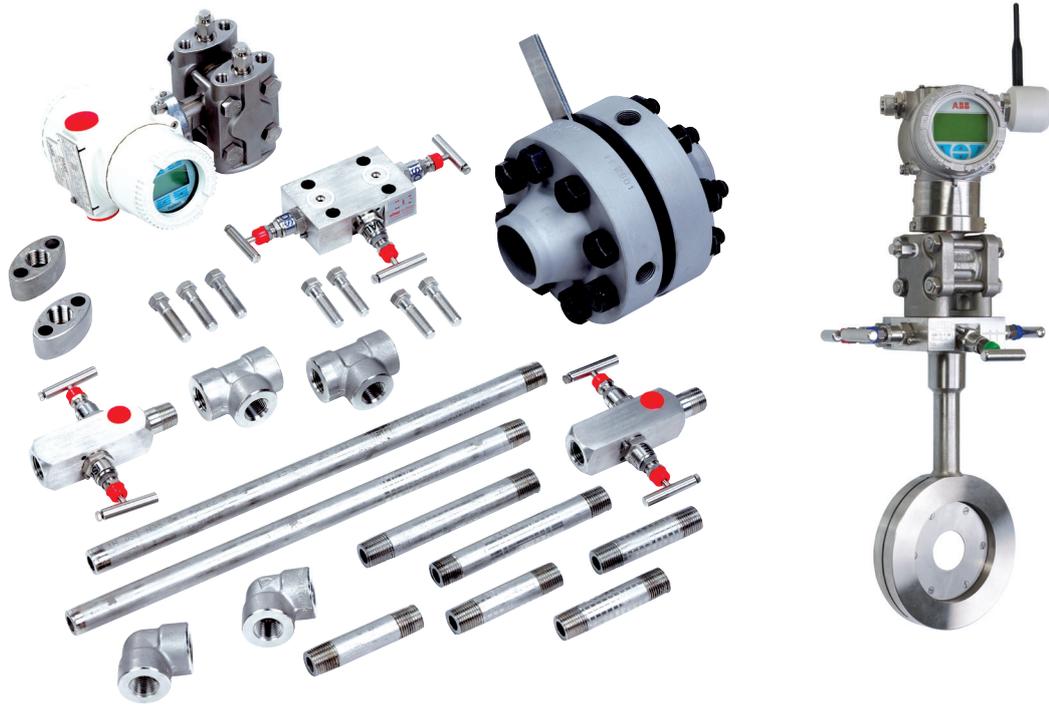
Accuracy, reliability & convenience

Conventional DP flow installations require the sourcing and careful installation/assembly of many separate items to create a flowmeter system - primary element, isolating and

equalizing manifold, DP transmitter, small-bore interconnecting tubing and the tube fittings to connect the system together. For convenience and enhanced functionality, ABB's compact DP flow family combines all these requirements into single, factory tested assemblies.

Simplicity with reduced costs

The compact DP flow family encompasses 4 technologies - Orifice, Wedge, Averaging Pitot and Integral Orifice - and offers flow solutions for gases, steam and liquids (including dirty or viscous liquids and slurries).



— Typical orifice meter parts kit that is replaced by a single OriMaster

“This arrangement has significant benefits in that it greatly simplifies the piping and, most importantly, reduces the number of joints, and thus the number of leak paths at threaded connections and compression fittings.”

Source: TUV NEL; “Good Practice Guide: Impulse Lines For Differential-Pressure Flow Meters”



OriMaster

The OriMaster compact orifice meter is an ideal upgrade solution for existing conventional orifice installations as well as being a cost-effective first-choice meter for new applications. Its optional removable orifice plate and integral temperature elements extend versatility and functionality even further.

