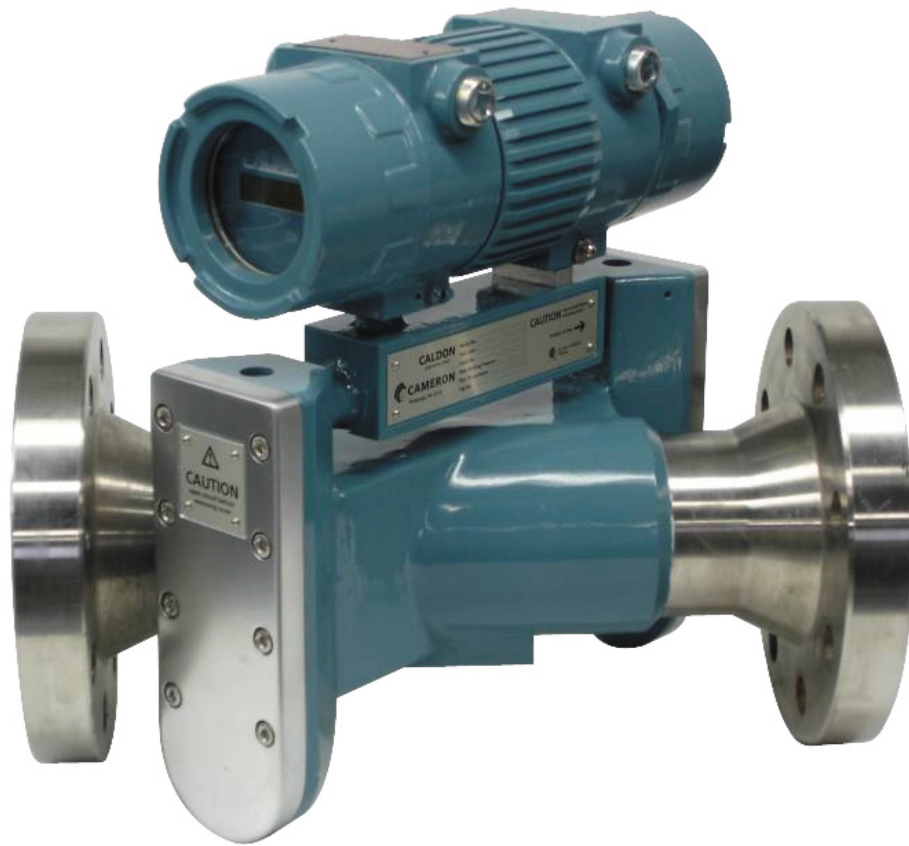


CALDON®

LEFM® 240Ci / 240C Ultrasonic Flow Meters



When accuracy and reliability are critical the Caldon® family of LEFM® Ultrasonic Meters provides the petroleum industry with a durable, stable and low cost-of-ownership measurement option. The three LEFM models - the LEFM 220C, LEFM 240C and LEFM 280C - cover a broad range of measurement demands and allow users to choose just the right amount of metering "horsepower" whether it is for custody transfer, check or allocation metering, or leak detection/line balance applications.

The LEFM 240C ultrasonic meter is a compact, high performance unit designed specifically for custody transfer or fiscal metering applications. The four-chordal path design ensures linearity over a wide flow range and the ability to handle a wide range of petroleum fluids including crude oils, refined products and blends. Its versatility allows application in single or multiple product pipelines, as well as ship loading/off loading and off-shore applications.

Custody transfer performance

Stable performance over:

- wide viscosity ranges
- large flow ranges

Ideally suited for refined products and crude oil

Provable

Enhanced flow stream and performance diagnostics

Meter Construction

The Caldon LEFM 240C 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 eight (8) piezoelectric transducer modules (typically 0.5MHz, 1.0MHz or 1.6MHz) forming four (4) chordal paths. These are mounted in pressure containing housings and can be replaced while the meter body is under operating conditions.

Electrical Approvals

The meter meets the requirements of NFPA 70 for use in Class 1, Division 1, Groups C and D hazardous locations and is classified by UL/cUL. It meets the requirements for NEMA 4X and NEMA 7. It is certified by ATEX (CENELEC IIB) for use in EExd IIB flameproof applications and has an ingress protection rating of IP66.

