



# Laminar Flow Elements

Meriam Laminar Flow Elements (LFEs) are excellent for measuring low gas flow rates from 0.2 SCCM up to 2250 SCFM. They are inherently accurate and repeatable and are calibrated traceable to NIST in our ISO 17025 certified Flow Lab. Flow turndown is 20:1 or better and the differential pressure generated is nearly linear to flow. This combination makes an LFE a great choice for gas flow measurement and flow control applications.

## APPLICATIONS

LFEs are applicable in most clean and non-condensing gas flow applications. They excel in critical gas flow measurement applications and make excellent calibration standards because of their inherent accuracy, stable calibration, excellent response time and repeatability. LFEs are used to calibrate turbine meters, variable area meters, flow regulators, mass flow meters, and thermal anemometers to name a few. Gas flow measurement for demanding flow control is a common application. Other applications include leak detection and quantification, design and testing of discrete parts, automotive engine and emissions testing, and window and door leak testing.



*LFEs for tapered or straight thread with O-ring process connections*



*LFEs for hose type process connections*



*LFEs for straight thread VCO process connections*

## Performance

Standard LFE calibration accuracy is  $\pm 0.72\%$  of Reading (not % of Full Scale) traceable to the National Institute of Standards and Technology (NIST). Rigid construction and lack of any moving parts make the LFE calibration stable. Only physical damage or particulate deposition in the element will cause a calibration shift.

Standard Accuracy:	$\pm 0.72\%$ to $\pm 0.86\%$ of Reading
Repeatability:	0.1%
Response time:	16 ms
Turndown:	20:1 achievable with accurate DP device Greater turndown achievable with precision DP device

## Utility

LFEs can be used to measure flow rate for a variety of gases and applications. Standard models are available to measure as little as 0.2 SCCM (5.9 E-06 SCFM) to as much as 2250 SCFM of air flow at standard conditions. Custom models for up to 15,000 SCFM of air are available. Stainless steel or aluminum materials make LFEs compatible with most gases. Flow rate of gas mixtures can also be measured when the percentages of component gases and mixture properties are known.

## The LFE Matrix

The LFE matrix can be made from individual SS tubes or windings of SS foil. These tubes are long enough, relative to their inside diameter, to cause laminar flow to occur inside each tube. The result is a near linear relationship between DP and flow rate. The DP generated across the matrix responds very quickly to changes in flow. All DP is permanent pressure loss to the system but LFEs are sized to produce no greater than 8" water column at maximum flowing conditions. Individual tube diameters are very small so flowing gases need to be clean and dry to preserve the calibration. Filtered inlet versions of most LFE models are available to keep the matrix clean and the calibration constant.



## Calibration and Accuracy

Meriam LFEs are calibrated with air at atmospheric conditions referenced to 29.92" mercury absolute (760mm Hg. Abs.) and 70°F (21.1°C). Each completed element is calibrated and traceable to the National Institute of Standards and Technology. Our Special Calibration Procedure #A-33544 is designed to meet the basic requirements of MIL-STD-45662A, ANSI Z540, 10CFR50 and MIL-Q-9858A.

Meriam LFEs are supplied with a reproducible flow curve in terms of SCFM versus inches of water differential pressure. Correction factors are included to cover an inlet pressure range from 26 to 36" Hg Abs. and an inlet temperature from 50°F to 150°F. For special flow applications, contact Meriam with complete flow information. The rated accuracy\* of all Meriam LFEs is percentage of actual reading; not the much wider percentage of full scale flow rate tolerance of other devices.

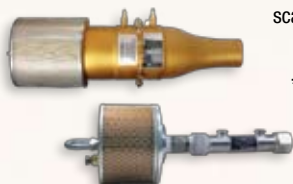
### \*Accuracy Levels Available:

Commercial Calibration	± 0.72% of Actual Reading†
Master Calibration	± 0.64% of Actual Reading††
Independent Lab Calibration	± 0.50% of Actual Reading or better, consult factory

† ± 0.86% Reading for full scale flow of 1000 SCFM or higher  
 †† ± 0.70% Reading for full scale flow of 1000 SCFM or higher



LFEs for flanged process connections



Filtered inlet LFE's available for intake measurement applications



## LFS-1 Flow Measurement System

The LFS-1 Flow Measurement System for Meriam LFEs provides a superior gas flow measurement solution. The integral flow computer makes real time corrections for changes in differential pressure, static pressure, temperature and relative humidity to provide the most accurate results possible. All LFS packages include complete instrumentation, system calibration and NIST traceable documentation.