PitotMaster

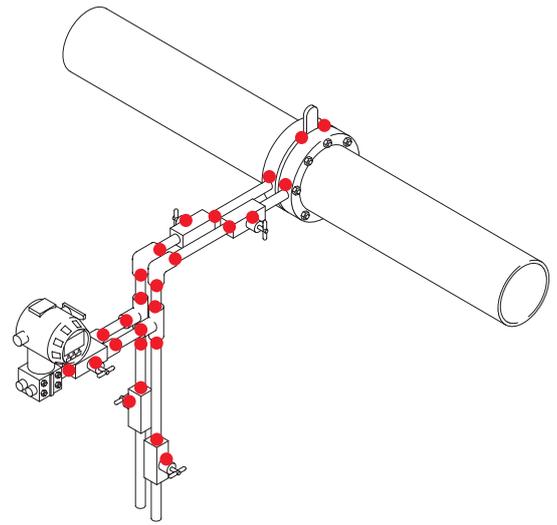
PitotMaster offers the perfect solution for applications requiring very low pressure losses and offers a simple and economical flowmeter solution in existing pipelines where no flowmeter exists. Being especially suited to low pressure gas measurement in larger pipelines, PitotMaster offers economy in purchase, installation and operating cost.

WedgeMaster

WedgeMaster offers reliable flow measurement in applications where available upstream and downstream straight pipe lengths are insufficient for a conventional orifice installation. In addition, the performance of WedgeMaster is maintained down to Reynolds Numbers as low as 500 and offers flow ranges beyond those of other DP meters.

IOMaster

IOMaster is designed to measure low flowrates of liquids and gases in small pipelines. With a wide selection of orifice bores available, replaceable orifice plates and optional fitted upstream and downstream flanged pipe sections, IOMaster can be readily re-scaled as process conditions change.



— Traditional orifice installation highlighting potential leakage points

“Right first time” installation

Every compact DP flowmeter is factory assembled, tested and configured for the application and is provided with a factory acceptance test certificate. This concept has a number of advantages over conventional DP flow meter installations:

- Transmitter is ranged and configured to match the flow element
- Reduced time and cost for procurement and inventory
- Reduced time and cost for installation and commissioning
- Reduction of up to 70% in the number of potential leaks/blockages
- Reduced overall cost of ownership
- Increased performance, including plugged impulse line detection

Mass and corrected volume versions are available, with the options of integral temperature elements and Wireless HART.

Simple to use with innovative features

All ABB compact DP flow meters share the same user friendly HMI which allows simple and intuitive transmitter operation without the need for an expensive hand-held terminal. Simplifying operation even further, ABB is the first instrumentation company that is able to offer Through The Glass (TTG) Technology on DP flow meters, enabling users to interact directly with the unit without removing the windowed cover.

Reliable measurement

Process diagnostics continuously monitor the meters for impulse line clogging or freezing. Once a process anomaly is detected, the Plugged Impulse Line Detection (PILD) function generates a warning on the local LCD as well as via the communication protocol.

**Safety by design**

The compact family meets the requirements for SIL2 (in a single transmitter configuration - 1oo1) and SIL3 (in a redundant configuration - 1oo2) applications. The meters are also available with Wireless HART, providing remote access to what would otherwise be stranded information and maximizing instrument availability.

Venturi tubes

Sustainable flow solutions for complex applications

Venturi tubes offer excellent resistance to wear and consequently require virtually no maintenance. They have a very long service life which is typically the whole life of the plant on which they are installed. They produce a low net pressure loss and therefore reduce energy costs by typically 20 to 25%, with a consequent reduction in greenhouse gas emissions.

Wide range of sizes and materials to match application

ABB are specialists in the engineering and supply of venturi tubes in the demanding applications found in oil and gas, petrochemicals and process industries. Many units are in use in Liquefied Natural Gas (LNG) plants, Gas to Liquids (GTL) processes and in refining. ABB manufacture and supply the complete loop, from DP, pressure and temperature sensors and transmitters through to complete process automation systems.

