CAMERON
A Schlumberger Company

CALDON LEFM 280Ci

Ultrasonic flowmeter

APPLICATIONS

- Custody transfer
- Check or allocation metering
- Leak detection/line balance

BENEFITS

- Reliable and long-term stability

FEATURES

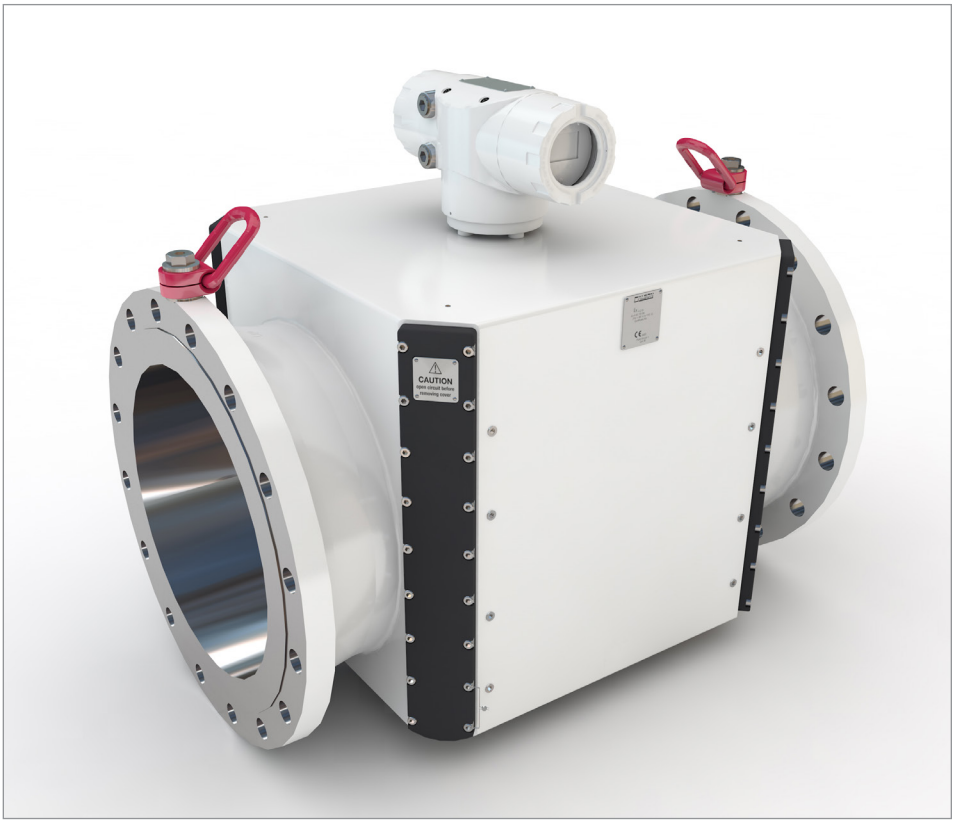
- Insensitivity to swirl
- Electronics can be integrally or remote mounted
- Available in 4- to 40-in sizes
- ±0.10% linearity over the nominal flow range
- OIML R117-1 Edition 2007 (E); Accuracy Class 0.3
- Third generation (G3) electronics

When accuracy and reliability are critical the CALDON* family of leading edge flowmeters (LEFM*) provides the petroleum industry with a durable, stable, and low cost-of-ownership measurement option. The CALDON LEFM 280Ci Series eight-path liquid ultrasonic flowmeter covers a broad range of measurement demands and provides users with metering horsepower—whether for custody transfer, check or allocation metering, or leak detection/line balance applications.

The design of the CALDON LEFM 280Ci flowmeter makes it immune to swirl and less sensitive to other installation effects. This fact makes the CALDON LEFM 280Ci flowmeter ideal for the transfer of laboratory calibration to the field. It can be used with confidence in remote applications, where provers are not practical or where space and weight allowances are limited.

