

Q.Sonic Ultrasonic Gas Flow Meters



ITT Controls Instromet

Q.Sonic Ultrasonic Gas Flow Meters Deliver Unparalleled Performance

ITT Controls Instromet's Q.Sonic series is the most accurate and flexible ultrasonic meter for custody transfer applications.

Advantages

- Large turn down ratio
- Bi-directional
- Flow profile detection
- CMB signal processing
- Swirl and asymmetry detection
- Reflective technology
- TwinSonic, a Q.Sonic with redundant electronics
- Uniguard™ diagnostic software
- Flow conditioner and adjacent spool pieces
- Assure measurement and operational integrity
- Advanced path configuration
- Dynamic flow profile correction
- Extended diagnostic functions
- Ultrasonic noise suppression
- Application Related Path Substitution (ARPS)
- High-pressure calibration
- Material certificates: EN 10204 - 3.2, NACE MR-01-75
- No moving parts
- No pressure drop
- ISO CD17089 compliant
- AGA-9 compliant
- Highest noise immunity
- Highest repeatability



Theory of Operation

An ultrasonic flow meter takes advantage of the principle that an ultrasonic pulse travels faster with the gas flow than against the flow. The larger the difference between the upstream travel time versus the downstream, the more gas has passed through the meter. The advent of high speed computer processors has made it possible to detect very small time differences between the upstream and the downstream travel times. Because ultrasonic meters do not depend on the kinetic energy from the field, very low flows can be detected.

Ultrasonic Flow Meters

Based on performance, reliability and availability the patented single and double reflection paths have proven to be the standard in custody transfer gas measurement systems. Q.Sonic series is the most accurate and flexible ultrasonic meter for custody transfer applications and our single and double reflective path technology delivers unparalleled flow velocity recognition and range. Q.Sonic meters are available in sizes ranging from 4" to 64" with a turndown ratio as high as 100:1 and can be used in bi-directional applications.

Fit for Purpose with Integrity in Measurement

In practice, there are no simple solutions and a "one size fits all" solution cannot be optimal. Ultrasonic gas flow meter applications have expanded considerably since their introduction over two decades ago. Tougher applications demand technically advanced solutions and Elster Instromet continues to meet the challenge. The 4th generation ultrasonic meters produced by Elster Instromet today are the most sophisticated on the



market and contain many advancements. The Q.Sonic line of ultrasonic flow meters are the only ones featuring extended diagnostics with the possibility of detecting fouling and ultrasonic flow pattern recognition.

Cost Advantages & Installation Savings

Because of no pressure drop and high rangeability, ultrasonic meters can have a beneficial impact on installation capital expenditures.

In the example below, twelve 12" orifice meter runs were replaced by one 18" ultrasonic meter. The cost savings for the ultrasonic installation were in excess of \$850,000.00.

Maintenance Savings:

Ultrasonic meters with no moving parts and rugged, field tested design have a real maintenance cost advantage over the life of the metering application. Ultrasonic meters can also communicate their diagnostics remotely, saving maintenance time and expense.

The optional retractable transducer design cuts down on the cost of maintenance and installation by allowing removal of transducers under flowing pressure without the need for block valves or bypass lines.



Before



After



Ultrasonic Expertise

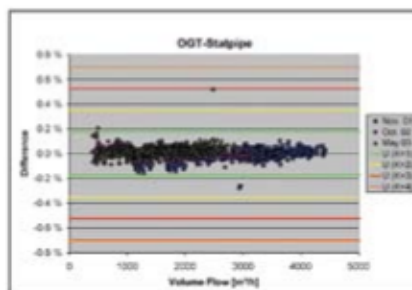
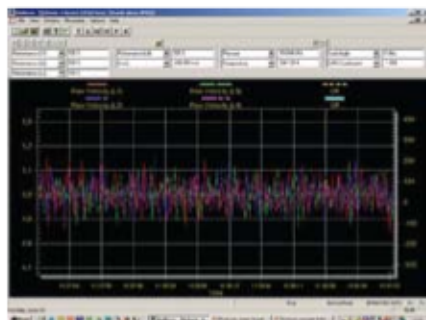


Figure 12: "Footprints" from three different months since September 2001.



User Interface

UNIFORM – the most used Ultrasonic Flow Meter (USM) interface now available for monitoring Series-IV electronics. The communication capabilities include four independent serial ports and allows parameter setting "on the fly".