Remote Mounted Wall Transmitter and Compact Transmitter¹



¹ Approval pending for compact transmitter.

Meter Body



Sizes, Maximum Flow Rates and K Factors

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

K Factor is based on ~ 1.1 KHz at maximum nominal rate. Other K factors can be programmed but must be between 4 Hz and 10 KHz at all operating flow rates.

Standard Materials of Construction

Meter Body	Stainless Steel	Carbon Steel
Flanges	316 Forged Stainless Steel	Forged Carbon Steel – ASTM A105
Body	Cast Stainless Steel – CF8M (316)	Cast Carbon Steel – ASTM A216 Gr WCB
Manifold	304 Stainless Steel	304 Stainless Steel
Manifold Covers	316 Stainless Steel	316 Stainless Steel
Transducer Housings	316 Stainless Steel	316 Stainless Steel
Junction Boxes (optional)	Epoxy Painted Copper-Free Aluminum	Epoxy Painted Copper-Free Aluminum
Compact Transmitter Enclosure		
EX – NEMA 7/4X	Copper-Free Aluminum	Copper-Free Aluminum
Remote Wall Mounted Transmitter		
GP – NEMA 4X	304 Stainless Steel	304 Stainless Steel
EX – NEMA 7	Copper-Free Aluminum	Copper-Free Aluminum

Standard End Connections & Maximum Working Pressure

Maximum Working Pressure -20° F to 100° F (-29° C to 38° C)

ANSI B16.5 Raised Face	Stainless Steel		Carbon Steel	
Class 150	275 psi	(18.96 Bars)	285 psi	(19.65 Bars)
Class 300	720 psi	(49.64 Bars)	740 psi	(51.02 Bars)
Class 600	1,440 psi	(99.29 Bars)	1,480 psi	(102.05 Bars)
Class 900	2,160 psi	(148.93 Bars)	2,220 psi	(153.07 Bars)
Class 1500	3,600 psi	(248.22 Bars)	3,705 psi	(255.46 Bars)

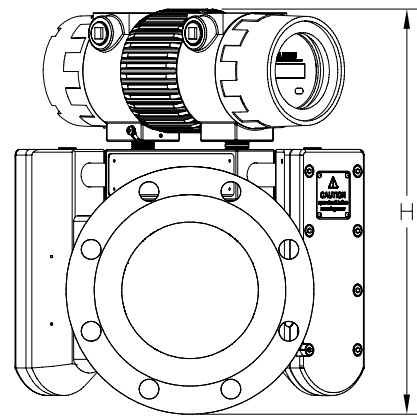
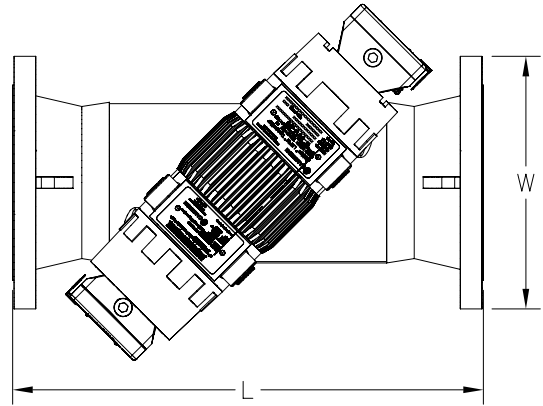
General Specifications

