

+ CALDON LEFM Ultrasonic Flowmeters for Liquids

**Integrating experience, proven technology,
and innovation**





CALDON LEFM FLOWMETER FIRSTS

- 1965-70 First chordal multipath flowmeters
- 1970-75 First nuclear reactor coolant application
- 1974-75 First crude oil application
- 1994-99 First measurement uncertainty recapture uprate at nuclear facilities
- 1995 First military-specification flowmeter
- 2003 First application for custody transfer of liquid hydrocarbons
- 2005 First application for custody transfer of LNG
- 2008 First application for custody transfer of heavy, viscous crude oils up to 3,000 mm²/s



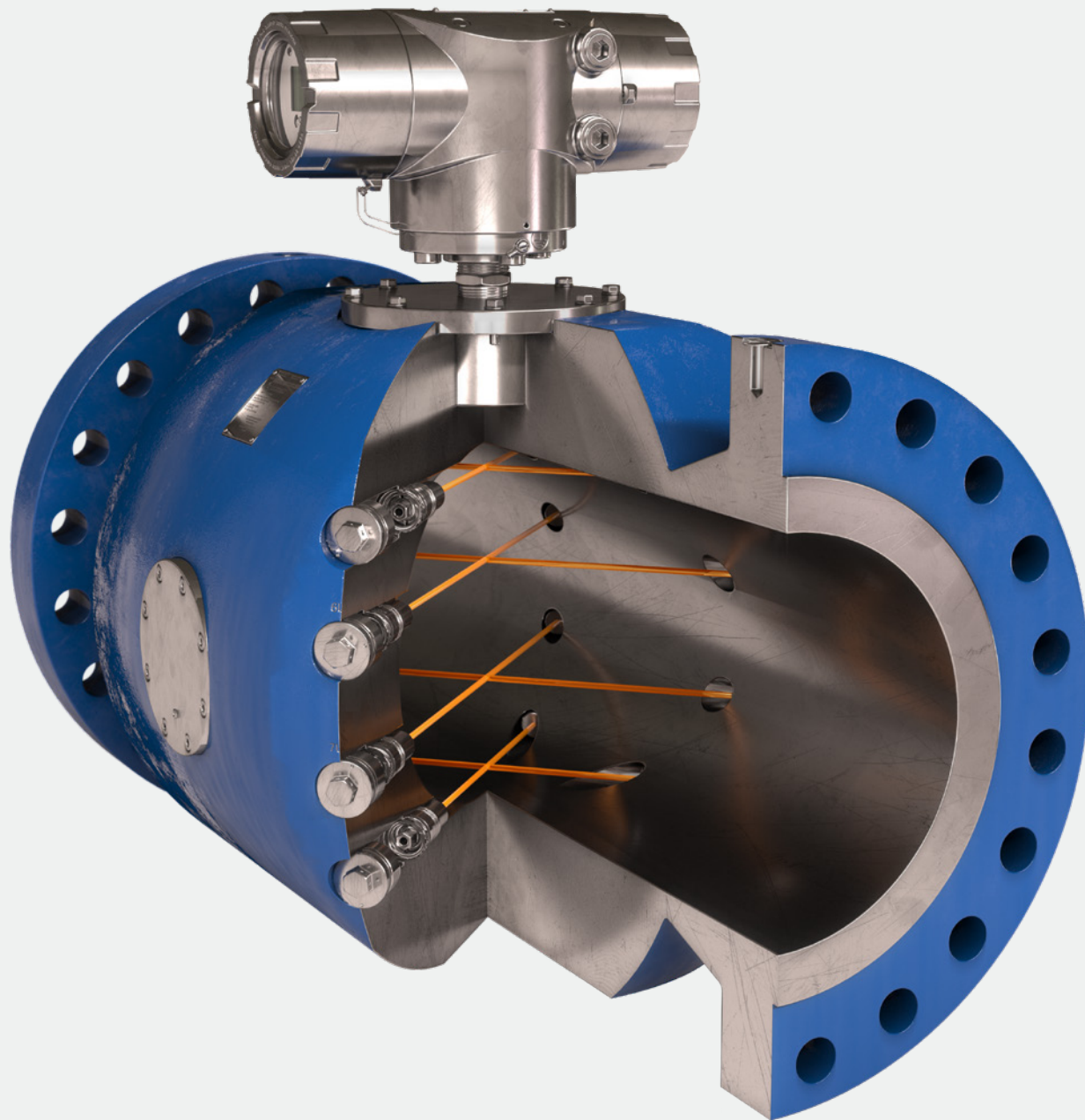
Count on Sensia

Backed by more than 50 years of experience and a history of technological firsts, the Sensia portfolio of CALDON LEFM ultrasonic flowmeters combines experience, innovation, and proven technology into the broadest offering of custody transfer, fiscal, check metering, and leak detection innovations for the liquid hydrocarbon industry. The CALDON LEFM flowmeter series accommodates the largest range of applications, including high-viscosity crude oils and LNG.

CALDON LEFM flowmeters for liquids have become the benchmark around the world. Leveraging expertise from one of the most advanced liquid hydrocarbon calibration laboratories, Sensia offers the most complete capabilities to fit all customer application and service needs.

>50yrs

experience and a history of technological firsts with multipath inline ultrasonic flowmeters



- + 5-diameter minimum upstream pipe run and no requirement for flow conditioner, which reduces total cost of ownership**

Advantages

- + Compliance with API MPMS Chapter 5.8, International Organization of Legal Metrology (OIML) Recommendation R 117-1 Class 0.3, Measuring Instruments Directive (MID) 2014/32/EU, and NACE MR0175