Calibration offers increased performance

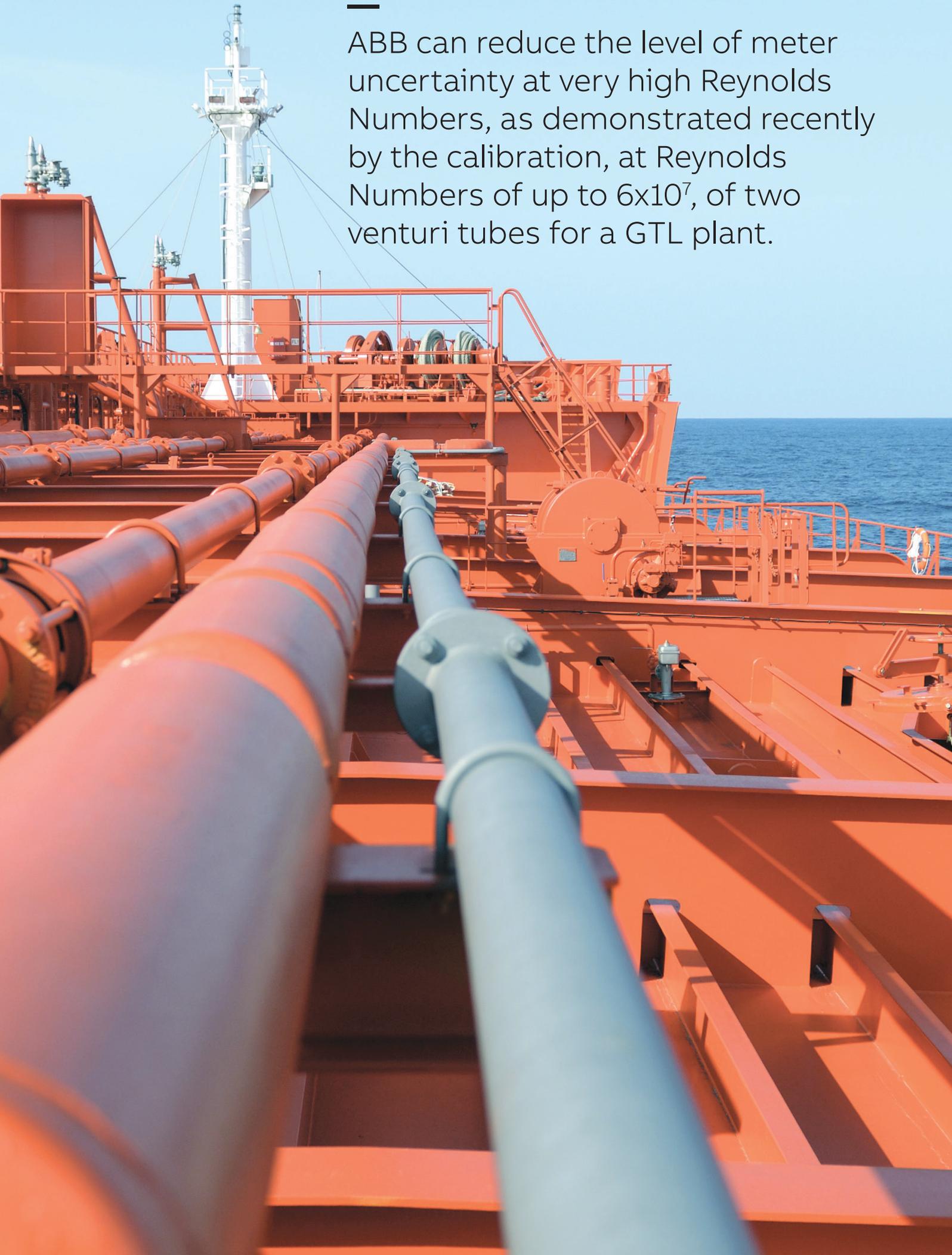
ABB is one of only a few DP flow suppliers to offer in-house calibration of large venturi tubes. Without calibration, all venturi tubes have a larger uncertainty based on (for example) the ISO5167 published coefficient, which necessarily allows for manufacturing tolerances, etc. At very high Reynolds Numbers, the uncertainty band is even wider.

Calibration reduces the overall uncertainty by establishing the actual, as-manufactured discharge coefficient over the meter's operating range of Reynolds Numbers.



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A typical Venturi tube

ABB can reduce the level of meter uncertainty at very high Reynolds Numbers, as demonstrated recently by the calibration, at Reynolds Numbers of up to 6×10^7 , of two venturi tubes for a GTL plant.



