

CALDON LFM 380Ci

Gas ultrasonic flowmeters

APPLICATIONS

- Natural gas

BENEFITS

- Compact installation footprint reduces the length of upstream pipe and eliminates the need for a flow conditioner
- Reliable and long-term stability

FEATURES

- Eight-path, dual-plane configuration
- Fully isolated transducer design
- Proprietary coating
- Third generation (G3) electronics

When accuracy and reliability are critical, the CALDON* family of Leading Edge Flowmeters (LEFM*) provide the petroleum industry with a durable, stable and low cost-of-ownership ultrasonic measurement option. LEFM models cover a broad range of measurement demands and allow users to choose just the right meter for applications ranging from heavy oil, LNG, and NGLs to natural gas.

The CALDON LFM 380Ci Series eight-path gas ultrasonic flowmeter is designed specifically for measurement of natural gas where accuracy and reliability are critical. Transducers are isolated from the process, located behind a pressure boundary, eliminating transducer failures due to erosion, chemical attack, or sudden pressure or temperature changes. Unique to the LFM 380Ci flowmeter, the design allows the transducer elements to be safely removed from behind the pressure boundary without requiring special tools.

Owing to the particular arrangement of its eight measurement paths, the LFM 380Ci flowmeter is inherently immune to the effects of swirl within the flow stream, eliminating the need for flow conditioning elements and long upstream piping configurations, reducing the footprint and installation costs.

The LFM 380Ci flowmeter combines exceptional signal processing technology with advanced transducer design that results in a measurement solution that excels in performance, reliability, and safety.

Meter construction

The CALDON LFM 380Ci meter body is designed and manufactured in accordance with national and international codes, regulations, and standards (e.g. ASME, PED etc.) making it suitable for the global natural gas market.

The LFM 380Ci has 16 piezoelectric ultrasonic transducer modules that are arranged in pairs to form eight measurement paths. Two paths are paired at each of the four horizontal chords in the pipe cross section. The paired paths are angled with respect to the pipe axis such that four horizontal chords lie in each of the angled planes, forming an X when viewed from above.



CALDON LEFM 380Ci

Electrical safety approvals

	Meter body with integral transmitter		Meter body with remote transmitter	
	 		 	
Class	II 2 G, Ex d IIC Gb T6	Class I, Div. 1, Groups B,C, & D T6	II 2 G, Ex d IIC Gb T3	Class I, Div. 1, Groups B,C, & D T3C
Temperature	-58 to 158 degF [-50 to 70 degC]	-58 to 158 degF [-50 to 70 degC]	-58 to 257 degF [-50 to 125 degC]	-58 to 257 degF [-50 to 125 degC]

Standard materials of construction (PED compliant)

Meter body and flanges	Carbon steel (stainless and duplex optional)
Transducer housings	Inconel
Junction boxes	Copper-free aluminum (stainless steel—optional)
Transmitter enclosure	Copper-free aluminum (stainless steel—optional)

Typical meter sizes and flow rates—schedule 80 pipe

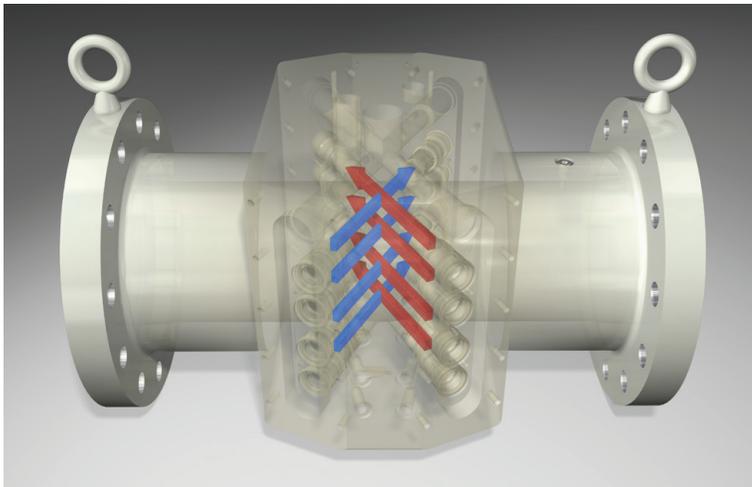
Meter size		Flow rate, ft ³ /hr [m ³ /hr], actual			
Size, in	DN	Q _{min}	Q _t	Q _{max}	Q _{over-range}
6	150	1,283 [36.3]	6,521 [185]	65,209 [1,847]	78,251 [2,216]
8	200	2,247 [63.6]	11,423 [323]	114,234 [3,235]	137,081 [3,882]
10	250	3,534 [100.1]	17,964 [509]	179,644 [5,087]	215,573 [6,104]
12	300	5,000 [141.6]	12,501 [354]	254,180 [7,198]	305,016 [8,637]
14	350	6,039 [171.0]	15,098 [428]	306,997 [8,693]	368,397 [10,432]
16	400	7,917 [224.2]	19,793 [560]	402,453 [11,396]	482,944 [13,675]
18	450	10,049 [284.5]	25,122 [711]	510,811 [14,465]	612,973 [17,357]
20	500	12,437 [352.2]	31,092 [880]	632,212 [17,902]	758,655 [21,483]
24	600	17,970 [508.8]	44,925 [1,272]	913,467 [25,867]	1,096,160 [31,040]