Meter construction

The CALDON LEFM 280Ci meter body is designed and manufactured in accordance with ASME B31.3 Process Piping Code or the Pressure Equipment Directive (PED) 97/23/EC and is suitable for handling pressurized liquid hydrocarbons. It has 16 piezoelectric transducer modules (typically 1.0 MHz or 1.6 MHz) forming eight chordal paths. These are mounted in pressure containing housings and can be replaced while the meter body is under operating conditions. Ingress protection rating for the transmitter and meter body is IP66 (NEMA 4/4X).



CALDON LEFM 280Ci ultrasonic flowmeter

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Sizes, Maximum Flow Rates and K-factors			
Size, in	**DN**	**Nominal maximum flow, bbl/h [m^3/h]**	**K-factor, P/bbl [P/m^3]**
4	100	2,050 [325]	2,000 [12,600]
6	150	4,650 [740]	1,000 [6,300]
8	200	8,150 [1,290]	500 [3,150]
10	250	12,800 [2,030]	350 [2,200]
12	300	19,300 [3,070]	250 [1,570]
14	350	23,600 [3,750]	200 [1,000]
16	400	28,700 [4,560]	150 [940]
18	450	41,000 [6,500]	100 [630]
20	500	50,000 [7,900]	85 [530]
24	600	72,000 [11,500]	60 [380]
26	650	87,000 [13,900]	45 [280]
28	700	100,000 [16,200]	40 [240]
30	750	115,000 [18,700]	35 [220]
32	800	130,000 [21,300]	30 [185]
34	850	150,000 [24,200]	25 [165]
36	900	165,000 [27,200]	25 [145]
40	1,000	205,000 [32,600]	20 [125]

K-factor is based on ~ 1.1 KHz output at maximum nominal rate. Other K-factors can be programmed but should be between 4 Hz and 10 KHz output at all operating flow rates. Meters are typically sized for a 10:1 flow range (from maximum flow) for sizes 4–8 in; 15:1 for sizes 10 in and larger.

Standard Materials of Construction		
Meter body	**Stainless steel**	**Carbon steel**
Flanges	Stainless steel	Carbon steel
Body	Cast or forged stainless steel	Cast or forged carbon steel
Manifold covers	Stainless steel or aluminum	Stainless steel or aluminum
Transducer housings	Stainless steel	Stainless steel or Inconel
Junction boxes (remote transmitter)	Copper-free aluminum or optional cast stainless steel	

Compact transmitter enclosure	**Standard**	**Optional**
	Copper-free aluminum	Stainless steel

Consult Cameron for other material options.

Standard End Connections and Maximum Working Pressure[†]		
ANSI B16.5 raised face	**Stainless steel**	**Carbon steel**
Class 150	275 psi [19.0 bar]	285 psi [19.6 bar]
Class 300	720 psi [49.6 bar]	740 psi [51.1 bar]
Class 600	1,440 psi [99.3 bar]	1,480 psi [102.1 bar]
Class 900	2,160 psi [148.2 bar]	2,220 psi [153.2 bar]
Class 1500	3,600 psi [248.2 bar]	3,705 psi [255.3 bar]

[†] Maximum working pressure at –20–100 degF [–29–38 degC]

CALDON LEFM 280Ci

General Specifications	
Electronics	
Power requirements—DC power	
Voltage	24 VDC (18–30 VDC)
Current draw	0.25 A at 24 VDC
Power consumption	6 W
Power requirements—AC power	
Voltages	120 (60 Hz) / 230 (50 Hz) VAC
Voltage range	108–253 VAC
Frequency range	47–63 Hz
Current draw	0.14A
Power consumption	7.3 W
Relative humidity	0–95%
Operating temperature	–58–158 degF [–50–70 degC]
Local display	400 pixel × 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, 0 duty cycle
	Channel B indicates flow direction
	Forward flow = 0
	Reverse flow = High (5 VDC or 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	–58–284 degF [–50–140 degC]