Upgrades of software can be simply downloaded while parameters and logged data are preserved.

- Data logging: more than 35 days of hourly records
- Path substitution: calculates failing path value based on historic ratio's of your application
- Verification and audit trail: traceability of parameter settings and alarm listing
- Data security: 5 levels of password protection available now
- Integration algorithm: recent research of distorted flow profile effects results in improved characterization of flow profile properties and reduces measuring errors due to installation effects

Long-term Stability

Regular verification is mandatory to maintain accuracy of a metering system, but contributes heavily to the operational cost of the system. The verification intervals depend mostly on the primary flow measurement element and indirectly on the measurement technology.

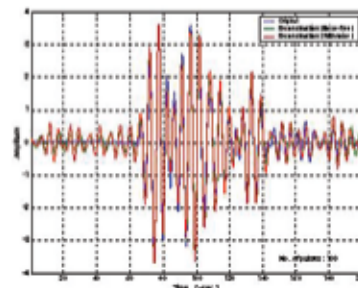
The graph above confirms the excellent repeatability, which is the key to accurate measurement, and long-term stability of an Elster Instromet USM which, due to the unique path configuration, is even able to monitor its performance in the process itself.

Our Guarantee

ITT Controls Instromet not only provides the highest quality, best performing ultrasonic meters but also a wide range of technical solutions using an unprecedented range of products and services.

Elster Instromet products and solutions support is among the most experienced in the world.

Ultrasonic Advancements



Transducer Technology

ITT Controls Instromet's proprietary transducer designs have been the vital element enabling Elster Instromet meters

to perform to the highest industry standards. The high efficiency and power of these devices enable the use of longer path lengths with multiple reflections, resulting in unmatched flow velocity recognition and range. Today's transducers are smaller and more rugged than in the past and are

available in a variety of configurations:

- space-polymer technology for high-temperature applications
- special compounds with extreme resistance to high H_2S concentrations in natural gas
- high-frequency design for noise immunity, high CO_2 concentrations, low-pressure operation
- the ability to exchange transducers without re-calibrating or fine-tuning or the need for double-block-and-bleed valves.

Diagnostics

ITT Controls Instromet meter design allows two major diagnostic capabilities:

Snapshot Diagnostic –

checks USM operation within accuracy specifications via extensive self testing. It allows the operator not only to examine signal waveform and amplitude but also, on account of the path configuration, to detect and compensate for swirl and flow-profile asymmetry. Also Speed-of-Sound (SOS) can be used to detect deviations in both the meter and the process itself.

Healthcare Diagnostic –

monitors the metering process and trending to evaluate effects on meter performance. For example, wall contamination can change the effective pipe diameter and thus introduce error. Non-reflective ultrasonic meters do not have this capability.

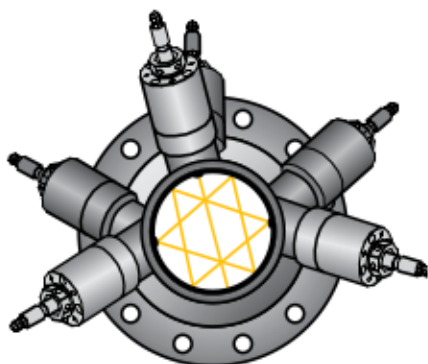
Coded Multiple Burst

Coded Multiple Burst (CMB) technology – to help solve noise problems.

Regulating valves create line noise whose frequencies often fall in a meter's ultrasonic range. Part of the energy created during pressure reduction is transferred into acoustic energy, which can lower the meter signal-to-noise ratio and resulting measurement accuracy. Our research has led to the design of a model, adopted by ISO, to project proper meter functioning in a specific installation.

The CMB approach tells the meter "what to look for" in ultrasonic signals so noise is largely ignored. Unlike stacking or averaging techniques, CMB does not cause any delay in measuring time. An Elster Instromet ultrasonic meter can therefore be placed nearer to a pressure-regulating valve in full compliance with AGA and ISO norms.

ITT Controls Instromet has developed a range of Ultrasonic Gas Flow Meters, each model designed to best meet the individual operational demand.

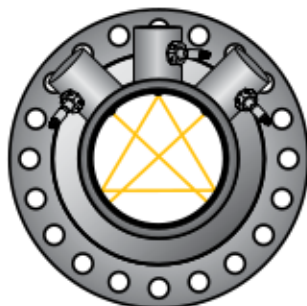


Q.Sonic-3 – Meeting Industry Standards

With more than 2000 3-path meters in operation worldwide, the Q.Sonic-3 is the industry standard for custody transfer.