- + Four- and eight-path chordal designs for optimal linearity and repeatability
- + Industry-leading eight-path chordal design with dramatically reduced sensitivity to swirl and asymmetry effects
- + 5-diameter minimum upstream pipe run and no requirement for flow conditioner, which reduces total cost of ownership
- + Advanced signal processing with real-time diagnostic analysis
- + Reducing nozzle design that delivers improved flow stability and unparalleled accuracy for in-situ proving and for applications with high-viscosity and/or low Reynolds numbers
- + Four- and eight-path designs for cryogenic applications that require custody transfer and allocation performance
- + Transducers that are isolated from the process and outside the pressure boundary for ease of service, if required
- + No recalibration or zeroing required if transducer is replaced
- + In-house transducer manufacturing for maximum quality control
- + Internal resistance temperature detector (RTD) for thermal expansion compensation
- + Continuous logging capabilities
- + Optional corrosion- and contamination-resistant internal coating

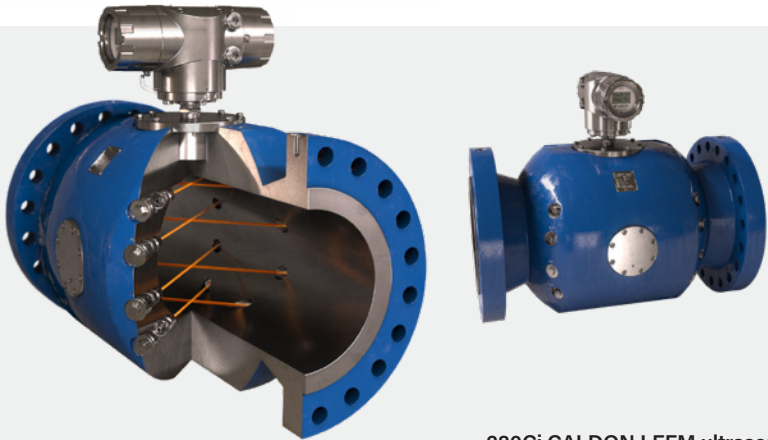


280Ci CALDON LEFM ultrasonic flowmeter

CALDON LEFM Flowmeter Models for Liquids

280Ci

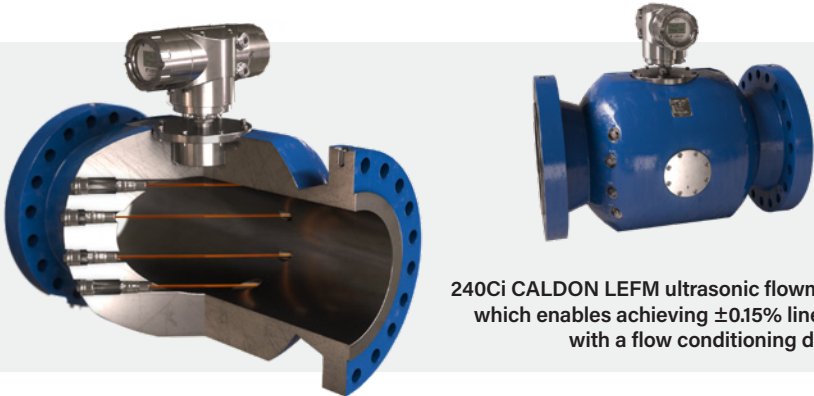
The eight-path 280Ci CALDON LEFM ultrasonic flowmeter is a compact, high-performance unit designed to meet the most stringent requirements of custody-transfer and fiscal metering applications. The design of the 280Ci model provides a low sensitivity to swirl and flow profile effects and is capable of $\pm 0.1\%$ linearity without requiring a flow conditioner. The flowmeter can be installed with only 5 pipe diameters straight run upstream to achieve premium performance.