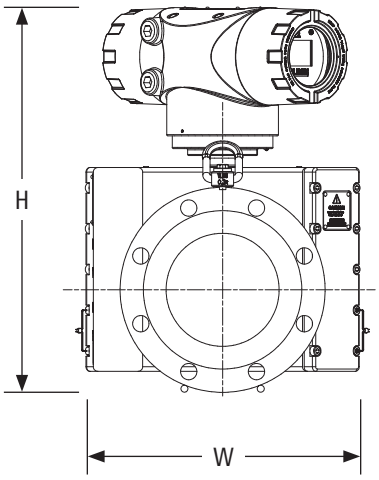
CALDON LEFM 280Ci

Dimension and Weights for LEFM 280Ci (Integral Manifold) with Compact Transmitter

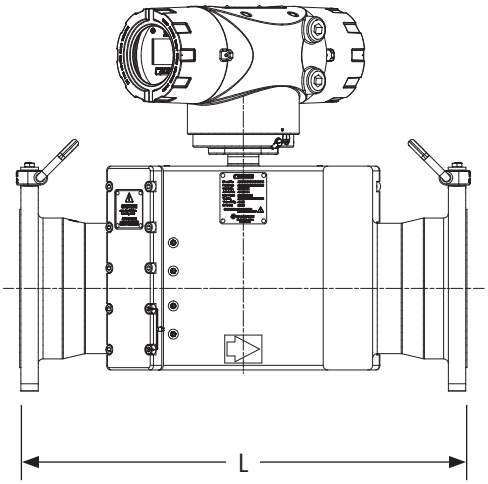
Pipe size, in [DN]	ANSI class	Length (L), in [mm]	Max width (W)† (including manifolds and sunshield), in [mm]	Height (H), in [mm]	Assembled meter weight with Xmtr‡, lbm [kg]
4 [100]	150	21.00 [533]	17.7 [450]	19.2 [487]	332 [151]
	300	21.75 [552]	17.7 [450]	19.7 [500]	352 [160]
	600	23.50 [597]	17.7 [450]	20.1 [510]	385 [174]
	900	24.50 [622]	17.7 [450]	20.4 [519]	419 [190]
	1500	25.25 [641]	17.7 [450]	20.8 [529]	464 [211]
6 [150]	150	24.00 [610]	17.7 [450]	21.1 [535]	494 [224]
	300	24.75 [629]	17.7 [450]	21.8 [554]	535 [243]
	600	26.75 [679]	17.7 [450]	22.6 [573]	624 [283]
	900	28.50 [724]	17.7 [450]	23.1 [586]	705 [320]
	1500	31.00 [787]	17.7 [450]	23.3 [592]	839 [381]
8 [200]	150	26.75 [679]	17.7 [450]	23.6 [598]	733 [332]
	300	27.50 [699]	17.7 [450]	24.3 [618]	793 [360]
	600	29.75 [756]	17.7 [450]	25.1 [637]	929 [421]
	900	32.00 [813]	18.5 [470]	26.1 [662]	1,112 [504]
	1500	36.00 [914]	19.0 [483]	26.3 [668]	1,334 [605]
10 [250]	150	28.75 [730]	17.7 [450]	25.7 [652]	1,010 [458]
	300	30.00 [762]	17.7 [450]	26.4 [672]	1,104 [501]
	600	33.25 [845]	20.0 [508]	27.7 [703]	1,364 [619]
	900	35.75 [908]	21.5 [546]	28.4 [722]	1,596 [724]
	1500	41.25 [1,048]	23.0 [584]	29.2 [741]	2,090 [948]
12 [300]	150	31.75 [806]	19.6 [497]	28.4 [722]	1,382 [627]
	300	33.00 [838]	20.5 [521]	29.2 [741]	1,509 [684]
	600	35.50 [920]	22.0 [559]	29.9 [760]	1,812 [822]
	900	39.00 [991]	24.0 [610]	30.9 [786]	2,194 [995]
	1500	45.50 [1,156]	26.5 [673]	32.2 [818]	3,067 [1,391]
14 [350]	150	34.00 [864]	21.0 [533]	30.2 [767]	1,669 [757]
	300	35.25 [895]	23.0 [584]	31.2 [792]	1,858 [843]
	600	37.50 [953]	23.8 [603]	31.6 [802]	2,180 [989]
	900	41.25 [1,048]	25.3 [641]	32.3 [821]	2,619 [1,188]
	1500	48.00 [1,219]	29.5 [749]	34.4 [875]	3,889 [1,764]
16 [400]	150	35.75 [908]	23.5 [597]	32.7 [830]	2,165 [982]
	300	37.25 [946]	25.5 [648]	33.7 [856]	2,400 [1,088]
	600	40.25 [1,022]	27.0 [686]	34.4 [875]	2,932 [1,330]
	900	43.25 [1,099]	27.8 [705]	34.8 [884]	3,373 [1,530]
	1500	50.75 [1,289]	32.5 [826]	37.2 [945]	5,104 [2,315]
18 [450]	150	38.75 [984]	25.0 [635]	34.4 [873]	2,659 [1,206]
	300	40.25 [1,022]	28.0 [711]	35.9 [911]	2,969 [1,347]
	600	42.75 [1,086]	29.3 [743]	36.5 [927]	3,654 [1,657]
	900	46.25 [1,175]	31.0 [787]	37.4 [949]	4,405 [1,998]
	1500	54.00 [1,372]	36.0 [914]	39.9 [1,013]	6,593 [2,990]
20 [500]	150	41.13 [1,045]	27.5 [699]	36.6 [930]	3,247 [1,473]
	300	42.50 [1,080]	30.5 [775]	38.1 [968]	3,607 [1,636]
	600	45.25 [1,149]	32.0 [813]	38.9 [987]	4,554 [2,066]
	900	49.75 [1,264]	33.8 [857]	39.8 [1,010]	5,479 [2,485]
	1500	58.25 [1,480]	38.8 [984]	42.3 [1,073]	8,208 [3,723]
24 [600]	150	45.75 [1,162]	32.0 [813]	40.8 [1,037]	4,586 [2,080]
	300	47.00 [1,194]	36.0 [914]	42.8 [1,087]	5,159 [2,340]
	600	50.25 [1,276]	37.0 [940]	43.3 [1,100]	6,617 [3,001]
	900	57.25 [1,454]	41.0 [1,041]	45.3 [1,151]	8,877 [4,027]
	1500	66.25 [1,683]	46.0 [1,168]	47.8 [1,214]	12,695 [5,758]

