



Flow Meter Selection Guide

Flow measurement is **essential** for optimizing industrial processes and ensuring accurate control. Spartan Controls offers **tailored solutions** for diverse applications.

Flow Meter Selection

Flow Meter requirements vary, from mass flow to volume flow and beyond. There are some key considerations with respect to Technology selection when it comes to selecting the right flowmeter.

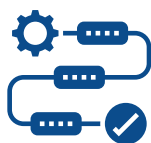


This document is intended to provide a rough overview and guide to technology selection commonly found in industry. Some key considerations selecting a flowmeter can be separated as shown to the right. There remains complexity in flowmeter selection, for optimal selection for the use case it is recommended to connect with a Spartan Controls Measurement Specialist to consult with selection, sizing, limitations, model number selection and cost.



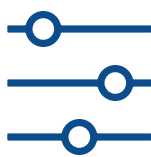
APPLICATIONS

Control
Monitoring & Optimization
Functional Safety
Custody Transfer
Fit for Purpose



PROCESS

Measurement Type
Fluid Type
Process Conditions



PREFERENCES

Cost - CAPEX
Maintenance & Calibration - OPEX
Accuracy / Performance
Installation Constraints
Connectivity

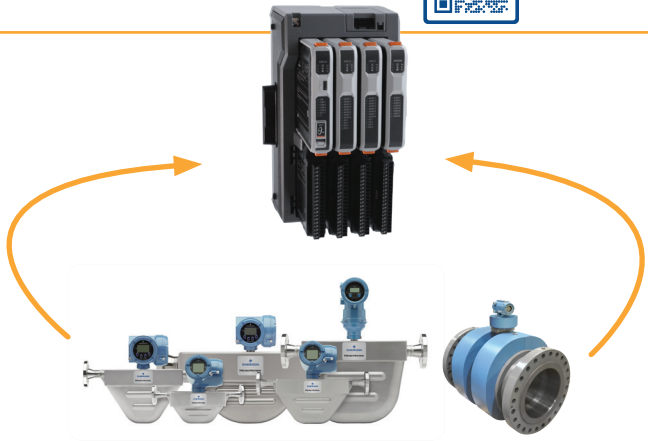


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Requirements for a Flow System



- **Primary:** Flow element (measurement device)
- **Secondary:** Electronic transmitter
- **Tertiary:** Flow computer designed with appropriate flow calculations (AGA, API, ISO) to learn more about flow computers and application suites please contact Spartan Controls.



Items for Consideration

- **“Recommended” Rating:** If this criteria is the absolute most important factor, these technologies should be your top choice.
- **“Suitable” Rating:** If this criteria is important, these technologies should be considered. On this single criteria, a different flow technology may have better performance.
- **“Not Suitable” Rating:** If this criteria is important, these technologies are not a good choice.
- **Typical Accuracy:** Most common accuracy for this flow technology.
- **Best Accuracy:** Best accuracy option for this flow technology with proper installation conditions.
- **Standard reference accuracies** have been provided, these values can be increased or decreased based on line size, model, etc. Reference accuracy should not be confused with uncertainty which is defined in AER Directive 17.
- **Turndown:** Can vary based on the specific model for each flow technology. Turndown shown is available on top tier product offering. Turndown = Maximum Flow Rate ÷ Minimum Flow Rate at which the meter maintains its stated accuracy.
- **Straight Pipe:** Can vary based on specific model for each flow technology. Straight pipe listed is distance required on top tier product offering without impacting accuracy.