280Ci CALDON LEFM ultrasonic flowmeter, which is insensitive to swirl

240Ci

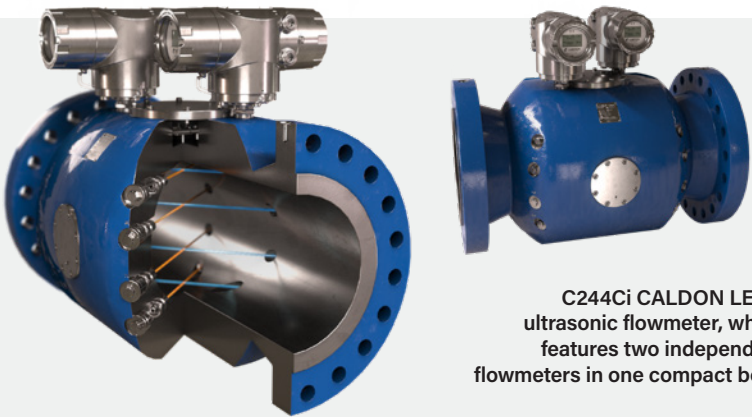
The 240Ci CALDON LEFM ultrasonic flowmeter for liquids is designed to achieve $\pm 0.15\%$ linearity in combination with a flow conditioning device, meeting or exceeding the industry standards for performance and reliability.



240Ci CALDON LEFM ultrasonic flowmeter, which enables achieving $\pm 0.15\%$ linearity with a flow conditioning device

244Ci

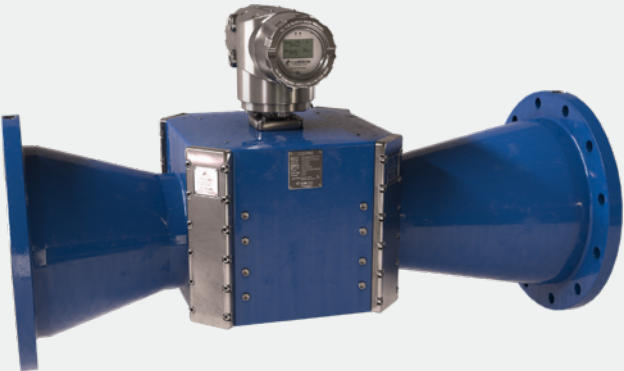
The 244Ci CALDON LEFM ultrasonic flowmeter is a high-performance unit designed for custody-transfer or fiscal metering applications that features two independent four-path flowmeters in one compact meter body. The four-path-plus-four-path dual-meter design meets all custodytransfer requirements while offering full redundancy and meter-to-meter comparison for in situ validation.



C244Ci CALDON LEFM ultrasonic flowmeter, which features two independent flowmeters in one compact body

280CiRN

The eight-path 280CiRN CALDON LEFM ultrasonic flowmeter is designed with a reduced bore and a special nozzle-shaped entry in which the velocity profile is stabilized. Repeatability is improved to levels suitable for direct proving, making this meter ideal for replacement of turbine and positive-displacement flowmeters. The velocity-profile related problems of transitional flow at Reynolds numbers below 10,000 are overcome. High-viscosity fluids are measured without compromising performance.



280CiRN CALDON LEFM ultrasonic flowmeter, which overcomes repeatability and velocity-profile-related challenges.