The Q.Sonic-3 complies with AGA Report 9 and ISO standard CD17089.

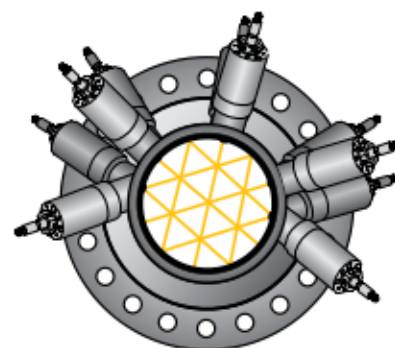
Suggested upstream length without flow conditioner – 10D, with flow conditioner – 5D



Q.Sonic-4 – Exceeding Industry Standards

In addition to the 2 double reflection paths of the Q.Sonic-3, the Q.Sonic-4 has two single reflection paths crossing each other at an angle of 90°. This makes the meter less sensitive to asymmetric flow distortions and results in a 10D straight upstream requirement. The meter is designed for short upstream lengths which are most common with offshore applications and measurement and regulation stations.

Suggested upstream lengths without flow conditioner – 10D, with flow conditioner – 5D



Q.Sonic-5 – Highest Industry Standard

The Q.Sonic-5 has the highest level of flow profile recognition in the industry and has long been recognized as the most accurate and flexible ultrasonic meter available. Due to the unique path pattern it gives the most reliable diagnostic data to maintain lowest uncertainty.

Suggested upstream lengths without flow conditioner – 10D, with flow conditioner – 5D

ITT Controls Instromet Bounce Technology

ITT Controls Instromet uses a combination of two distinct path configurations to make it possible to measure not only the flow, but also the swirl angle. The unique closely spaced network of single bounce and double bounce paths provides analysis of the flow profile and swirl components

of the gas. The measurement of the flow is insensitive to the orientation of the meter with respect to the pipe. Due to the nearly six times longer path length, the Elster Instromet multi-path meter provides a much more accurate flow velocity measurement.

Along with improved flow profile and swirl information, the reflective path matrix provides diagnostic information about the inside pipe diameter condition. Changes in the path length caused by build-ups inside the pipe can be reported and alarmed by the diagnostics in the Elster Instromet meter.