	LEFM 240Ci Electronics	LEFM 240C Wall Mounted Electronics	Meter Body
Voltage	18-30 VDC	120 VAC, 240 VAC ± 10% 18-30 VDC	
Power	10 W	80 W	
Relative Humidity	0-100%	0-100%	0-100%
Operating Temperature	-40° F to 140° F (-40° C to 60° C)	-30° F to 140° F (-35° C to 60° C)	-40° F to 200° F (-40° C to 93° C) Extended Range: -328° F to 464° F (-200° C to 240° C)
Local Display	Yes	No	
Remote Mounting from Meter	328 feet (100 meters)	328 feet (100 meters)	
Analog Input(s)	One, 4-20 mA Configured for temperature, pressure or density.	Up to three, 4-20 mA Configured for temperature, pressure or density.	
Analog Output(s)	One, 4-20 mA Any process variable measured by the meter is available as an analog output.	Up to four, 4-20 mA Any process variable measured by the meter is available as an analog output.	
Digital Outputs			
Flow	Two pulse output channels selectable as either 0-5 V or 0-12 V; A and B continuous 50/50 duty cycle. Programmable K Factor.	Three pulse output channels 0-5 V; 2 A channels, and 1 B continuous 50/50 duty cycle. Programmable K Factor. A channels are identical; B channel is 90° out of phase with A for flow direction.	
Flow Direction	B channel can be programmed as 90° out of phase with A or as a direction-indicating voltage level (high = forward flow)	0-5 V (5 = forward flow)	
Alarm Status	0-5 V or 0-12 V selectable (0 = alarm)	0-5 V (0 = alarm)	
Serial Communication	ModBus RTU: RS-485 (2) – Up to 3,900 feet (1,200 meters)	ModBus RTU: RS-485 (2) – Up to 3,900 feet (1,200 meters)	

Dimension & Weights for LFM 240Ci with Compact Electronics

Pipe Size Inches (DN)	ANSI Class	Length (L)		Width (W)		Height (H)		Unpacked Weight	
		Inches	(mm)	Inches	(mm)	Inches	(mm)	lbs.	(kg)
4 (100)	150	18.0	(457)	11.0	(280)	16.2	(411)	153	(70)
	300	18.8	(477)	11.0	(280)	16.7	(424)	170	(77)
	600	20.5	(521)	11.0	(280)	17.1	(434)	204	(93)
	900	21.5	(546)	11.5	(292)	17.4	(442)	222	(101)
	1500	22.3	(565)	12.3	(311)	17.8	(452)	266	(121)
6 (150)	150	20.5	(521)	12.8	(324)	18.1	(460)	226	(103)
	300	21.3	(540)	12.8	(324)	18.8	(478)	260	(118)
	600	23.2	(590)	14.0	(356)	19.6	(498)	338	(154)
	900	25.0	(635)	15.0	(381)	20.1	(511)	396	(180)
	1500	27.5	(699)	15.5	(394)	20.3	(516)	506	(230)
8 (200)	150	24.0	(610)	14.8	(375)	20.3	(516)	377	(171)
	300	24.8	(629)	15.0	(381)	21.1	(536)	433	(196)
	600	27.0	(686)	16.5	(419)	21.8	(554)	539	(244)
	900	29.3	(743)	18.5	(470)	22.8	(579)	649	(294)
10 (250)	150	26.0	(660)	17.0	(432)	22.7	(577)	559	(253)
	300	27.2	(692)	17.5	(445)	23.4	(594)	637	(289)
	600	30.5	(775)	20.0	(508)	24.7	(627)	835	(379)
	900	33.0	(838)	21.5	(546)	25.4	(645)	975	(442)
12 (300)	150	29.5	(749)	19.0	(483)	25.2	(640)	773	(351)
	300	30.7	(781)	20.5	(521)	25.9	(658)	893	(405)
	600	33.2	(844)	22.0	(559)	26.7	(678)	1063	(482)
	900	36.8	(934)	24.0	(610)	27.7	(704)	1263	(573)
14 (350)	150	32.0	(813)	21.0	(533)	26.9	(683)	992	(450)
	300	33.2	(844)	23.0	(584)	27.9	(709)	1132	(513)
	600	35.5	(902)	23.8	(603)	28.3	(719)	1332	(604)
	900	39.3	(997)	25.3	(641)	29.1	(739)	1572	(713)
16 (400)	150	33.5	(851)	23.5	(597)	29.2	(742)	1156	(524)
	300	35.0	(889)	25.5	(648)	30.2	(767)	1376	(624)
	600	38.0	(965)	27.0	(686)	30.9	(785)	1656	(751)
	900	41.5	(1054)	27.8	(705)	31.3	(795)	1866	(846)
18 (450)	150	37.0	(940)	25.0	(635)	31.0	(787)	1259	(571)
	300	38.5	(978)	28.0	(711)	32.5	(826)	1599	(725)
	600	41.0	(1041)	29.3	(743)	33.1	(841)	1909	(866)
	900	44.5	(1130)	31.0	(787)	34.0	(864)	2319	(1052)
20 (500)	150	39.4	(1000)	27.5	(699)	33.2	(843)	1404	(637)
	300	40.8	(1035)	30.5	(775)	34.7	(881)	1844	(836)
	600	43.5	(1105)	32.0	(813)	35.5	(902)	2224	(1009)
	900	48.0	(1219)	33.8	(857)	36.3	(922)	2704	(1226)
24 (600)	150	44.0	(1118)	32.0	(813)	37.5	(953)	1717	(779)
	300	45.2	(1149)	36.0	(914)	39.5	(1003)	2357	(1069)
	600	48.5	(1232)	37.0	(940)	40.0	(1016)	2857	(1296)
	900	55.5	(1410)	41.0	(1041)	42.0	(1067)	4197	(1904)
26 (650)	150	43.5	(1105)	34.3	(870)	39.6	(1006)	1904	(864)
	300	48.5	(1232)	38.3	(972)	41.6	(1057)	2514	(1140)
28 (700)	150	45.9	(1166)	36.5	(927)	41.7	(1059)	2096	(951)
	300	51.5	(1308)	40.8	(1036)	43.8	(1113)	2871	(1302)
30 (750)	150	48.8	(1239)	38.8	(984)	43.8	(1113)	2288	(1038)
	300	54.5	(1384)	43.0	(1092)	46.0	(1168)	3228	(1464)
32 (800)	150	51.4	(1305)	41.8	(1060)	46.3	(1176)	2585	(1172)
	300	57.5	(1461)	45.3	(1149)	48.1	(1222)	3585	(1626)
34 (850)	150	53.8	(1366)	43.8	(1111)	48.3	(1227)	2742	(1244)
	300	60.2	(1530)	47.5	(1207)	50.2	(1275)	3952	(1792)
36 (900)	150	56.4	(1432)	46.0	(1168)	50.5	(1283)	3028	(1374)
	300	63.0	(1600)	50.0	(1270)	52.5	(1334)	4298	(1950)