240CiLT-R and 280CiLT-R

The CALDON LEFM 240CiLT-R* four-path ultrasonic flowmeter and CALDON LEFM 280CiLT-R* eight-path ultrasonic flowmeter are designed for measurement of LNG at cryogenic temperatures, providing the performance required for custody transfer, allocation, and check metering. The design of the eight-path 280CiLT-R model has a low sensitivity to swirl and profile effects, thereby eliminating the need for flow conditioning elements and their associated pressure drop while maintaining accuracy suitable for custody transfer.



CALDON LEFM 280CiLT-R ultrasonic flowmeter, which is less sensitive to swirl and profile effects

Isolated transducer housing design

Our ultrasonic flowmeters for liquids have transducers that are installed into stainless steel transducer housings. The transducer housing is a pressure boundary between the transducer assembly and the process.

The operator does not have to depressurize the meter if a CALDON LEFM flowmeter transducer should ever need to be replaced. A transducer can be replaced safely with fluid flowing in the meter. The design does not require any special tools or extraction devices for transducer replacement.



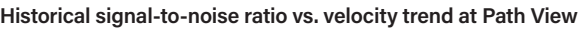
Liquid transducer housing, which enables safe, simple replacements

CALDON USM Measurement Advisor condition-based monitoring (CBM) software helps reduce risks by monitoring key parameters, changes in process conditions, and other factors that affect measurement uncertainty and data integrity in ultrasonic flowmeters.

The CALDON USM Measurement Advisor Meter Explorer module enables users to clearly visualize meter location using a four-level hierarchy to replicate system structure. This enables high-level or deep-dive analysis. The simple-to-use interface also includes a meter setup wizard and full meter backup and restore facilities.

- + Compliance with international standards, including ISO 17089
- + Real-time or time-period data
- + Alarms for meter hard errors, global CBM limits, fingerprint limits
- + Multiple configurable fingerprint data groups
- + Multivariable time-based trending
- + Configurable meter hierarchy
- + Customizable customer logo on reports
- + Easy navigation to all connected meters
- + Meter configuration and setup wizard

Output options include screen, historian, and reports.
[†]Up to 11 variables, depending on meter configuration.
[‡]8-path meters only.



*For temperatures > 158 degF [70 degC], the body shape and weight may be different than shown. Contact Sensia for further details.

Recommended Flow Velocity Range ¹					
2XXCi	Full bore	Nominal size			
		< 10 inch [DN 250]	≥ 10 inch [DN 250]		
	Min Velocity, m/s [ft/s]	1.2 [3.9]	0.8 [2.6]		
	Max Velocity, m/s [ft/s]	12 [39.4]	12 [39.4]		
2XXCiRN	Reducing nozzle	All sizes			
	Min Throat Velocity, m/s [ft/s]	1.3 [4.2]			
	Max Throat Velocity, m/s [ft/s]	19.2 [63]			
		Throat/pipe diameter ratio (beta)			
	Typical beta ² (-)	0.63	0.67	0.72	0.79
	Min Pipe Velocity, m/s [ft/s]	0.51 [1.7]	0.57 [1.9]	0.66 [2.2]	0.80 [2.6]
	Max Pipe Velocity, m/s [ft/s]	7.6 [25]	8.6 [28.3]	10.0 [32.7]	12.0 [39.4]

The velocities stated here are recommended but are not limiting. Higher or lower velocities can be accommodated upon review by Sensia. MID/OIML R117 Certificate TC7381 permits velocities in the range 0.2 to 16.6 m/s for 2XXCi full bore flow meters and 0.2 to 21 m/s throat velocity for 2XXCiRN reducing nozzle flow meters. Flow rates are calculated by multiplying the velocity by the corresponding internal cross-sectional area, with appropriate unit conversions.

The throat diameter over pipe diameter ratio of the reducing nozzle meter (beta) is a variable. Recommended velocities are shown for typical beta values.

Flow rates shown are for indicative purposes only. Additional meter sizes, including larger meters, are available. Please consult Sensia for an appropriate meter sizing.

Tabulated rates are based on the recommended flow velocity range for meters sized with Standard wall thickness. 2XXCiRN maximum and minimum flow rates are shown for beta 0.79 and 0.63 respectively; recommended maximum and minimum rates can be calculated by selecting a beta value and its corresponding recommended flow velocity range.

Consult Sensia for other material options.