Torbar averaging pitot tubes

High performance with minimal pressure loss

- 01 Torbar
- 02 Withdrawable (hot tap) Torbar with geared retraction

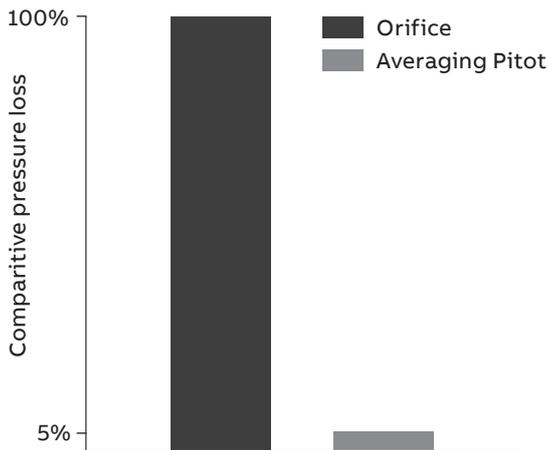
Being insertion devices with a relatively small aspect ratio, Torbars incur a very low pressure loss and are also very economical both to purchase and install, especially in larger pipelines and rectangular ducts. Torbars are also available in retractable versions, allowing insertion and withdrawal from a pipeline without draining the process fluid.

Accuracy and stability, proven across the industry spectrum

Torbars have unique sensor design features, offering more accurate and more stable measurement over a very wide flow range.

Torbar incurs a pressure loss many times lower than that of other DP devices, meaning that energy costs incurred in restoring the lost pressure are minimal. Installation is also much simpler as it typically only requires a single hole in the pipe wall.

Relative pressure losses of a Torbar and an Orifice plate



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Helping to keep track of emissions

Designed to meter stack gases, or other gases containing solids, StackMaster is a Torbar-based mass/volume flow solution, incorporating an automatic air-purging system which periodically flushes the meter ports clear of solid accumulations, thereby maintaining performance and extending meter life. StackMaster is designed and engineered to meet the latest international standards and requirements, including EN15267, MCERTS and EPA. Whether used alone or as part of an ABB emissions monitoring system, StackMaster is your route to legislation compliance, both today and in the future.

Torbar has a unique “dual averaging” system which enhances flow accuracy where the flow profile is asymmetrical.



Wedge meters

Robust, reliable flow solutions for difficult applications

—
01 WedgeMaster
—
02 Flow element
coefficient
comparison chart

The ABB wedge meter product range is adaptable to almost any process condition or installation requirements. Wedge meters are particularly suitable for fluids that are dirty, viscous, abrasive or with a tendency to foul, providing accurate measurements and resisting conditions that would normally wear the sensitive measurement surfaces found in orifice plate, turbine and cone meter or positive displacement meters. In addition they have the widest flow range of any DP-based flow device and require shorter upstream and downstream straight pipe lengths.

Reliable solutions

The wedge element allows any solids or entrained gases to pass through the meter without hold-up. The meter was invented by Taylor Instruments - now part of ABB - some 40 years ago and has been handling difficult, dirty fluids ever since.

Available with tapping designs that can accept remote seal elements, the wedge meter avoids the blockage of impulse lines and response time problems that other devices can encounter when metering slurries and viscous products. As ABB are the leading manufacturer of remote seal systems for transmitters, with the longest experience, the combination of a wedge with ABB's all-welded seals gives the user long term performance and reliability, even in vacuum service.



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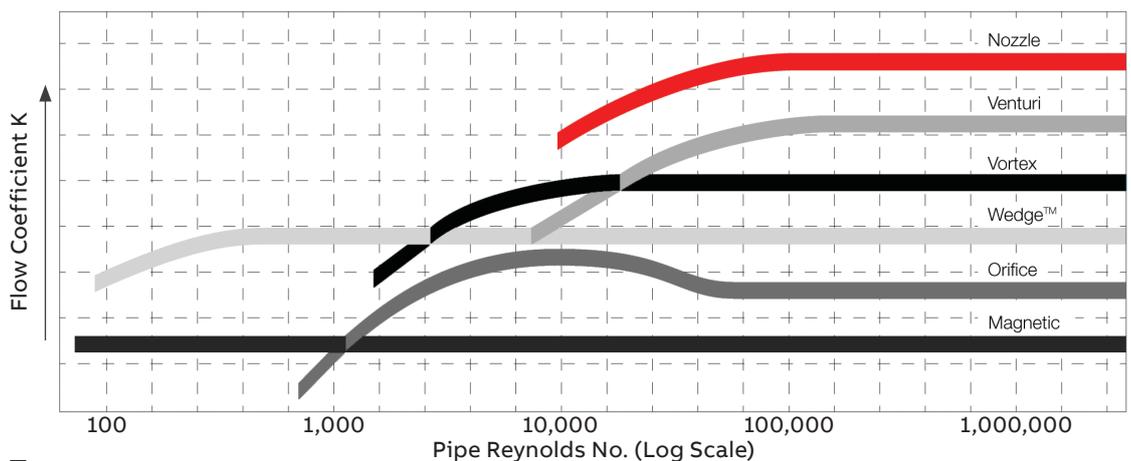