Swirl Paths



Diagonal Paths

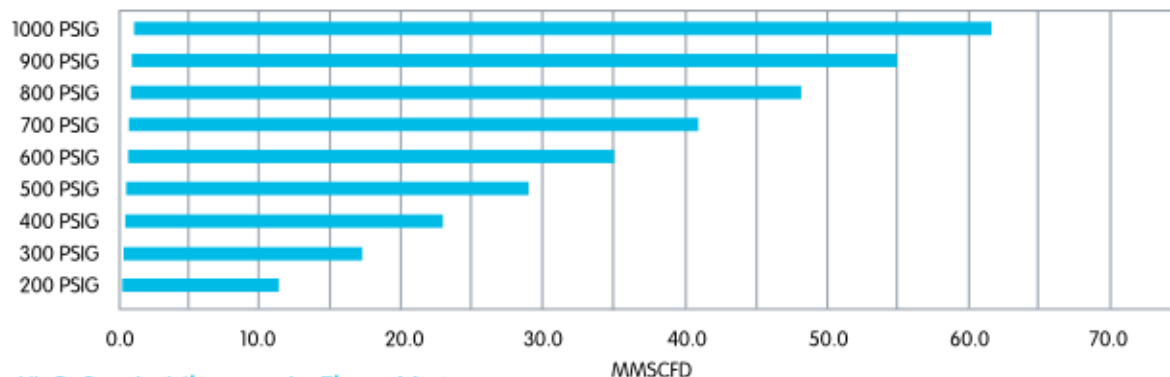


Cross-sectional Paths

Ultrasonic Flow Meter Capacity Tables

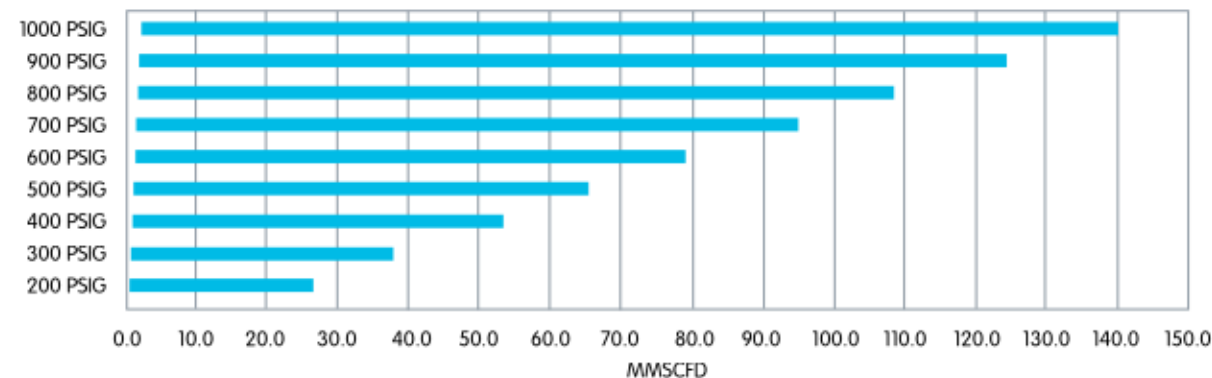
4" Q.Sonic Ultrasonic Flow Meter

4" MMSCFD	200 PSIG	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	0.2	0.3	0.5	0.6	0.7	0.8	1.0	1.1	1.2
Q_{max}	11.5	17.1	22.9	28.9	35.1	40.8	48.1	54.8	61.8



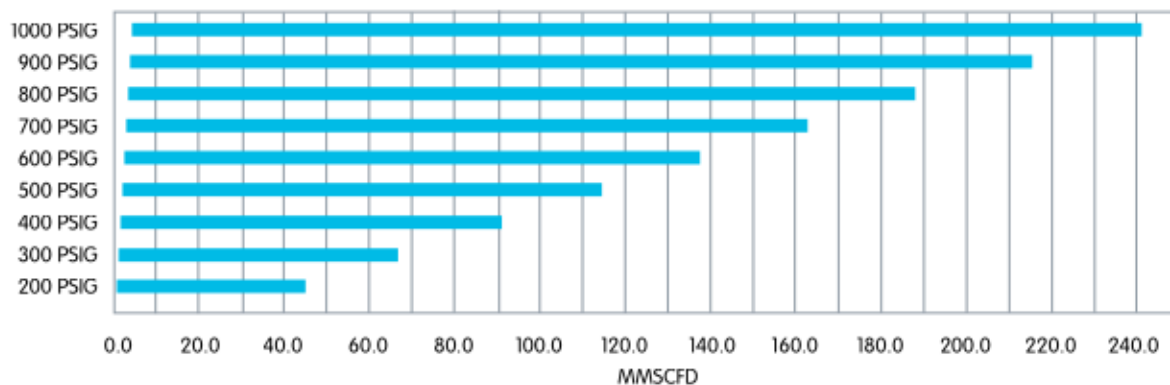
6" Q.Sonic Ultrasonic Flow Meter

6" MMSCFD	200 PSIG	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	0.5	0.8	1.0	1.3	1.6	1.9	2.2	2.5	2.8
Q_{max}	26.1	38.8	52.0	65.6	79.7	94.1	109.1	124.4	140.2



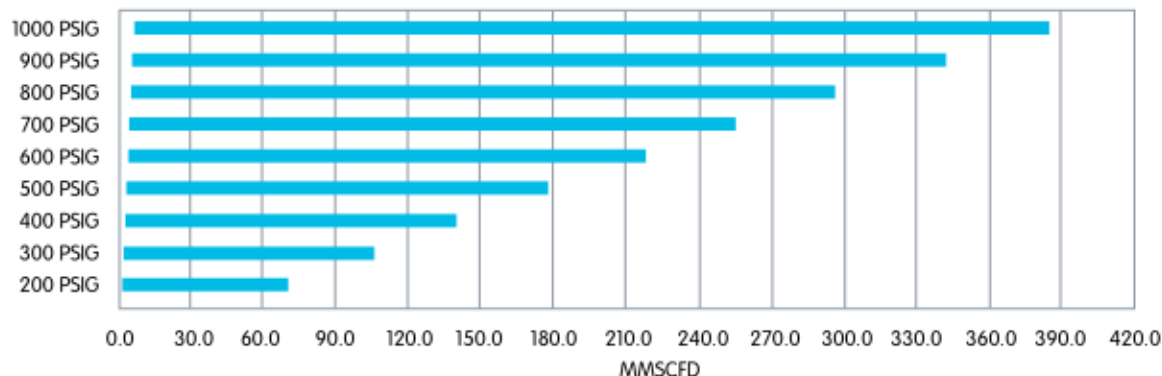
8" Q.Sonic Ultrasonic Flow Meter

8" MMSCFD	200 PSIG	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	0.9	1.3	1.8	2.3	2.8	3.3	3.8	4.3	4.9
Q_{max}	45.2	67.3	90.1	113.6	137.9	163.8	188.8	215.4	242.8