Nominal Size, inch [mm]	Flowrate, bbl/h [m³/hr]			
	2XXCi		2XXCiRN	
	Min	Max	Min	Max
4 [100]	223 [35]	2,232 [355]	-	-
6 [150]	506 [81]	5,064 [805]	214 [34]	5,064 [805]
8 [200]	877 [139]	8,770 [1394]	371 [59]	8,770 [1394]
10 [250]	922 [147]	13,823 [2198]	585 [93]	13,823 [2198]
12 [300]	1,322 [210]	19,826 [3152]	839 [133]	19,826 [3152]
14 [350]	1,611 [256]	24,171 [3843]	1,023 [163]	24,171 [3843]
16 [400]	2,135 [339]	32,019 [5091]	1,356 [216]	32,019 [5091]
18 [450]	2,731 [434]	40,968 [6514]	1,734 [276]	40,968 [6514]
20 [500]	3,401 [541]	51,019 [8112]	2,160 [343]	51,019 [8112]
24 [600]	4,962 [789]	74,425 [11833]	3,151 [501]	74,425 [11833]

Meter images shown in this brochure are MK I, MK III and MK IV meter bodies. MK I to MK V meter bodies may be supplied depending on specific application and project requirements.

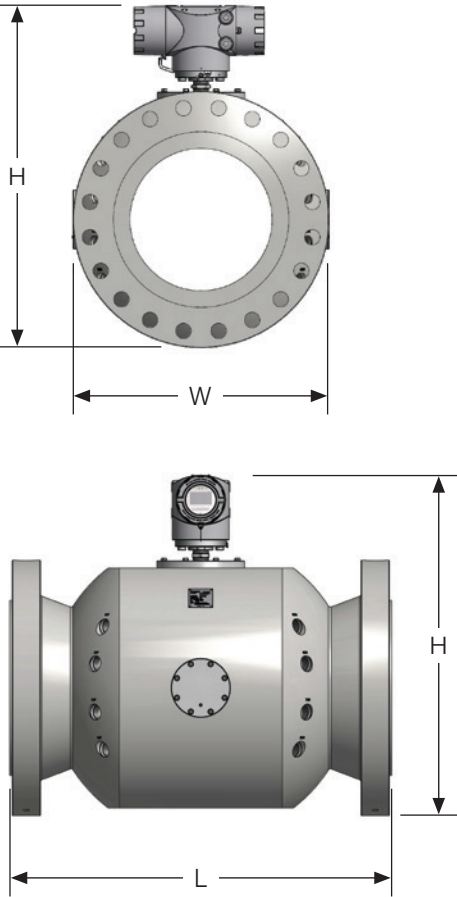
² Rangeability can be extended upon review of application conditions and accuracy requirements. Meters can operate from zero flow up to velocities in excess of 21 m/s [70 ft/s].

³ Consult Sensia for additional information on model and beta selection for Reynolds numbers < 10,000

+ + + + + **INTELLIGENT ACTION**

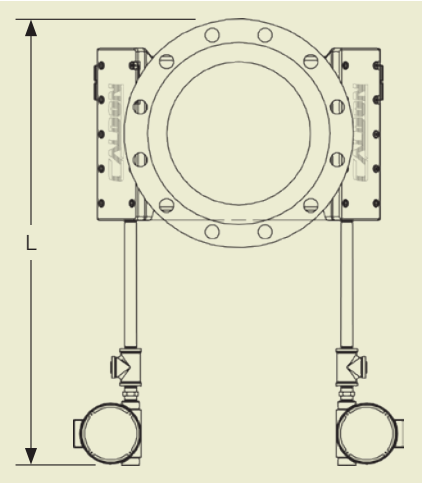
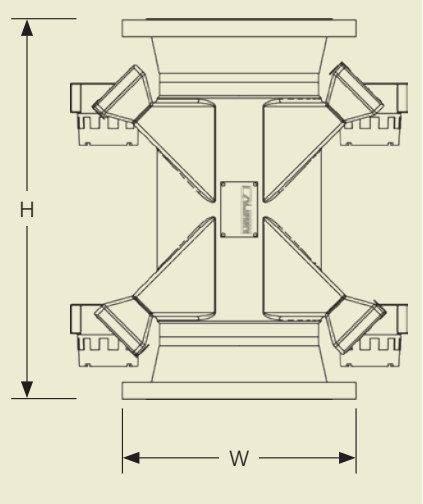
Dimensions and Weights