Mastering molten sulfur

Wedge meters used on molten sulfur have overcome the challenges of its high viscosity, high temperature and a tendency to solidify in the process. Coupled to a DP transmitter with high temperature remote seal technology, the wedge meter has no narrow impulse lines to block and the process temperature can be higher, reducing the risks of solidification. Its linear performance down to Reynolds numbers as low as 500 allows its application to fluids at high viscosity.

The characteristics of a wedge include:

- No critical surface dimensions; durable; excellent long term stability
- Stable performance down to Reynolds Numbers as low as 500, giving a large flow turndown
- No dead zones for a secondary phase to build-up (remote seal element)
- Bidirectional flow capability
- High temperature/pressure limits
- Flowpath can be coated/clad to enhance physical or chemical resistance



Flow nozzles

Flow solutions for steam in the power industry

—
01 Flow nozzle
—
02 PTC6 nozzle

Flow nozzles are designed for long term repeatability and reliable flow metering, especially in high velocity applications where erosion or cavitation would wear or damage the critical dimensions of an orifice plate and where high accuracy needs to be maintained.

Long term accuracy and repeatability

Nozzles do not rely on a sharp edge (which can degrade over time) for accuracy, and therefore offer excellent long-term accuracy. ABB offers a range of nozzles, primarily used in power generation, to the following design standards:

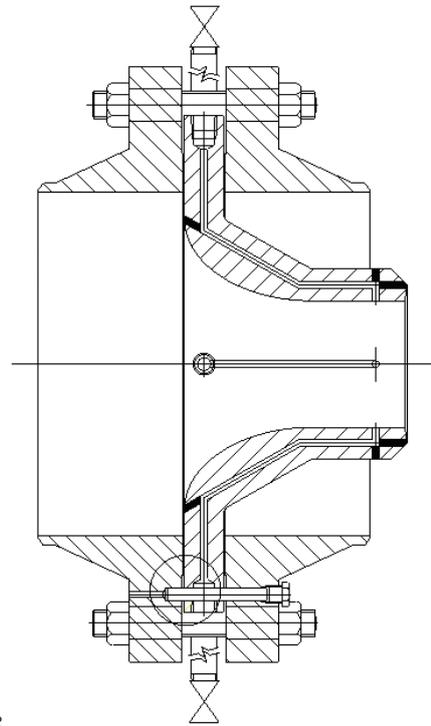
- ISA 1932
- Long radius (high and low rates)
- Throat tap nozzles to ASME PTC-6



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Superheated steam measurement to PTC6

The main application for flow nozzles is in the measurement of superheated steam. A flow nozzle can measure flow rates that are approximately 55% higher than those of an equivalent orifice plate. ASME code PTC-6 includes nozzles for steam turbine testing and their design comprises a throat tap flow nozzle, an upstream pipe section (with integral flow conditioning plate) and a downstream pipe section. The pipe sections are optionally honed to ensure concentricity, minimize ovality and give a precise, known pipe bore. Finally the whole assembly is flow calibrated before delivery.