Coriolis Meters



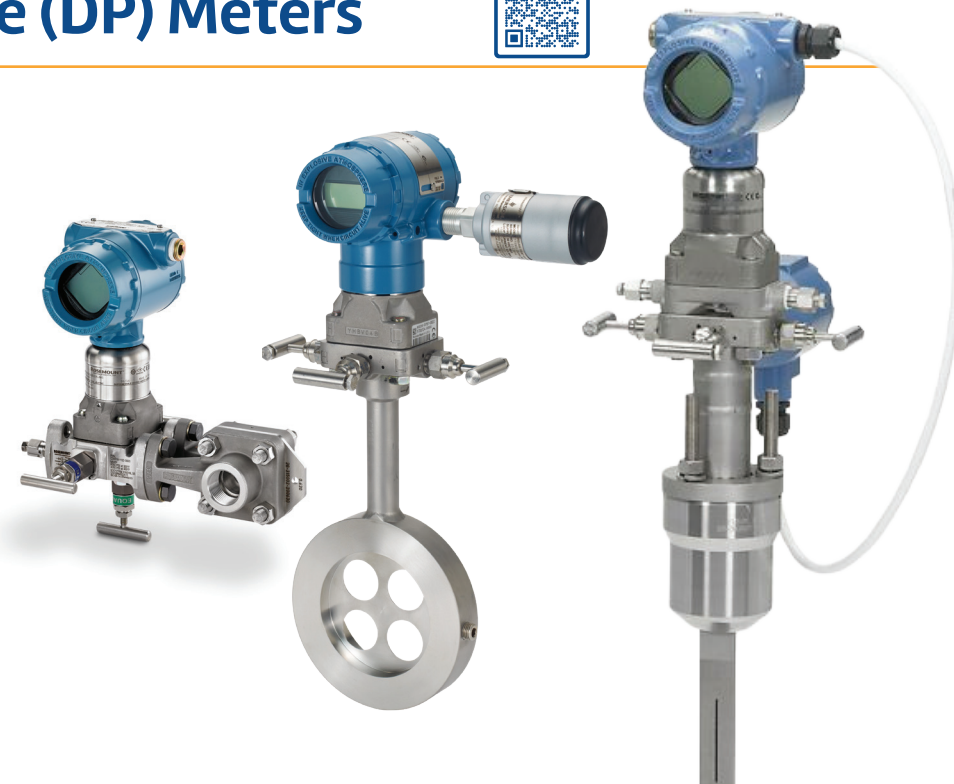
Coriolis meters are generally considered the most repeatably accurate flow meters available today. Coriolis meters are ideal for any application where high accuracy is a key factor for consistent product quality, safety and revenue. They are often applied in custody transfer applications due to their excellent accuracy over broad conditions and low maintenance requirements.



Differential Pressure (DP) Meters



Differential Pressure is the oldest industrial measurement technology still in use today, with a proven documented history of performance. Our ongoing research ensures that the 100-year-old design is fine-tuned for today's flow meters. The differential pressure flow meter is the most widely used flow technology in industrial process measurement and control, natural gas custody transfer measurement and many other applications.



Magnetic Meters



Electromagnetic flow meters (known more simply as magnetic flow meters, or mag meters), represent the second largest segment within the precision flow meter market. Magnetic flow meters are a top choice for measuring the volumetric flow of conductive liquids due to their excellent measurement performance across a wide range of process conditions.



Non-Intrusive Ultrasonic Meters



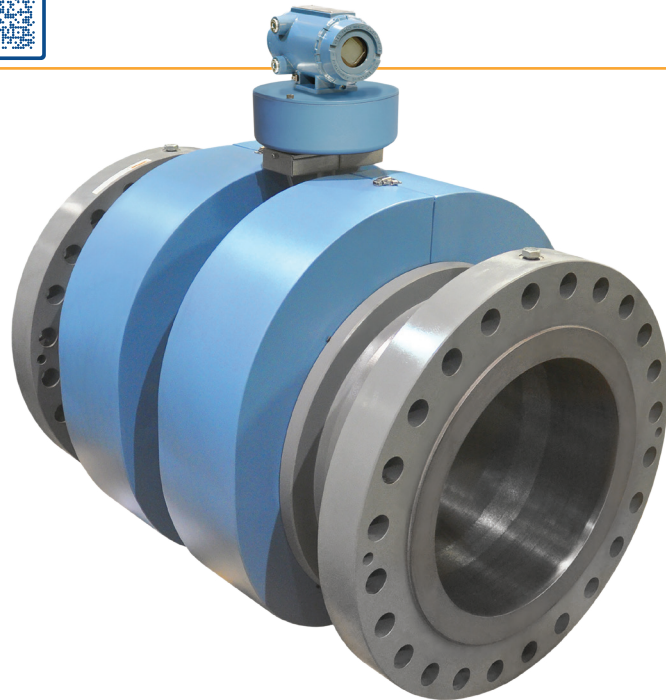
Flexim non-intrusive ultrasonic flow meters offer precision measurement accuracy without the need for direct contact with the pipe. This innovative, clamp-on technology can accurately measure liquid, gas, clean steam or thermal energy in various industries, optimizing efficiency and reducing downtime.