Flowrates in the table above are for meters matched to schedule 80 pipe. Consult Cameron for other pipe schedules or meter sizes and applications outside the range of this table.

Standard end connections and maximum working pressure[†]

ANSI B16.5 raised face	Stainless steel	Carbon steel
Class 300	720 psi [49.6 bar]	740 psi [51.0 bar]
Class 600	1,440 psi [99.3 bar]	1,480 psi [102.0 bar]
Class 900	2,160 psi [148.2 bar]	2,220 psi [153.1 bar]
Class 1500	3,600 psi [248.2 bar]	3,705 psi [255.5 bar]

[†] Meters can be supplied with various end fittings. Consult Cameron for further information.



CALDON LEFM 380Ci ultrasonic flowmeter two plane path configuration

CALDON LEFM 380Ci

General specifications

Electronics

Power Requirements—DC Power

Voltage required	24 VDC (18 VDC to 30 VDC)
Current draw	0.25 A at 24 VDC
Power consumption	6 W

Power Requirements—AC Power

Voltage	120 (60 Hz)/230 (50 Hz) VAC
Voltage range	108–253 VAC
Frequency range	47–63 Hz
Current draw	0.14 A
Power consumption	7.3 W

Relative humidity 0–95%

Operating temperature –58–158 degF [–50–70 degC]

Local display 400 × 240 pixel LCD showing flow, diagnostics data, and alarms

Remote mounting electronics from meter 328 ft [100 m]

Analog inputs (three) 4–20 mA configured for pressure, temperature, or other

RTD input Meter body temperature

Analog outputs (two) 4–20 mA (max load 650 ohms)

Digital outputs

Flow Four pulse output channels

Programmable K-factor

Programmable configuration:

1. Dual frequency set-up, 50/50 duty cycle
Channel B lags channel A by 90° for forward flow
Channel B leads channel A by 90° for reverse flow
 2. Frequency and direction, 50/50 duty cycle
Channel B indicates flow direction
Forward flow = 0
Reverse flow = High (5–12 VDC)
 3. Alternating, Forward flow frequency on
Channel A only Reverse flow frequency
on Channel B only 50/50 duty cycle
-

Alarm status Four outputs, 0–5 VDC or 0–12 VDC selectable (0 volts = alarm)

Communication Three serial

Ethernet or fiber modem

Meter body

Relative humidity 0–95%

Operating temperature –58–257 degF [–50–125 degC]

Metrology Certifications

OIML R137 Accuracy Class 0.5

Measurement Instruments Directive (MID) Accuracy Class 1.0

CALDON LFM 380Ci

Dimension and weights for compact standard LFM 380Ci (compact length)