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Wet gas meters

Helping make gas fields economic

— 01 Phase flow map for a typical wet gas application

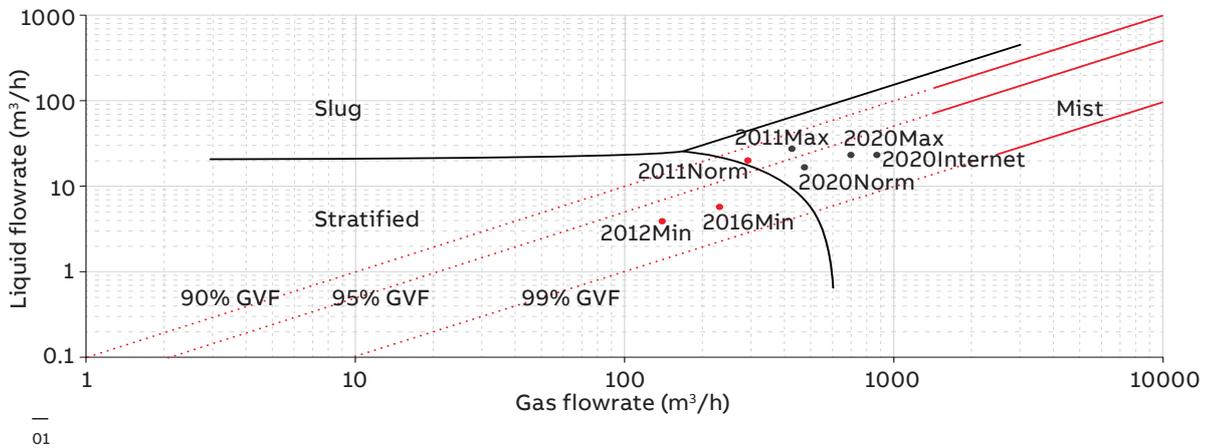
— 02 Wet gas metering system

With many of the most economically attractive gas fields already on stream, the more marginal fields are now being exploited, including gas condensate fields. Here the gas is the primary resource and only small amounts of hydrocarbon liquid and/or water are contained in the gas stream. Separation of the phases for well testing is often either not possible or uneconomic and there is a requirement for meters to measure the gas flow and disregard the liquid phase. ABB's wet gas metering solution is the answer.

Correcting for the liquid content

The metering of wet gas is a difficult application that requires a special approach in both hardware and data processing. The presence of liquid in a

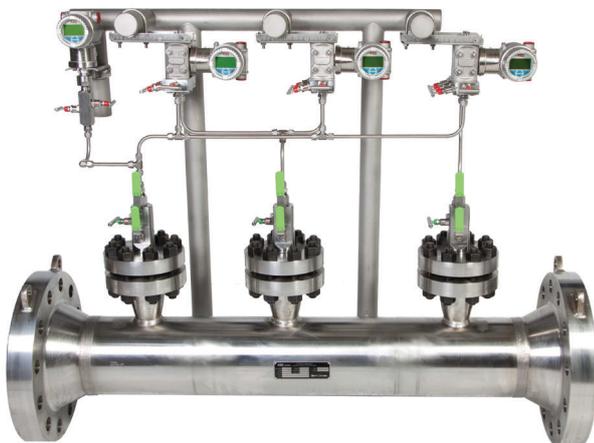
gas stream affects the flow reading of a DP-based meter, giving a value higher than the true flowrate. ABB's wet gas meter uses a venturi tube as the primary element - ideal for use in wet gas metering as it is less affected than most by the presence of liquid in a gas phase. The meter is typically supplied with multivariable and DP transmitters, or separate DP, pressure and temperature transmitters. The over-reading is corrected by algorithms (including De Leeuw, Steven, Chisholm, Dickinson and Jamieson correlations) within the supplied PLC/DCS/FC to provide true gas flow readings.





Wet gas meters are used in a number of applications, including:

- Development of marginal oil and gas fields
- Process metering - where gas contains hydrocarbon liquid water or a mixture of the two
- Allocation metering - enabling individual well control
- Well management
- Well testing - reducing CAPEX in evaluation of new wells
- Production optimization



DeepSeaMaster

Subsea flow solutions - proven at extreme conditions

— 01 DeepSeaMaster with dual subsea transmitters

— 02 DeepSeaMaster with manifold, subsea transmitter and umbilical

The ever-increasing depth of oil and gas discoveries has compelled the industry to move away from offshore platforms and towards seabed operations, with equipment mounted directly onto or near the wells themselves. ABB's DeepSeaMaster is designed to operate in this environment.