Ultrasonic Meters



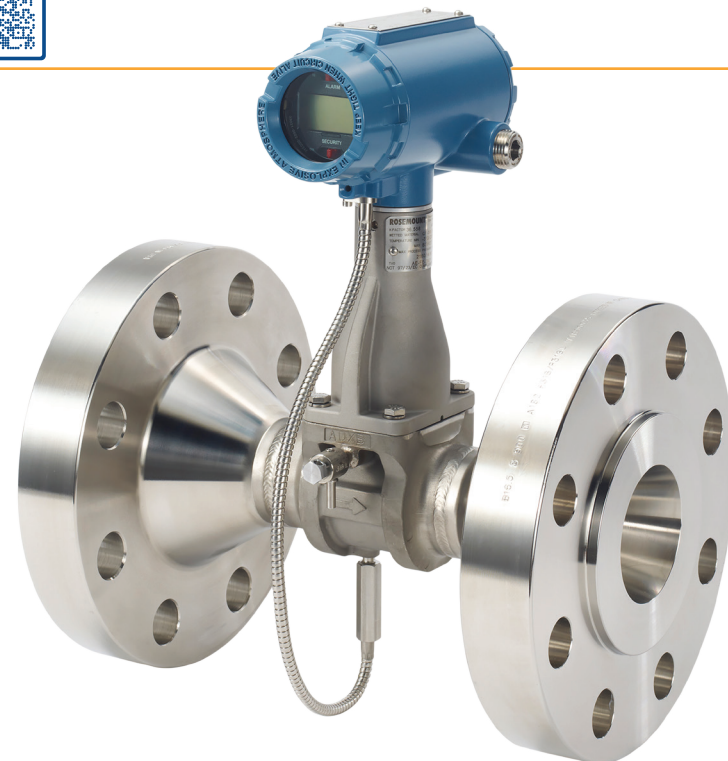
Ultrasonic meters are commonly used for custody transfer and fiscal oil and gas measurement. An ultrasonic flow meter measures the velocity of a fluid in a closed pipe using ultrasonic sound pulses. However, process conditions such as composition, pressure and temperature dictate which type of ultrasonic meter is most appropriate.



Vortex Meters



Vortex meters can be used to measure gases and low-viscosity liquids over a wide range of conditions, and with the recent development of multivariable flow measurement capability, they can also directly output referred units such as gas standard volume, liquid standard volume, mass flow, and energy/heat index values such as British Thermal Units (BTU). Vortex meters have exhibited steady growth in recent years, primarily due to their adoption in saturated steam and oil & gas applications.



Flare Ultrasonic Meters



Flare Ultrasonic Meters are used to measure and monitor flare and vent gas flows across a wide range of industrial applications, including oil and gas, petrochemical, LNG, and renewable energy sectors. These meters support emissions monitoring, regulatory compliance, leak detection, and loss tracking. Flare metering poses its own challenges with requirements of measuring pilot gas to large volumes of gas during upset conditions. With advanced signal processing and multi-path configurations, they provide reliable flow measurement even under challenging process and environmental conditions. Typical turndown requirements are 4000:1 or from flow rates of 0.03m/s to 120m/s.



Thermal Mass Meters



Thermal Mass Flow Meters are known for their high accuracy, reliability, and suitability for demanding industrial gas applications across various conditions. Key applications include flare metering, essential for regulatory compliance in industrial flaring, incinerating, and venting, ensuring safe and accurate flare gas measurement.