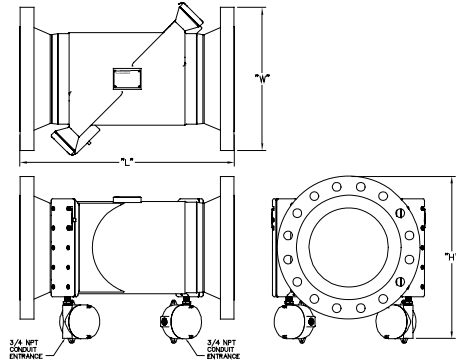
LFM 240Ci
with Compact Electronics



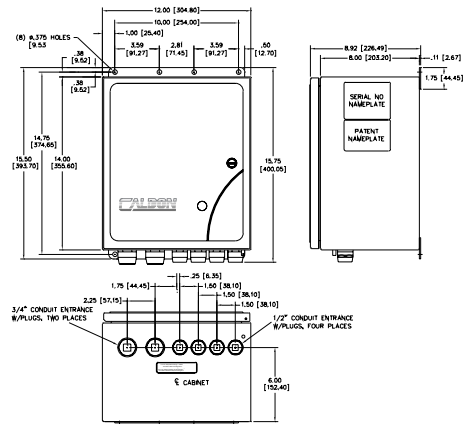
Dimension & Weights for LFM 240C Meter Body only