Dimensions and Weights for 2xxCi and 280CiRN CALDON LEFM Ultrasonic Flowmeters					
Nominal Pipe Size, in [mm] ¹	Flange ANSI Class	Width (W), in [mm]	Height (H), in [mm]	Length (L), in [mm]	Meter Weight, lbm [kg] ²
4 [100]	150	17.7 [450]	19.2 [487]	21.0 [533]	333 [151]
	300	17.7 [450]	19.7 [500.0]	21.7 [552]	353 [160]
	600	17.7 [450]	20.1 [510.0]	23.5 [597]	384 [174]
	900	17.7 [450]	20.4 [519]	24.5 [622]	419 [190]
	1500	17.7 [450]	20.8 [529]	25.2 [641]	465 [211]
6 [150]	150	17.7 [450]	21.1 [535]	24.0 [610]	494 [224]
	300	17.7 [450]	21.8 [554.0]	24.8 [629]	536 [243]
	600	17.7 [450]	22.6 [573.0]	26.7 [679]	624 [283]
	900	17.7 [450]	23.1 [586]	28.5 [724]	705 [320]
	1500	17.7 [450]	23.3 [592]	31.0 [787]	840 [381]
8 [200]	150	17.0 [432]	23.9 [606]	26.8 [679]	769 [349]
	300	17.0 [432]	24.4 [619]	27.5 [699]	824 [374]
	600	17.0 [432]	25.1 [638]	29.8 [756]	919 [417]
	900	18.5 [470]	26.1 [662]	32.0 [813]	1,111 [504]
	1500	19.0 [483]	26.3 [668]	36.0 [914]	1,334 [605]
10 [250]	150	20.0 [508]	27.4 [695]	28.8 [730]	1,193 [541]
	300	20.0 [508]	27.4 [695]	30.0 [762]	1,279 [580]
	600	20.0 [508]	28.6 [727]	33.3 [845]	1,462 [663]
	900	21.5 [546]	28.4 [722]	35.7 [908]	1,596 [724]
	1500	23.0 [584]	29.2 [741]	41.3 [1,048]	2,090 [948]
12 [300]	150	22.0 [559]	30.4 [773]	31.8 [806]	1,641 [744]
	300	22.0 [559]	30.4 [773]	33.0 [838]	1,754 [795]
	600	22.0 [559]	30.9 [785]	35.5 [902]	1,927 [874]
	900	24.0 [610]	30.9 [786]	39.0 [991]	1,812 [822]
	1500	26.5 [673]	30.9 [786]	45.5 [1,156]	3,067 [1,391]
14 [350]	150	23.8 [603]	32.3 [820]	34.0 [864]	2,011 [912]
	300	23.8 [603]	32.4 [822]	35.3 [895]	2,182 [990]
	600	23.8 [603]	32.7 [831]	37.5 [953]	2,328 [1,056]
	900	25.2 [641]	34.4 [875]	41.3 [1,048]	2,619 [1,188]
	1500	29.5 [749]	34.4 [875]	48.0 [1,219]	3,889 [1,764]
16 [400]	150	27.0 [686]	35.2 [895]	35.8 [908]	2,778 [1,260]
	300	27.0 [686]	35.3 [896]	37.3 [946]	2,992 [1,357]
	600	27.0 [686]	36.0 [916]	40.3 [1,022]	3,262 [1,480]
	900	27.8 [705]	34.8 [884]	43.3 [1,099]	3,373 [1,530]
	1500	27.8 [705]	37.2 [945]	50.7 [1,289]	5,104 [2,315]
18 [450]	150	29.3 [743]	37.2 [946]	38.8 [984]	3,309 [1,501]
	300	29.3 [743]	37.5 [954]	40.3 [1,022]	3,602 [1,634]
	600	29.3 [743]	38.2 [970]	43.3 [1,099]	3,913 [1,775]
	900	31.0 [787]	37.4 [949]	46.3 [1,175]	4,405 [1,998]
	1500	36.0 [914]	39.9 [1,013]	54.0 [1,372]	6,592 [2,990]
20 [500]	150	32.0 [813]	39.6 [1,006]	41.1 [1,045]	4,118 [1,868]
	300	32.0 [813]	40.0 [1,016]	42.5 [1,080]	4,462 [2,024]
	600	32.0 [813]	40.7 [1,035]	46.3 [1,175]	4,886 [2,216]
	900	33.7 [857]	39.8 [1,010]	49.8 [1,264]	5,478 [2,485]
	1500	38.7 [984]	42.2 [1,073]	58.3 [1,480]	8,208 [3,723]
24 [600]	150	37.0 [940]	41.9 [1,063]	45.8 [1,162]	5,555 [2,520]
	300	37.0 [940]	43.9 [1,114]	48.5 [1,232]	6,123 [2,777]
	600	37.0 [940]	44.4 [1,127]	52.3 [1,327]	6,681 [3,030]
	900	41.0 [1,041]	45.3 [1,151]	57.2 [1,454]	8,878 [4,027]
	1500	46.0 [1,168]	47.8 [1,214.0]	66.3 [1,683]	12,694 [5,758.0]