Pipe size, in [DN]	Flange ANSI class	Max width (W), in [mm]	Height (H), in [mm]	Length (L), in [mm]	Assembled meter weight (excluding transmitter), lbm [kg]	Assembled meter weight (including transmitter), lbm [kg]
6 [150]	150	11.0 [279]	20.5 [520]	18.50 [470]	386 [175]	401 [182]
	300	12.5 [318]	21.2 [539]	19.25 [489]	427 [194]	442 [200]
	600	14.0 [356]	22.0 [558]	21.25 [540]	508 [231]	523 [237]
	900	15.0 [381]	22.5 [571]	23.00 [584]	586 [266]	601 [272]
	1500	15.5 [394]	22.7 [577]	25.50 [648]	720 [326]	735 [333]
8 [200]	150	13.5 [343]	23.0 [584]	20.50 [521]	560 [254]	575 [261]
	300	15.0 [381]	23.7 [603]	21.25 [540]	615 [279]	630 [286]
	600	16.5 [419]	24.5 [622]	23.50 [597]	741 [336]	756 [343]
	900	18.5 [470]	25.5 [647]	25.75 [654]	913 [414]	928 [421]
	1500	19.0 [483]	25.7 [654]	29.75 [756]	1,139 [517]	1,154 [524]
10 [250]	150	16.0 [406]	25.1 [638]	21.25 [540]	748 [339]	763 [346]
	300	17.5 [445]	25.9 [657]	22.50 [572]	833 [378]	848 [385]
	600	20.0 [508]	27.1 [689]	25.75 [654]	1,075 [487]	1,090 [494]
	900	21.5 [546]	27.9 [708]	28.25 [718]	1,290 [585]	1,305 [592]
	1500	23.0 [584]	28.6 [727]	33.75 [857]	1,784 [809]	1,799 [816]
12 [300]	150	19.0 [483]	27.9 [708]	23.25 [591]	992 [450]	1,007 [457]
	300	20.5 [521]	28.6 [727]	24.50 [622]	1,112 [504]	1,127 [511]
	600	22.0 [559]	29.4 [746]	27.00 [686]	1,379 [625]	1,394 [632]
	900	24.0 [610]	30.4 [771]	30.50 [775]	1,740 [789]	1,755 [796]
	1500	26.5 [673]	31.6 [803]	37.00 [940]	2,591 [1,175]	2,606 [1,182]
14 [350]	150	21.0 [533]	29.6 [752]	24.75 [629]	1,205 [546]	1,220 [553]
	300	23.0 [584]	30.6 [777]	26.00 [660]	1,373 [623]	1,388 [630]
	600	23.8 [603]	31.0 [787]	28.25 [718]	1,656 [751]	1,671 [758]
	900	25.3 [641]	31.7 [806]	32.00 [813]	2,068 [938]	2,083 [945]
	1500	29.5 [749]	33.9 [860]	38.75 [984]	3,302 [1,498]	3,317 [1,505]
16 [400]	150	23.5 [597]	32.1 [816]	25.75 [654]	1,492 [677]	1,507 [684]
	300	25.5 [648]	33.1 [841]	27.25 [692]	1,709 [775]	1,724 [782]
	600	27.0 [686]	33.9 [860]	30.25 [768]	2,180 [989]	2,195 [995]
	900	27.8 [705]	34.2 [870]	33.25 [845]	2,581 [1,171]	2,596 [1,178]
	1500	32.5 [826]	36.6 [930]	40.75 [1,035]	4,263 [1,934]	4,278 [1,940]
18 [450]	150	25.0 [635]	33.8 [858]	27.50 [699]	1,795 [814]	1,810 [821]
	300	28.0 [711]	35.3 [897]	29.00 [737]	2,081 [944]	2,096 [951]
	600	29.3 [743]	35.9 [912]	31.50 [800]	2,663 [1,208]	2,678 [1,215]
	900	31.0 [787]	36.8 [935]	35.00 [889]	3,350 [1,520]	3,365 [1,526]
	1500	36.0 [914]	39.3 [998]	42.75 [1,086]	5,480 [2,486]	5,495 [2,493]
20 [500]	150	27.5 [699]	36.0 [916]	28.88 [733]	2,144 [972]	2,159 [979]
	300	30.5 [775]	37.5 [954]	30.25 [768]	2,476 [1,123]	2,491 [1,130]
	600	32.0 [813]	38.3 [973]	33.00 [838]	3,272 [1,484]	3,287 [1,491]
	900	33.8 [857]	39.2 [995]	37.50 [953]	4,129 [1,873]	4,144 [1,879]
	1500	38.8 [984]	41.7 [1,058]	46.00 [1,168]	6,789 [3,079]	6,804 [3,086]
24 [600]	150	32.0 [813]	39.8 [1,011]	31.25 [794]	2,654 [1,204]	2,669 [1,211]
	300	36.0 [914]	41.8 [1,062]	32.50 [826]	3,223 [1,462]	3,238 [1,469]
	600	37.0 [940]	42.3 [1,074]	35.75 [908]	4,435 [2,012]	4,450 [2,019]
	900	41.0 [1,041]	44.3 [1,125]	42.75 [1,086]	6,537 [2,965]	6,552 [2,972]
	1500	46.0 [1,168]	46.8 [1,189]	51.75 [1,314]	10,223 [4,637]	10,238 [4,644]

Consult Cameron regarding availability of other meter sizes.