† On sizes up to 8-in Class 600 the sun shield is widest; on larger sizes the flange is the widest.

‡ Consult Cameron for weights of cast or other meter construction.



6-in LEFM 280Ci ultrasonic flowmeter, side view.



6-in LEFM 280Ci ultrasonic flowmeter, front view.

CALDON LEFM 280Ci

General Performance	
Linearity	±0.10% over nominal flow range with recommended installation.
Reynolds number[†]	Performance may degrade when Reynolds number falls below 10,000.
Repeatability/uncertainty	0.02%; calibrated per API MPMS Chapter 5.8 Table B-1 to achieve a meter factor uncertainty of ± 0.027%.
Nominal flow range[‡]	10:1 for sizes 4–8 in [DN100–DN200] from nominal maximum flow; 15:1 or greater for sizes 10 in and larger [DN250 and larger] from nominal maximum flow.
Long-term stability	Meter factor is unaffected by usage.
Water in oil[§]	The meter can operate on water in oil content as high as 50% provided the water and oil are well mixed, typically at velocities above 6.5 fps [2.5 m/s]. Meter operation may be affected if the water and oil phases separate or are not well mixed. Contact Cameron for further advice on high water-cut applications.
Viscosity	The maximum allowable viscosity is based on maintaining the recommended minimum operating Reynolds number and/or the maximum allowable signal attenuation. Contact Cameron for max. allowable viscosity for specific operating conditions.
Custody transfer certification	OIML R 117-1 Edition 2007 (E); Accuracy Class 0.3.