## 50MC2-T Series

- LFE for flows of 400 SCFM to 2250 SCFM
- No straight run requirements upstream of inline filter assembly
- Mechanism allows end user to change filter with virtually no effect on the calibration curve (no more than ±0.3%)





# LFE

## LFS-1 Flow Measurement System

The LFS-1 Flow Measurement System for Meriam LFEs takes advantage of the wide flow turndown and the percent of Reading precision of the LFE, as well as Meriam's calibration expertise, to provide a superior gas flow measurement solution. The integral flow computer makes real time corrections for changes in differential pressure, static pressure, temperature and relative humidity to provide the most accurate results possible. Calibration coefficients for up to five (5) LFEs can be stored in memory and called up for later use with a push of a button. For control or data transmission purposes, the LFS-1 Flow Measurement System has both analog and digital outputs. 4–20 mA and 0–10 volts analog output options are ideal for control and recording functions. RS-232 and RS-485 digital communications are standard.

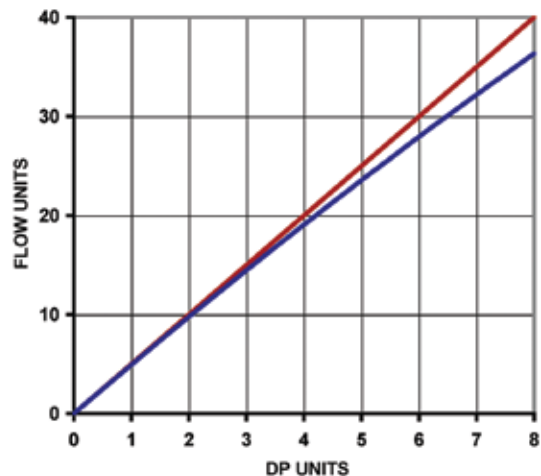
Special application requirements can often be accommodated by the LFS. For example, simultaneous flow measurement of two LFEs can be made and the summation of the two flows calculated and displayed. Or, for testing over a wide range for flow, the LFS can be set up to automatically switch from one LFE to an LFE of a different flow capacity as flow rate increases to a predetermined set point.

Meriam's LFS-1 provides standard system accuracy of  $\pm 1.0\%$  of Reading over a 10:1 flow turndown and  $\pm 1.1\%$  over 20:1 turndown. Calibration of the LFE and LFS-1 as a system makes this possible. Meriam can offer LFS accuracy as low as 0.60% of Reading over a 10:1 flow turndown by using better calibration standards. All LFS packages include complete instrumentation, system calibration and NIST traceable documentation. LFEs and systems cover gas flow ranges from 0.2 SCCM to 15,000 SCFM.

To provide the accurate answers you need in the shortest amount of time, please provide us with the following ordering data:

1. Model number.
2. Flowing gas data;
  - a. Flow rate in desired units.
  - b. Base conditions.
    - i. Pressure
    - ii. Temperature
  - c. Flowing conditions
    - i. Pressure
    - ii. Temperature
    - iii. Viscosity at flowing temperature.
  - d. Differential at maximum flow.
  - e. Specific gravity, if other than air.
  - f. Flowing gas, if other than air.
3. Readout instrument.
4. Description of installation configuration.
5. Line size.
6. Line Material.
7. Accuracy required

Typical Laminar Flow Element DP vs. Flow Curve



KEY  
 Red line: Straight line for reference  
 Blue line: Typical LFE calibration curve