Pipe Size Inches (DN)	ANSI Class	Length (L)		Width (W)		Height (H)		Unpacked Weight	
		Inches	(mm)	Inches	(mm)	Inches	(mm)	lbs.	(kg)
4 (100)	150	18.0	(457)	11.0	(280)	17.9	(454)	153	(70)
	300	18.8	(477)	11.0	(280)	18.4	(467)	170	(77)
	600	20.5	(521)	11.0	(280)	18.8	(476)	204	(93)
	900	21.5	(546)	11.5	(292)	19.1	(486)	222	(101)
	1500	22.3	(565)	12.3	(311)	19.5	(496)	266	(121)
6 (150)	150	20.5	(521)	12.8	(324)	19.8	(502)	226	(103)
	300	21.3	(540)	12.8	(324)	20.5	(521)	260	(118)
	600	23.2	(590)	14.0	(356)	21.3	(540)	338	(154)
	900	25.0	(635)	15.0	(381)	21.8	(553)	396	(180)
	1500	27.5	(699)	15.5	(394)	22.0	(559)	506	(230)
8 (200)	150	24.0	(610)	14.8	(375)	22.0	(559)	377	(171)
	300	24.8	(629)	15.0	(381)	22.8	(578)	433	(196)
	600	27.0	(686)	16.5	(419)	23.5	(597)	539	(244)
	900	29.3	(743)	18.5	(470)	24.5	(623)	649	(294)
10 (250)	150	26.0	(660)	17.0	(432)	24.4	(619)	559	(253)
	300	27.2	(692)	17.5	(445)	25.1	(638)	637	(289)
	600	30.5	(775)	20.0	(508)	26.4	(670)	835	(379)
	900	33.0	(838)	21.5	(546)	27.1	(689)	975	(442)
12 (300)	150	29.5	(749)	19.0	(483)	26.9	(683)	773	(351)
	300	30.7	(781)	20.5	(521)	27.6	(702)	893	(405)
	600	33.2	(844)	22.0	(559)	28.4	(721)	1063	(482)
	900	36.8	(934)	24.0	(610)	29.4	(746)	1263	(573)
14 (350)	150	32.0	(813)	21.0	(533)	28.6	(727)	992	(450)
	300	33.2	(844)	23.0	(584)	29.6	(753)	1132	(513)
	600	35.5	(902)	23.8	(603)	30.0	(762)	1332	(604)
	900	39.3	(997)	25.3	(641)	30.8	(781)	1572	(713)
16 (400)	150	33.5	(851)	23.5	(597)	30.9	(784)	1156	(524)
	300	35.0	(889)	25.5	(648)	31.9	(810)	1376	(624)
	600	38.0	(965)	27.0	(686)	32.6	(829)	1656	(751)
	900	41.5	(1054)	27.8	(705)	33.0	(838)	1866	(846)
18 (450)	150	37.0	(940)	25.0	(635)	32.7	(830)	1259	(571)
	300	38.5	(978)	28.0	(711)	34.2	(868)	1599	(725)
	600	41.0	(1041)	29.3	(743)	34.8	(884)	1909	(866)
	900	44.5	(1130)	31.0	(787)	35.7	(906)	2319	(1052)
20 (500)	150	39.4	(1000)	27.5	(699)	34.9	(887)	1404	(637)
	300	40.8	(1035)	30.5	(775)	36.4	(925)	1844	(836)
	600	43.5	(1105)	32.0	(813)	37.2	(944)	2224	(1009)
	900	48.0	(1219)	33.8	(857)	38.0	(966)	2704	(1226)
24 (600)	150	44.0	(1118)	32.0	(813)	39.2	(995)	1717	(779)
	300	45.2	(1149)	36.0	(914)	41.2	(1046)	2357	(1069)
	600	48.5	(1232)	37.0	(940)	41.7	(1058)	2857	(1296)
	900	55.5	(1410)	41.0	(1041)	43.7	(1109)	4197	(1904)
26 (650)	150	43.5	(1105)	34.3	(870)	41.3	(1049)	1904	(864)
	300	48.5	(1232)	38.3	(972)	43.3	(1100)	2514	(1140)
28 (700)	150	45.9	(1165)	36.5	(927)	43.4	(1103)	2091	(948)
	300	51.5	(1308)	40.8	(1035)	45.5	(1157)	2891	(1311)
30 (750)	150	48.8	(1239)	38.8	(984)	45.5	(1157)	2288	(1038)
	300	54.5	(1384)	43.0	(1092)	47.7	(1211)	3228	(1464)
32 (800)	150	51.4	(1305)	41.8	(1060)	48.0	(1220)	2585	(1172)
	300	57.5	(1461)	45.3	(1149)	49.8	(1265)	3585	(1626)
34 (850)	150	53.8	(1366)	43.8	(1111)	50.0	(1271)	2742	(1244)
	300	60.2	(1530)	47.5	(1207)	51.9	(1319)	3952	(1792)
36 (900)	150	56.4	(1432)	46.0	(1168)	52.2	(1325)	3028	(1374)
	300	63.0	(1600)	50.0	(1270)	54.2	(1376)	4298	(1950)