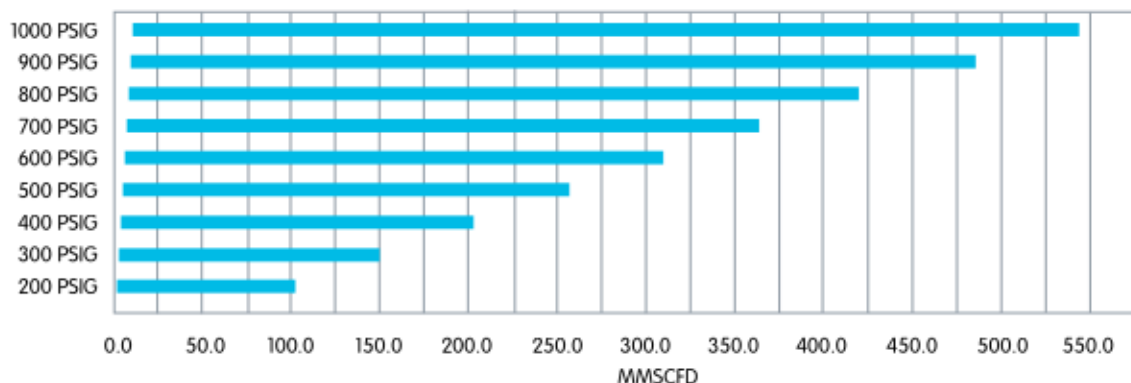
10" Q.Sonic Ultrasonic Flow Meter

10" MMSCFD	200 PSIG	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	1.4	2.1	2.8	3.6	4.3	5.1	6.0	6.8	7.7
Q_{max}	71.2	106.0	142.0	179.1	217.4	256.9	297.7	339.6	382.6



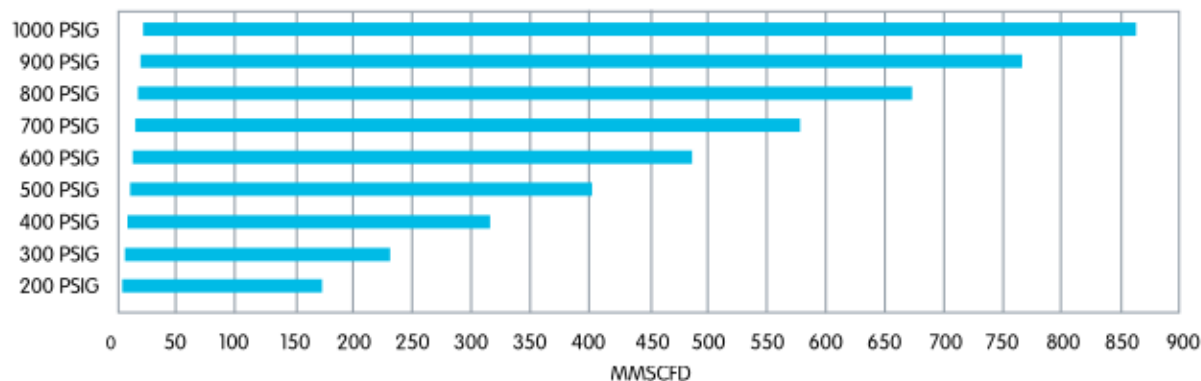
12" Q.Sonic Ultrasonic Flow Meter

12" MMSCFD	200 PSIG	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	2.0	3.0	4.0	5.1	6.2	7.3	8.5	9.6	10.9
Q_{max}	101.0	150.5	201.5	254.2	308.6	364.7	422.5	482.0	543.1