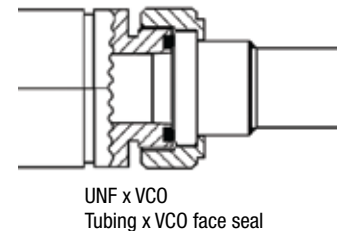
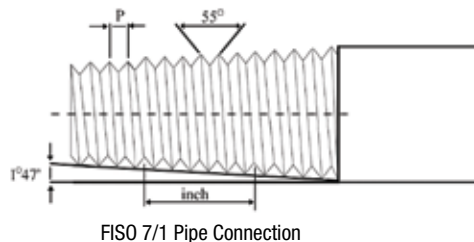
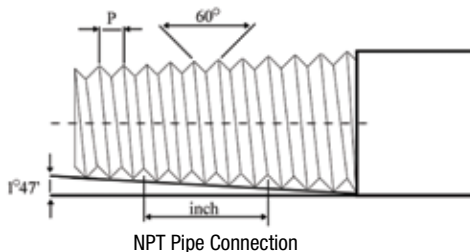
Model Number & Description	Tube Size	UNF x VCO process conn., 1/4" SAE J1926 port, O-ring boss DP conn.	Nominal Air Flow Range (29.92" Hg. Abs. & 70°F)		Max. DP In. H <sub>2</sub> O	Nominal Air Flow Range (760 MM Hg. Abs. & 21.1°C)			Max DP MM H <sub>2</sub> O
			SCFM*	PPM		CC/MIN*	LPM*	Kg/M	
<b>50MT10</b> Utilizes stainless steel capillary tubes cemented into a stainless steel body. Inlet and outlet connections are VCO type. Differential pressure connections are 1/4" SAE J1926 port, O-ring boss.	1/4"	50MT10-8	0.00019	1.42x10 <sup>-5</sup>	4"	5.38	0.00538	6.44x10 <sup>-6</sup>	101.6
	1/4"	50MT10-7	0.00062	4.64x10 <sup>-5</sup>	4"	17.5	0.0175	2.10x10 <sup>-5</sup>	101.6
	1/4"	50MT10-6	0.000124	9.28x10 <sup>-5</sup>	4"	35.1	0.0351	4.21x10 <sup>-5</sup>	101.6
	1/4"	50MT10-5	0.0025	1.87x10 <sup>-4</sup>	4"	70.8	0.0708	8.48x10 <sup>-5</sup>	101.6
	1/4"	50MT10-4	0.0046	3.45x10 <sup>-4</sup>	4"	130	0.130	1.56x10 <sup>-4</sup>	101.6
	1/4"	50MT10-3	0.0081	6.07x10 <sup>-4</sup>	4"	229	0.229	2.75x10 <sup>-4</sup>	101.6
	1/4"	50MT10-2	0.0149	0.00112	4"	422	0.422	5.06x10 <sup>-4</sup>	101.6
<b>50MT10</b> All stainless steel unit with fused matrix. Inlet and outlet connections are VCO type. Differential pressure connections are 1/4" SAE J1926 port, O-ring boss.	1/2"	50MT10-14	0.10	0.00749	8"	2830	2.83	0.00339	203.2
	1/2"	50MT10-13	0.18	0.0135	8"	5100	5.10	0.0061	203.2
	1/2"	50MT10-12	0.38	0.0285	8"	10700	10.8	0.0129	203.2
	1/2"	50MT10-11	0.70	0.0524	8"	19800	19.8	0.0237	203.2
	1/2"	50MT10-10	1.60	0.120	8"	45300	45.3	0.0543	203.2
	3/4"	50MT10-9	3.00	0.225	8"	85000	85.0	0.102	203.2
<b>50MT20</b> All stainless steel unit with fused matrix. Inlet and outlet connections are VCO type. Differential pressure connections are 1/4" SAE J1926 port, O-ring boss.	1"	50MT20-1	7.5	0.562	8"	2.12x10 <sup>5</sup>	212	0.254	203.2
	1 1/2"	50MT20-1 1/2	22	1.65	8"	6.23x10 <sup>5</sup>	6.23	0.746	203.2
	2"	50MT20-2	40	3.00	8"	1.13x10 <sup>6</sup>	1130	1.357	203.2

**NOTES:**

- The flows and differential pressure rating of production units are subject to a variation of plus or minus 10% from the nominal values listed above.
- Each LFE unit is calibrated with air to Meriam flow standards which are traceable to the National Bureau of Standards. Meriam calibration flow curves are furnished with each unit.
- A special service is available for those Meriam LFE units which are governed by quality programs requiring periodic recalibration. The Special Calibration Procedure A-33544 is designed to meet the basic requirements of 10CFR50, ANSI-Z540-1 & ML-Q-9858A. Contact Meriam direct for information.
- The catalog capacities refer to the following base conditions:  
Air, 29.92" Hg Abs., 70° F, 181.87 micropoises.  
Base Reynold's Number: 300 at 8" H<sub>2</sub>O, 150 at 4" H<sub>2</sub>O.
- SCFM\* - Equivalent air flow at base conditions listed above.
- All units are offered with optional integral filter on inlet side except those marked (x). Removal or replacement of filter necessitates recalibration.
- Rated flow pressure and temperature for standard units are 30 psig and 150°F to maintain laminar flow, calibration, linearity and accuracy.  
For higher pressure and temperature rating contact a Meriam Representative, or Meriam Process Technologies direct.

For sizing information, please consult Meriam's Technical / Sizing Bulletin F/N 501:215TECH or contact Meriam directly.