Nominal Pipe Size, in [mm]	Flange ANSI Class	Height (H),† in [mm]	Width (W), in [mm]	Length (L), in [mm]	Weight, lbm [kg]
8 [200]	150	25.6 [650]	14.8 [375]	24.0 [610]	474 [215]
	300	26.4 [671]	15.0 [381]	24.8 [629]	530 [240]
	600	27.1 [688]	16.5 [419]	27.0 [686]	636 [289]
	900	28.1 [714]	18.5 [470]	29.3 [743]	746 [338]
10 [250]	150	27.9 [709]	17.0 [432]	26.0 [660]	714 [324]
	300	28.7 [729]	17.5 [445]	27.2 [692]	792 [359]
	600	29.9 [759]	20.0 [508]	30.5 [775]	990 [449]
	900	30.7 [780]	21.5 [546]	33.0 [838]	1,130 [513]
12 [300]	150	30.4 [772]	19.0 [483]	29.5 [749]	987 [448]
	300	31.2 [792]	20.5 [521]	30.7 [781]	1,107 [502]
	600	31.9 [810]	22.0 [559]	33.2 [844]	1,277 [579]
	900	32.9 [836]	24.0 [610]	36.8 [934]	1,477 [670]
14 [350]	150	32.0 [813]	21.0 [533]	32.0 [813]	1,265 [574]
	300	33.0 [838]	23.0 [584]	33.2 [844]	1,405 [637]
	600	33.4 [848]	23.8 [603]	35.5 [902]	1,605 [728]
	900	34.2 [869]	25.3 [641]	39.3 [997]	1,845 [837]
16 [400]	150	34.4 [874]	23.5 [597]	33.5 [851]	1,467 [666]
	300	35.4 [899]	25.5 [648]	35.0 [889]	1,687 [765]
	600	36.2 [919]	27.0 [686]	38.0 [965]	1,967 [892]
	900	36.5 [927]	27.8 [705]	41.5 [1,054]	2,177 [988]
18 [450]	150	36.2 [919]	25.0 [635]	37.0 [940]	1,614 [732]
	300	37.7 [958]	28.0 [711]	38.5 [978]	1,954 [887]
	600	38.3 [973]	29.3 [743]	41.0 [1,041]	2,264 [1,027]
	900	39.2 [996]	31.0 [787]	44.5 [1,130]	2,674 [1,213]
20 [500]	150	37.8 [960]	27.5 [699]	39.4 [1,000]	1,640 [744]
	300	39.3 [998]	30.5 [775]	40.8 [1,035]	2,080 [943]
	600	40.0 [1,016]	32.0 [813]	43.5 [1,105]	2,460 [1,116]
	900	40.9 [1,039]	33.8 [857]	48.0 [1,219]	2,940 [1,333]
24 [600]	150	42.0 [1,067]	32.0 [813]	44.0 [1,118]	1,991 [903]
	300	44.0 [1,118]	36.0 [914]	45.2 [1,149]	2,631 [1,194]
	600	44.5 [1,130]	37.0 [940]	48.5 [1,232]	3,131 [1,420]
	900	46.5 [1,181]	41.0 [1,041]	55.5 [1,410]	4,471 [2,028]

† Height includes an 8-in nipple extension to penetrate the insulation. Consult Sensia for other sizes and pressure classes.



Hydrocarbon Calibration Laboratory

Notes:



The Sensia ISO 17025-
accredited hydrocarbon
calibration laboratory sets us
apart from all other ultrasonic
flowmeter suppliers.

sensiaglobal.com

Add intelligent action to your oil & gas solutions

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Rockwell Automation + Schlumberger