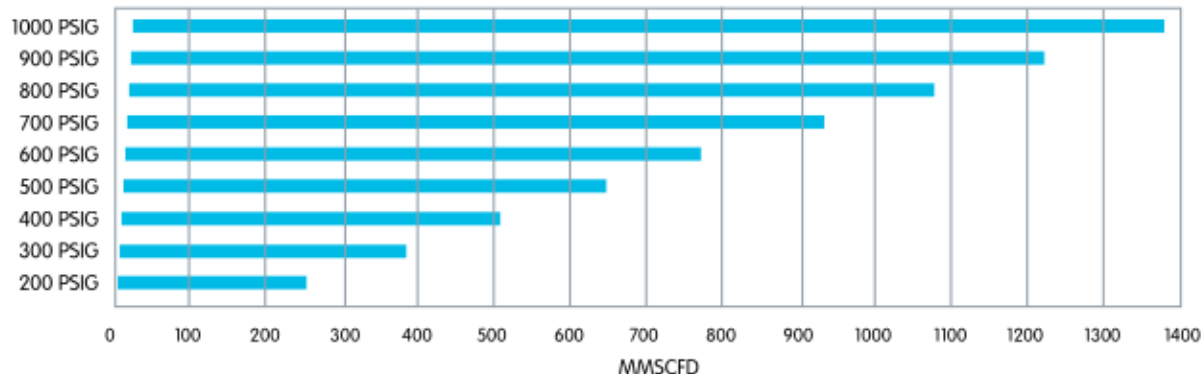
16" Q.Sonic Ultrasonic Flow Meter

16" MMSCFD	200 PSIG	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	3.2	4.8	6.4	8.0	9.7	11.5	13.3	15.2	17.2
Q_{max}	159.5	237.6	318.2	401.4	487.2	575.8	667.1	761.0	857.5



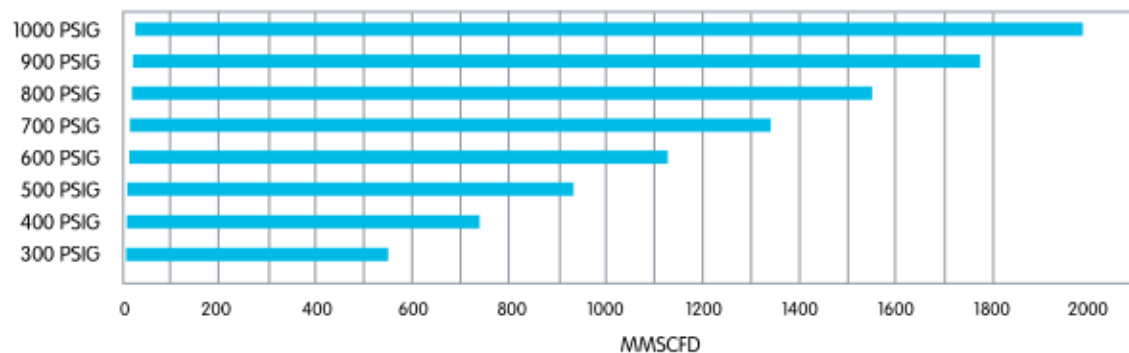
20" Q.Sonic Ultrasonic Flow Meter

20" MMSCFD	200 PSIG	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	5.1	7.6	10.2	12.9	15.6	18.5	21.4	24.4	27.5
Q_{max}	255.9	381.2	510.5	644.0	781.7	923.8	1070.3	1221.0	1375.8



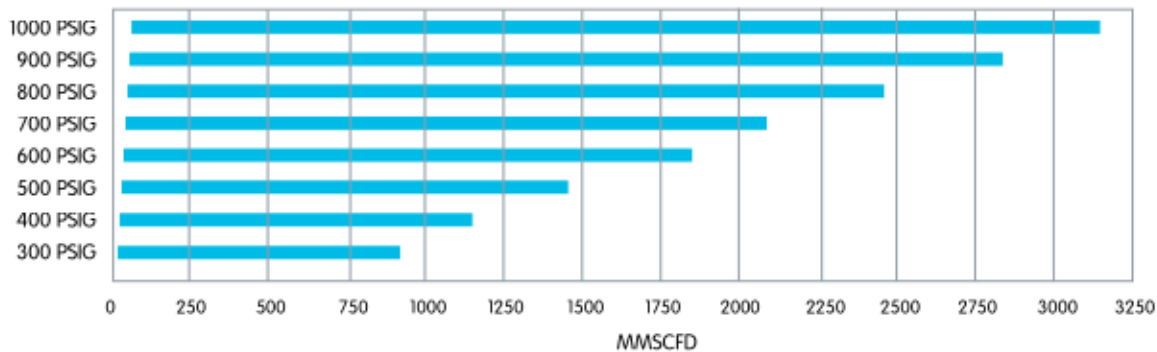
24" Q.Sonic Ultrasonic Flow Meter

24" MMSCFD	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	11.1	14.8	18.7	22.7	26.8	31.0	35.4	39.9
Q_{max}	552.6	740.0	933.5	1133.2	1339.2	1551.5	1769.9	1994.4