Flow Meter Applications Overview




CORIOLIS

- Highest accuracy mass flow and density measurement
- Ideal for critical product quality, safety, and fiscal applications
- Broad turndown and two-phase flow capability
- Data rich device



MAGNETIC

- Excellent measurement and cost effective for conductive liquids
- Highly corrosive applications
- Great for slurry applications
- Almost no pressure drop



DP FLOW (ORIFICE PLATE)

- Most widely known flow technology for field familiarity
- Cost effective for process control
- Options to reduce straight pipe run for compact installations



VORTEX

- Wide range of process flow rates supporting many different process fluid types with the same device
- Ultra low or ultra high temperature capabilities with standard product
- Low/no maintenance
- Online sensor replacement capability




THERMAL MASS

- Measures gas flow in industrial and oil & gas sectors
- Tracks biogas, flare, vent, and digester gas flows
- No moving parts; ideal for high-vibration environments
- Minimal pressure drop; suitable for low-pressure systems



DP FLOW (ANNUBAR)

- Measures gas, steam, and liquid flow in pipelines
- Ideal for high-pressure, high-temperature, severe service conditions
- Supports mass, energy, and volumetric flow calculations
- Enables bi-directional flow measurement with single sensor design



ULTRASONIC INLINE

- High accuracy, custody transfer, and fiscal applications
- Oil and gas pipelines: production & distribution
- High turndown
- Almost no pressure drop
- Low maintenance
- Data rich device



ULTRASONIC (FLARE)

- Measures flare gas in oil, gas, and petrochemical plants
- Operates in extreme temperatures and variable gas compositions
- Enables emissions monitoring for regulatory compliance and reporting
- Suitable for low-pressure, high-velocity flare gas conditions
- Non-intrusive installation on large-diameter flare stacks



ULTRASONIC (NON-INTRUSIVE)

- No corrosion, leakage, or contamination issues
- Cost effective for large line sizes and retrofits
- High pressure and high temperature applications
- High turndown
- Zero pressure drop
- Virtually no maintenance

Suitable Technologies Based on Applications

APPLICATIONS	CORIOLIS	MAGNETIC	VORTEX	DP FLOW (ORIFICE PLATE)	DP FLOW (ANNUBAR)	ULTRASONIC (IN-LINE)	ULTRASONIC (NON-INTRUSIVE)	ULTRASONIC (FLARE)	THERMAL MASS
CONTROL	●	●	●	●	●	-	●	-	○
MONITORING & OPTIMIZATION	●	●	●	●	●	○	●	●	○
FUNCTIONAL SAFETY	●	○	●	●	●	-	○	-	○
CUSTODY TRANSFER									
FISCAL (LIQUID & GAS)	●	-	○	○	-	●	-	-	-
FISCAL (STEAM)	-	-	●	●	●	-	-	-	-
ALLOCATION	●	-	○	●	○	●	●	●	○
FIT FOR PURPOSE									
BATCHING / DOSING	●	○	-	-	-	-	○	-	-
DISPENSING	●	-	-	-	-	-	-	-	-
CHEMICAL INJECTION	●	○	○	○	-	-	●	-	-

● Recommended ○ Suitable - Not Suitable

Suitable Technologies Based on Process

PROCESS	COROLIS	MAGNETIC	VORTEX	DP FLOW (ORIFICE PLATE)	DP FLOW (ANNUBAR)	ULTRASONIC (IN-LINE)	ULTRASONIC (NON-INTRUSIVE)	ULTRASONIC (FLARE)	THERMAL MASS
CUSTODY TRANSFER									
MASS	●	-	○	○	○	○	○	○	●
ENERGY	●	-	○	○	○	○	●	○	○
VOLUME	●	●	●	●	●	●	●	●	○
DENSITY, CONCENTRATION	●	-	-	-	-	-	○	-	-
MULTIVARIABLE	●	-	●	●	●	●	○	○	-
FLUID TYPE									
LIQUID: WATER BASED	●	●	●	●	●	○	●	-	-
LIQUID: HYDROCARBONS	●	-	●	●	●	●	●	-	-
LIQUID: CRYOGENIC	●	-	●	●	●	○	●	-	-
LIQUID: VISCOUS	●	●	-	○	-	○	●	-	-
LIQUID: ABRASIVE OR SLURRY	○	●	-	○	-	-	○	-	-
LIQUID: ENTRAINED AIR	●	○	-	○	-	○	○	-	-
STEAM: SATURATED	-	-	●	●	●	-	○	-	-
STEAM: SUPERHEATED	○	-	●	●	●	-	○	-	-
GAS: NATURAL GAS	●	-	●	●	●	●	●	○	●
GAS: UTILITY	●	-	●	●	●	○	●	○	●
GAS: WET GAS	○	-	○	●	○	●	○	-	-
GAS: HYDROGEN	●	-	●	●	●	○	●	○	●
CHANGING FLUIDS: CONSULT WITH SPARTAN	●	-	○	-	-	○	●	○	○
PROCESS CONDITIONS									
PRESSURE MAX	1,131 bar (16,401 psi)	425 bar (6,170 psi)	258 bar (3,750 psi)	425 bar (6,170 psi)	425 bar (6,170 psi)	275 bar (4,000 psi)	No Limit	20 bar (275 psi)	51 bar (740 psi)
TEMPERATURE	-253 – 426°C (-423 – 800°F)	-50 – 177°C (-58 – 350°F)	-201 – 450°C (-330 – 850°F)	-257 – 677°C (-430 – 1,250°F)	-198 – 816°C (-325 – 1,500°F)	-50 – 150°C (-58 – 302°F)	-200 – 630°C (-328 – 1,166°F)	-200 – +350°C (-328 – 662°F)	-40 – 121°C (-40 – -250°F)
LINE SIZE MIN	1 mm (1/12")	4 mm (0.15")	15 mm (0.5")	15 mm (0.5")	50 mm (2.0")	100 mm (4.0")	6 mm (0.25")	150 mm (6.0")	18 mm (0.75")
LINE SIZE MAX	350 mm (14")	1,200 mm (48")	350 mm (14")	1,800 mm (72")	5,200 mm (204")	1,050 mm (42")	6,500 mm (256")	2,500 mm (100")	1,750 mm (70")