Meter Body

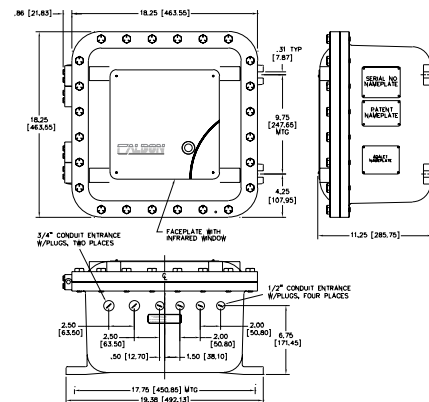


Wall Mounted EX Transmitter



EX - Explosion Proof - Unpacked Weight: 120 lbs. (54.5 kg)
Use 1/2 inch bolts/hardware (or equal) on all mounting points for the Explosion Proof (NEMA 7) transmitter. Cover bolts are metric (19 mm). Available with high quality offshore paint specification.

Wall Mounted GP Transmitter



GP - NEMA 4X - Unpacked Weight: 30 lbs. (13.6 kg)
Use 1/4 inch bolts/hardware (or equal) on at least the 2 top and 2 bottom mounting points for the NEMA 4X transmitter.

General Performance

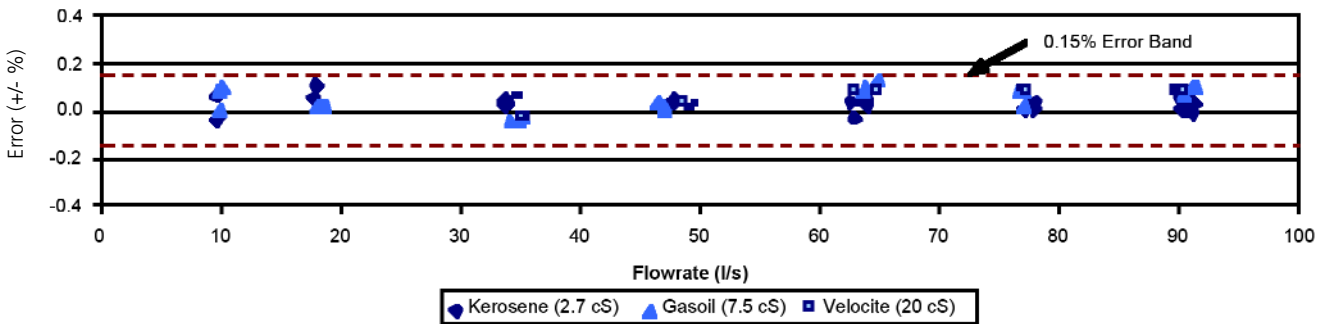
Linearity	± 0.15% over Nominal Flow Range with recommended flow conditioning
Repeatability	± 0.027% (API MPMS, Chapter 5.8, Table B-1)
Nominal Flow Range ¹	10:1 or greater for sizes 4 in. to 8 in. (DN100 – DN200) from max. flow; 15:1 or greater for sizes 10 in. and larger (DN250 and larger) from max. flow
Long Term Stability	Linearity is unaffected by usage
Reynolds Number	Performance may degrade when Reynolds Numbers fall below 10,000
Water in Oil ²	For water volumes up to 10% and velocities above 6.5 fps (2.0 mps), the meter will measure the total volume with no change in performance. Below 6.5 fps (2.0 mps) the performance depends on the separation of the water
Viscosity	Contact Cameron for applications with viscosity above 500 cSt for applicability
Custody Transfer Performance Approval (Pending for LEFM 240Ci with compact electronics)	OIML R 117 Edition 1995 (E) Accuracy Class 0.3 NMI Test Certificates TC3499R0, TC3499R1, CPC-051402-2, CPC-051402-3

¹ Nominal Flow Range will increase for values of linearity >0.15%.