30" Q.Sonic Ultrasonic Flow Meter

30" MMSCFD	300 PSIG	400 PSIG	500 PSIG	600 PSIG	700 PSIG	800 PSIG	900 PSIG	1000 PSIG
Q_{min}	17.5	23.4	29.5	35.8	42.3	49.0	55.9	63.0
Q_{max}	872.8	1168.8	1474.5	1789.9	2115.2	2450.5	2795.6	3150.1



For larger sizes, please contact your Elster Instrumet sales representative.

USM Specifications

		Q.Sonic-3	Q.Sonic-4	Q.Sonic-5
Diameter	(inch)	4-42	4-42	12-42
	(mm)	100-1050	100-1050	300-1050
Velocity Range	(fps)		2-100	
	(m/s)		≤ ± 30	
Pressure Range	(PSI)		116-2175	
	(bar)		8 – 150 (lower or higher pressures optional)	
Gas Temperature Range	(°F)		-4 / +176	
	(°C)		-20 / +80 (lower or higher temperatures optional)	
Ambient Temperature Range	(°F)		-4 / +140	
	(°C)		-20 / +60 (lower temperatures optional)	
Repeatability			≤ 0.05% *)	
Uncertainty			≤ 0.3% (high pressure flow calibrated) *)	
			≤ 0.5% typical, without flow calibration *)	
			0.2% non-linearity *)	
		Swirl Angle (°)	≤ 20	≤ 20
		Asymmetry	≤ 5%	≤ 15%
Rec. Upstream Pipe Length	without FC**)	10D	10D	10D
Rec. Upstream Pipe Length	with FC**)	5D	5D	5D
AGA-9 Compliance			yes	
Power Supply			12-24V DC	
Power Consumption			7W	
Outputs			2x RS232, 2x RS485 (up to 500m)	
			4x optocoupler 0-10KHz, free configurable	
			Analog 4-20mA optional	
Response Time			1 update / s	
Data Logging			> 35 days of hourly records according to API manual of petroleum measurement standards, chapter 21	
Position T Transmitter			3-5D upstream or 2-5D downstream	
Position P Transmitter			On the meter body	
Safety Marks			FM: Class1, Division 1, Group C & D ATEX: Zone 1, Gas Group IIA, IIB & IIC	
Pipe Material			Carbon steel	
Ingress Protection			IP65	
Upstream Pipe Condition			1% difference in diameter vs USM	
Downstream Pipe Condition			1% difference in diameter vs USM	
Options				
Application related path substitution: Uncertainty in case of path failure			≤ 0.3%	
Noise Suppression with CMB			typical 15-20dB	

*) between 5% Qmax and 100% Qmax **| FC = flow conditioner

Flow Range

Diameter		turn down	Q _{min}	Q _{max}	Q _{min}	Q _{max}	Meter Body Length
			m ³ /h	m ³ /h	cf/h	cf/h	
4"	100 mm	100:1	30	800	1100	28,300	40"
6"	150 mm	100:1	45	1800	1600	63,600	30"
8"	200 mm	100:1	60	3000	2200	106,000	40"
10"	250 mm	100:1	75	5000	2700	176,600	40"
12"	300 mm	100:1	90	8000	3200	282,600	40"
16"	400 mm	100:1	100	12,000	3600	423,800	48"
20"	500 mm	100:1	150	19,000	5300	671,000	60"
24"	600 mm	100:1	200	28,000	7100	988,900	72"
30"	750 mm	100:1	300	45,000	10,600	1,589,300	72"
36"	900 mm	100:1	425	65,000	15,100	2,295,600	84"
42"	1050 mm	100:1	525	80,000	18,600	2,825,300	—
48"	1200 mm	100:1	700	100,000	24,800	3,531,600	—

The volume shown is approximate, for exact calculation the pipe thickness is required. Volumes given in local approvals may differ. Larger dimensions up to 64" (1600 mm) are available. The meter body length can differ from the value in the table when using non-standard meter bodies.