● Recommended ○ Suitable - Not Suitable

Suitable Technologies Based on Preferences

PREFERENCES	COROLIS	MAGNETIC	VORTEX	DP FLOW (ORIFICE PLATE)	DP FLOW (ANNUBAR)	ULTRASONIC (IN-LINE)	ULTRASONIC (NON-INTRUSIVE)	ULTRASONIC (FLARE)	THERMAL MASS
CAPITAL COST									
SIZE LESS THAN 4"	○	●	●	○	○	-	○	-	●
4" TO 14" SIZE	○	●	○	●	●	○	●	●	○
SIZE GREATER THAN 14"	-	○	-	●	●	○	●	●	○
MAINTENANCE & CALIBRATION									
OPERATIONAL EXPENSE	●	○	●	○	○	●	●	●	○
HEALTH & PROCESS DIAGNOSTICS	●	●	●	○	○	●	●	●	○
AUTO VERIFICATION	●	●	○	-	-	●	●	○	●
ACCURACY (TYPICAL / BEST)									
LIQUID ACCURACY	0.1% / 0.05%	0.25% / 0.15%	0.65%	1.25% / 0.75%	1.25% / 0.8%	0.15%	1%	N/A	N/A
GAS ACCURACY	0.25% / 0.1%	N/A	1%	1.25% / 0.75%	1.25% / 0.8%	0.01%	1-2%	0.75%	1-1.5%
TURNDOWN / RANGEABILITY	30:1	40:1	38:1	14:1	14:1	100:1	200:1	4000:1	100:1
INSTALLATION CONSTRAINTS									
UPSTREAM STRAIGHT PIPE	0D	5D	10D	2D	8D	5D	10D	10D	15D
DOWNSTREAM STRAIGHT PIPE	0D	2D	5D	2D	4D	3D	5D	5D	10D
MINIMIZED PRESSURE DROP	○	●	○	-	○	●	●	●	●
NO LEAK POINTS	●	○	●	-	-	○	●	○	○
BI-DIRECTIONAL	●	●	-	○	○	●	●	○	-
INSTALL WITHOUT CUTTING PIPE	-	-	-	-	○	-	●	-	-
POWER OPTIONS	2-wire, 4-wire	4-wire	2-wire	Battery, 2-wire	Battery, 2-wire	4-wire	Battery, 4-wire	4-wire	4-wire
CONNECTIVITY									
MULTIPLE OUTPUTS	●	○	○	-	-	●	●	●	-
ETHERNET	●	●	-	-	-	●	●	○	-
NATIVE WIRELESS	WiFi, Bluetooth	-	-	Wireless HART	Wireless HART	-	-	-	-

● Recommended ○ Suitable - Not Suitable



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