ABB DeepSeaMasters are in use on applications where the downhole conditions are 150°C and 82 MPa (300°F and 12000 lbf/in²)

Metering where it is needed

DeepSeamaster is a flow meter used on the sea bed, either in the injection of additives or to measure product, often at depths of many hundreds of meters. High pressures are encountered both externally and internally; ambient temperatures are low whilst the fluid is warm; both the environment and the process fluid are aggressive.



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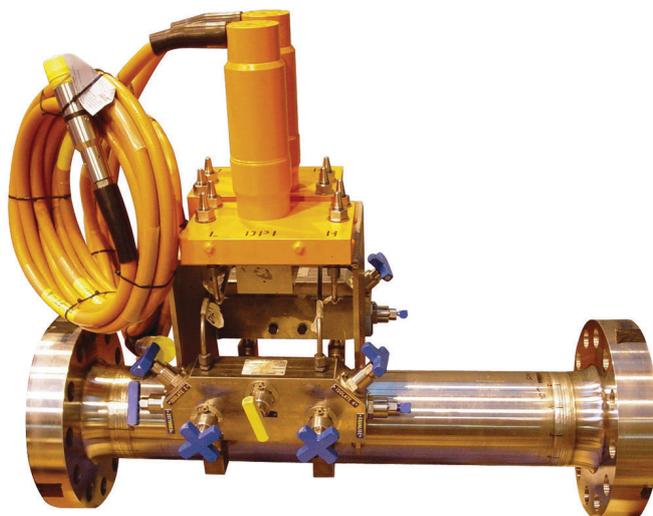


High reliability with low pressure losses

ABB's DeepSeaMaster is supplied with wetted materials to resist severe erosion and corrosion, with meters fabricated from a wide range of materials, including metal-overlay constructions. Subsea DP transmitters and cabling can be fitted and the metering element can be based on any one of a variety of classical DP metering techniques, depending upon the requirements of the application. In most cases venturi tube technology is used to provide low pressure losses with high tolerance of multiphase fluids.

Typical applications include

- Inhibitor injection to control hydrate formation
- Dry and wet hydrocarbon gas measurement
- Light and heavy HC liquids at low Reynolds Numbers



Orifice plates, unions and carriers

Proven, simple yet versatile

—
01 Orifice plates
- paddle, RTJ and
carrier examples

—
02 Sectioned orifice
metering run with
RTJ orifice plate

Devices based on orifice plates remain one of the best selling flow metering technologies. As well as measuring flow, they are used to restrict the flowrate to a certain value or to reduce the pressure at a certain flowrate. The technology is well-known and thoroughly proven and is available from ABB in a wide range of designs to suit most applications.

ABB routinely supply not only the orifice unit but also all of the documentation and certification the user demands to assure quality and suitability.