[†] Contact Cameron when operating Reynolds number is expected to be below 10,000

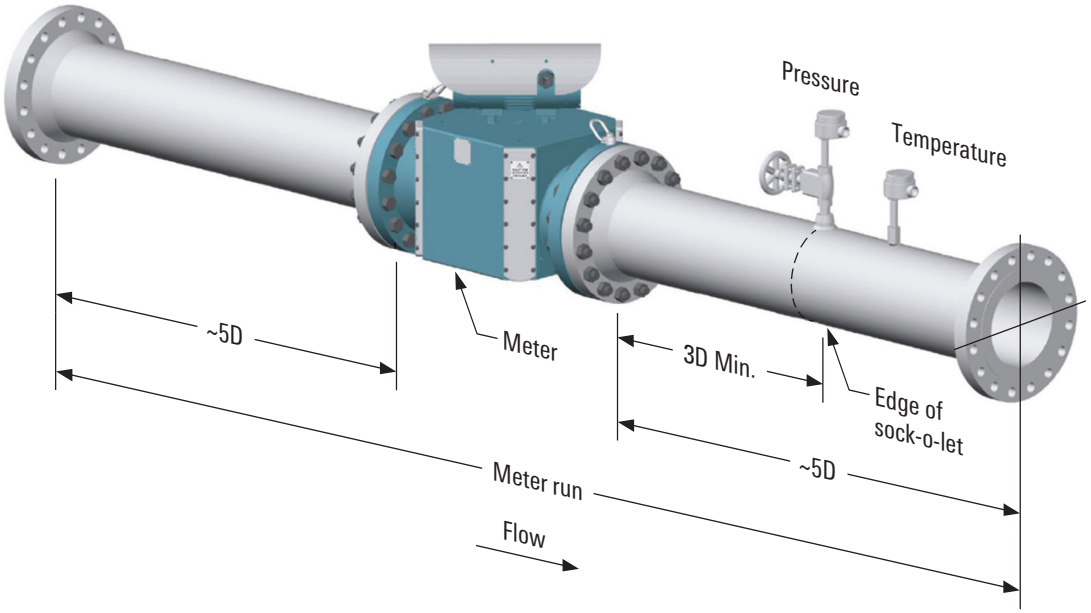
[‡] Nominal flow range will increase for values of linearity > 0.10%

[§] Call Cameron for special applications outside these ranges.

Installation

In order to limit uncertainty caused by hydraulic effects, it is recommended that the installation of the CALDON LEFM 280Ci 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. The LEFM 280Ci does not normally require the use of a flow conditioning element. An uninterrupted upstream pipe five pipe diameters in length is adequate in most applications.

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 reduced bore valve), it is recommended that this be separated from the meter by a pipe at least 15 pipe diameters in length. Downstream of the meter there should be an uninterrupted pipe at least three pipe diameters in length. For application specific recommendations or more detailed installation guidance, please consult Cameron.



CALDON LEFM 280Ci ultrasonic 6-in rendered meter run

CALDON LEFM 280Ci

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.

Calibration lab

The Cameron Hydrocarbon Calibration Laboratory is a state-of-the-art facility located in Pittsburgh, PA. Every CALDON LEFM Series 200 ultrasonic flowmeter is calibrated in this laboratory using up to three oils. The ability to use multiple oils allows calibration over a Reynolds number range that includes that of the customer's application. This ensures meter performance will be unaffected by changes in flow rate and viscosity once the meter is installed.

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