The Compact Standard meter body provides the LFM 380Ci flowmeter with the shortest possible face-to-face length dimension. For meters of 3 x DN face-to-face length, please see the following 3D Metric Standard meter body table.

CALDON LEFM 380Ci

Dimension and weights for 3D metric standard LEFM 380Ci (3 × DN in length)

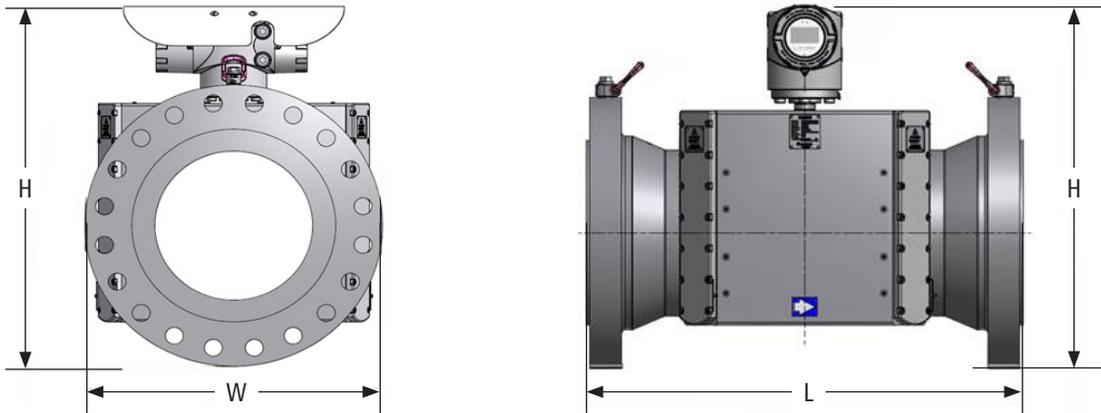
Pipe size, DN	Flange ANSI class	Width (W), mm	Height (H), mm	Length (L), mm	Assembled meter weight (excluding transmitter), kg	Assembled meter weight (including transmitter), kg
150	150 [†]	279	520	470 [†]	173	180
	300 [†]	318	539	489 [†]	189	196
	600 [†]	356	558	540 [†]	218	225
	900 [†]	381	571	584 [†]	246	253
	1500 [†]	394	577	648 [†]	295	301
200	150	343	584	600	267	273
	300	381	603	600	289	296
	600	419	622	600	337	344
	900 [†]	470	647	654 [†]	403	409
	1500 [†]	483	654	756 [†]	481	488
250	150	406	638	750	385	392
	300	445	657	750	417	423
	600	508	689	750	512	518
	900	546	708	750	595	602
	1500 [†]	584	727	857 [†]	774	781
300	150	483	708	900	530	537
	300	521	727	900	576	583
	600	559	746	900	693	700
	900	610	771	900	836	843
	1500 [†]	673	803	940 [†]	1,158	1,165
350	150	533	752	1,050	679	686
	300	584	777	1,050	745	752
	600	603	787	1,050	881	887
	900	641	806	1,050	1,046	1,053
	1500	749	860	1,050	1,531	1,538
400	150	597	816	1,200	872	879
	300	648	841	1,200	957	964
	600	686	860	1,200	1,190	1,196
	900	705	870	1,200	1,365	1,372
	1500	826	930	1,200	2,037	2,043
450	150	635	858	1,350	1,088	1,095
	300	711	897	1,350	1,201	1,208
	600	743	912	1,350	1,519	1,526
	900	787	935	1,350	1,830	1,837
	1500	914	998	1,350	2,689	2,696
500	150	699	916	1,500	1,329	1,335
	300	775	954	1,500	1,463	1,470
	600	813	973	1,500	1,918	1,925
	900	857	995	1,500	2,302	2,308
	1500	984	1,058	1,500	3,379	3,386
600	150	813	1,011	1,800	1,561	1,567
	300	914	1,062	1,800	1,807	1,814
	600	940	1,074	1,800	2,591	2,598
	900	1,041	1,125	1,800	3,568	3,575
	1500	1,168	1,189	1,800	5,127	5,134

[†]Please refer to the preceding Compact Standard meter body table

Consult Cameron regarding availability of other meter sizes.