² Call Cameron for special applications outside these ranges.

Typical Performance Curve

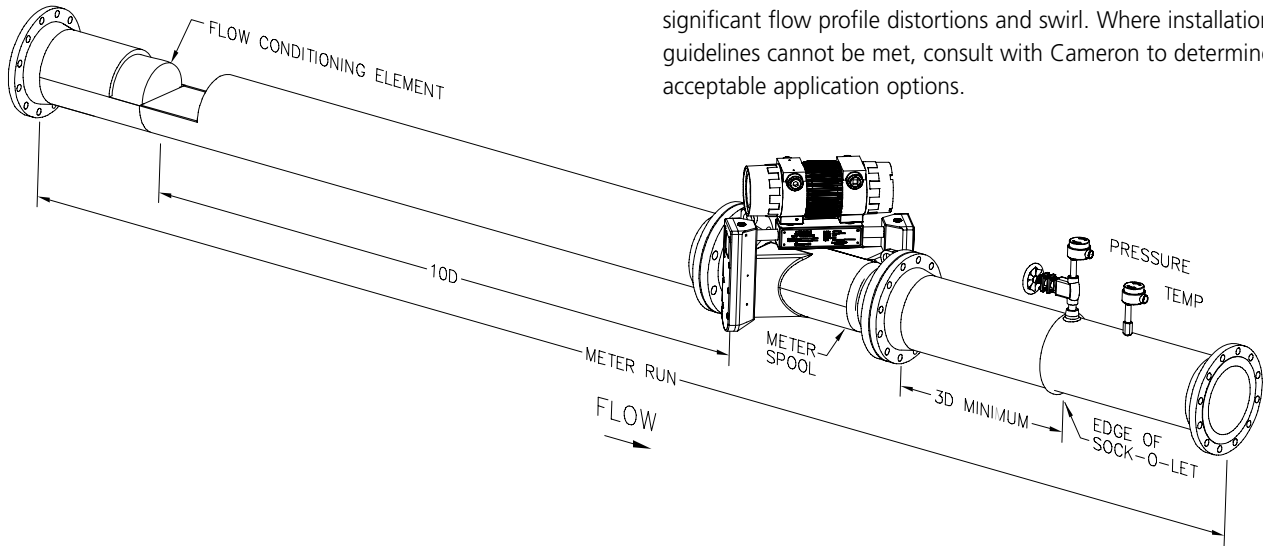
Error vs. Flow Rate (6" LEFM 240C)



Installation

To obtain the best possible performance for an LEFM 240C, there are some basic minimum installation requirements. The meter should have upstream straight pipe of the same schedule as the meter. Process temperature and pressure should be measured downstream of the meter. It is generally recommended that the LEFM 240C meter be installed

downstream of a flow conditioning element followed by 10 diameters of straight pipe. If there are no varying upstream conditions (manifolds, strainers, etc.) or swirl producing elements (out-of-plane elbows) then 20 diameters of straight pipe may be considered. There should be at least 3 diameters of straight pipe of the same nominal diameter as the meter downstream. These conditions minimize the possibility of significant flow profile distortions and swirl. Where installation guidelines cannot be met, consult with Cameron to determine acceptable application options.



U.S. Patents: 5546813, 5597962, 5639972, 5705753;
Korea Patent: 208678; Canada Patent: 2107.750;

Taiwan Patents: NI-080038, UM-119114.
U.S. and foreign patents pending.

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MEASUREMENT SYSTEMS

Formerly: NuFlo Measurement Systems • Barton Instrument Systems • Caldon, Inc.

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