From simple plates to metering runs

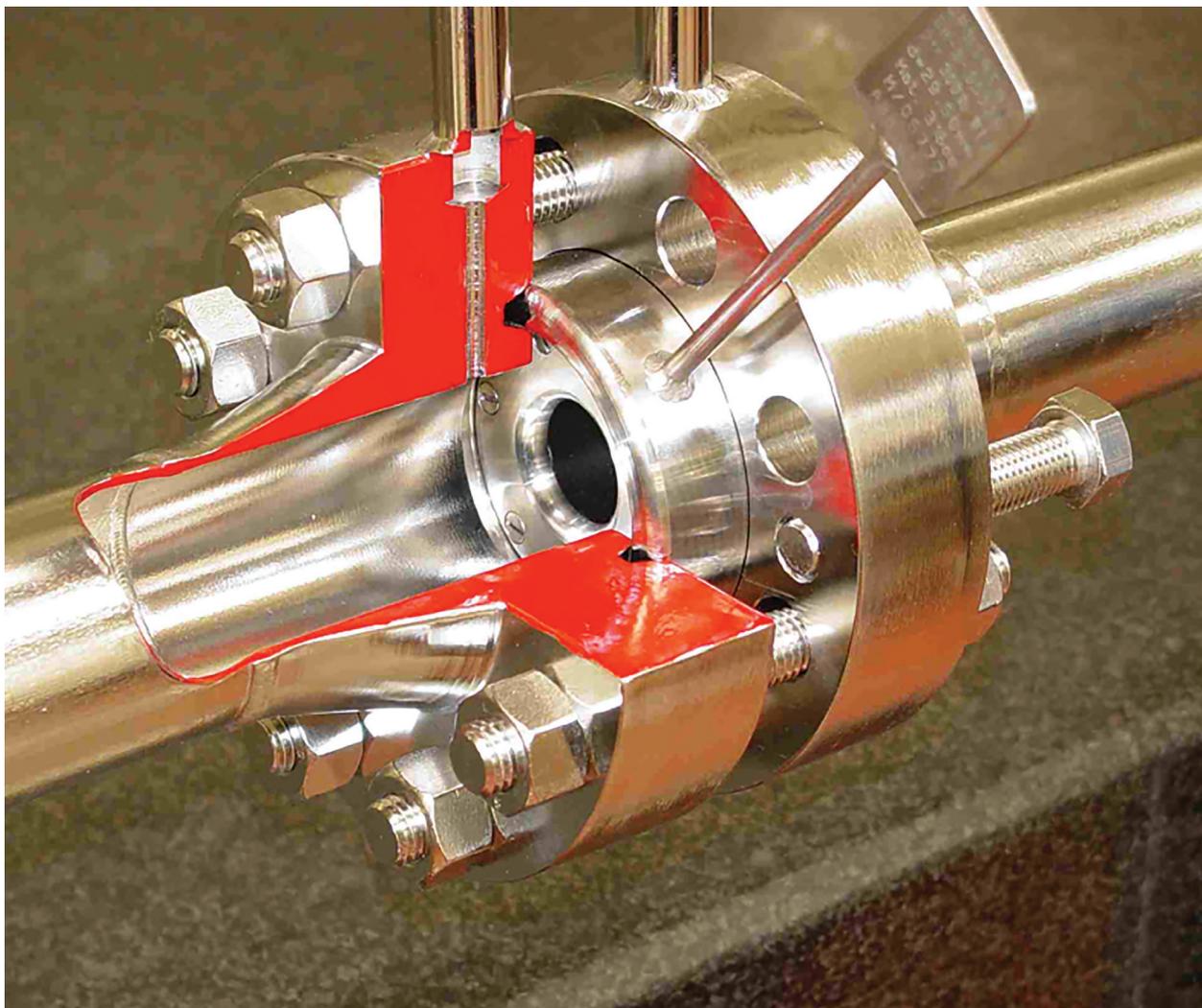
ABB have an orifice plate, union or orifice carrier for all orifice applications - simple flow measurement, flow restriction or pressure reduction.

The range includes:

- Paddle-type plates - square edged, quarter circle/conical, eccentric
- RTJ plates - with male or female process connections
- Orifice carriers - with integral tapping connections
- Orifice metering runs - with upstream/downstream pipe sections
- Complete Flanged Orifice Unions (Orifice Flange Assemblies)
 - Integral tapping connections
 - Butt-weld or slip-on pipe connections
 - ASME B16.36



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DP flow meters

A comprehensive offering by industry

	Compact DP flow meters				Orifice plates and carriers	
	OriMaster	IOMaster	PitotMaster	WedgeMaster	Orifice plates	Orifice assemblies
						
Industries						
Oil and gas			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Refining			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Subsea				<input type="checkbox"/>		
Unconventional gases				<input type="checkbox"/>		
Chemical	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Power	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Renewables						
Solar			<input type="checkbox"/>			
Biogas/biomass			<input type="checkbox"/>			
Pharmaceutical	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
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Desalination	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Mining	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Pulp and paper	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Metals	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Defence/military	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
Plastics	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>
HVAC			<input type="checkbox"/>			<input type="checkbox"/>

Averaging pitot	Flow tubes			Flow solutions		
Torbar	Venturi	Wedge	Nozzle	Wet gas systems	Subsea systems	Stack gas metering
						
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