The 3D Metric Standard meter body provides the LEFM 380Ci flowmeter in 3 × DN face-to-face length allowing for standardization of meter station design and ease of replacement of turbine and other meter types built to the 3D standard. For meters of a shorter length, please see the preceding Compact Standard meter body table.

CALDON LEFM 380Ci



Meter body with integral transmitter

General Performance: Meets or Exceeds the Requirements of AGA9, ISO17089-1 and OIML R137

Nominal flow velocity range

Flowrate	ft/s	m/s
Q_{min}	2	0.6
Q_t	for meters 6–10 in for meters 12 in and larger	3 1.5
Q_{max}	100	30.5
Over-range	120	36.6

Accuracy

Q_t to Q_{max}	Meter factor $\leq \pm 0.1\%$ (linearized relative to calibration facility) Repeatability ± 0.05 of reading, typical
Q_{min} to Q_t	Meter factor $\leq \pm 0.2\%$ (linearized relative to calibration facility) Repeatability ± 0.1 of reading, typical
Velocity sampling interval	≤ 0.06 seconds

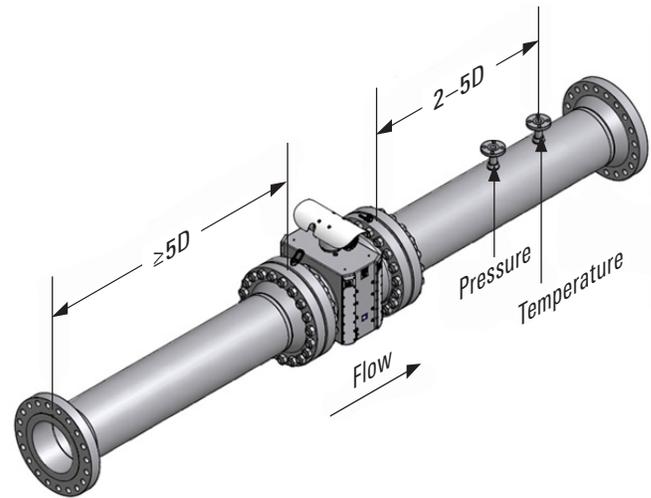
Q_{min} : Minimum flow rate
 Q_t : Transition flow rate
 for stated accuracy
 Q_{max} : Maximum flow rate
 for stated accuracy

CALDON LEFM 380Ci

Installation

The LEFM 380Ci does not require the use of a flow conditioning element.

In order to limit uncertainty caused by hydraulic effects, it is recommended that the installation of the LEFM 380Ci flowmeter comply with the following guidelines. The adjoining straight pipe should be of the same schedule as the meter. Temperature elements and pressure connections should be located downstream of the meter. An uninterrupted upstream pipe five pipe diameters in length is sufficient downstream of piping elements such as elbows, tees, and reducers. In situations where there is a constriction upstream of the meter that is smaller than the diameter of the meter run piping (such as a partially open or reduced bore valve), it is recommended that this be separated from the meter by 15 pipe diameters in length. Downstream of the meter there should be a straight pipe section of at least three pipe diameters in length. Thermowells should be installed at a distance of 2D to 5D downstream of the meter. For application specific recommendations or more detailed installation guidance, please consult Cameron.



LEFM SystemLink G3

The LEFM SystemLink G3 user interface software technology allows access to real-time diagnostic data, historical data, and event logs from a G3 ultrasonic flowmeter by using an Ethernet/fiber optic modem connection. Historical data and event logs are stored within the G3 transmitter, thus allowing for later retrieval—giving operators ability to monitor and analyze critical diagnostics, helping prevent unplanned downtime.

LEFM SystemLink G3 features:

- Health overview report show the current meter status as well as meter process measurements including flow rate, temperature, and pressure
- Detailed charts and graphs present the meter diagnostic information in an easy-to-understand format with alarm limits that help identify issues
- User defined reference points are built using the meter's stored data. These reference points allow the user to graphically compare current meter performance against user defined reference points. For example, current performance can be compared against calibration or commissioning data.
- Export data as both predefined PDF reports or to customer defined Excel spreadsheets.



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