## Threaded Connections Available on LFEs



DIN 3852 Part 2  
Tubing x straight thread / O-ring



SAE J1926  
Tubing x straight thread / O-ring

Model Number & Description	Pipe Size	NPT tapered thread	FISO 7/1 tapered thread	SAE J1926 straight thread w/ O-ring	DIN3852 Part 2 straight thread w/ O-ring
 <p>50MK10 Utilizes stainless steel capillary tubes cemented into a stainless steel body. Inlet, outlet and differential pressure connections are 1/4".</p>	1/4"	50MK10-8	50MK10-8MT	50MK10-8S	50MK10-8MS
	1/4"	50MK10-7	50MK10-7MT	50MK10-7S	50MK10-7MS
	1/4"	50MK10-6	50MK10-6MT	50MK10-6S	50MK10-6MS
	1/4"	50MK10-5	50MK10-5MT	50MK10-5S	50MK10-5MS
	1/4"	50MK10-4	50MK10-4MT	50MK10-4S	50MK10-4MS
	1/4"	50MK10-3	50MK10-3MT	50MK10-3S	50MK10-3MS
	1/4"	50MK10-2	50MK10-2MT	50MK10-2S	50MK10-2MS
	1/4"	50MK10-1	50MK10-1MT	50MK10-1S	50MK10-1MS
 <p>Model 50MJ10 All stainless steel unit with fused matrix. Differential pressure connections are 1/4". Line connections 1/2" NPT, except Type 9 which has 3/4" NPT.</p>	1/2"	50MJ10-14	50MJ10-14MT	50MJ10-14S	50MJ10-14MS
	1/2"	50MJ10-13	50MJ10-13MT	50MJ10-13S	50MJ10-13MS
	1/2"	50MJ10-12	50MJ10-12MT	50MJ10-12S	50MJ10-12MS
	1/2"	50MJ10-11	50MJ10-11MT	50MJ10-11S	50MJ10-11MS
	1/2"	50MJ10-10	50MJ10-10MT	50MJ10-10S	50MJ10-10MS
	3/4"	50MJ10-9	50MJ10-9MT	50MJ10-9S	50MJ10-9MS
 <p>50MW20 All stainless steel welded unit with fused matrix. Line connections are threaded. Differential pressure connections are 1/4".</p>	1"	50MW20-1	50MW20-1MT	50MW20-1S	50MW20-1MS
	1 1/2"	50MW20-1 1/2	50MW20-1 1/2MT	50MW20-1 1/2S	50MW20-1 1/2MS
	2"	50MW20-2	50MW20-2MT	50MW20-2S	50MW20-2MS
 <p>50MH10 All stainless steel welded unit with fused matrix. Line connections are tapered ends (no threads) for hose connection. Differential pressure connections are 1/4" NPT.</p>	1"	50MH10-1	----	----	----
	1 1/4"	50MH10-1 1/4	----	----	----
	1 1/2"	50MH10-1 1/2	----	----	----
	2"	50MH10-2	----	----	----
	3"	50MH10-3	----	----	----
	4"	50MH10-4	----	----	----
	5"	50MH10-5	----	----	----
	6"	50MH10-6	----	----	----
	8"	50MH10-8 (x)	----	----	----
	10"	50MH10-10 (x)	----	----	----
12"	50MH10-12 (x)	----	----	----	
16"	50MH10-16 (x)	----	----	----	

NOTES:

1. The flows and differential pressure rating of production units are subject to a variation of plus or minus 10% from the nominal values listed above.
2. Each LFE unit is calibrated with air to Meriam flow standards which are traceable to the National Bureau of Standards. Meriam calibration flow curves are furnished with each unit.
3. A special service is available for those Meriam LFE units which are governed by quality programs requiring periodic recalibration. The Special Calibration Procedure A-33544 is designed to meet the basic requirements of 10CFR50, ANSI-Z540-I & ML-Q-9858A. Contact Meriam direct for information.

Nominal Air Flow Range (29.92" Hg. Abs. & 70° F)		Max. DP In. H <sub>2</sub> O	Pipe Size	Nominal Air Flow Range (760 MM Hg. Abs. & 21.1° C)			Max DP MM H <sub>2</sub> O
SCFM*	PPM			CC/MIN*	LPM*	Kg/M	
0.00019	1.42 x 10 <sup>-5</sup>	4"	¼"	5.38	0.00538	6.44 x 10 <sup>-6</sup>	101.6
0.00062	4.64 x 10 <sup>-5</sup>	4"	¼"	17.5	0.0175	2.10 x 10 <sup>-5</sup>	101.6
0.000124	9.28 x 10 <sup>-5</sup>	4"	¼"	35.1	0.0351	4.21 x 10 <sup>-5</sup>	101.6
0.0025	1.87 x 10 <sup>-4</sup>	4"	¼"	70.8	0.0708	8.48 x 10 <sup>-5</sup>	101.6
0.0046	3.45 x 10 <sup>-4</sup>	4"	¼"	130	0.130	1.56 x 10 <sup>-4</sup>	101.6
0.0081	6.07 x 10 <sup>-4</sup>	4"	¼"	229	.229	2.75 x 10 <sup>-4</sup>	101.6
0.0149	0.00112	4"	¼"	422	.422	5.06 x 10 <sup>-4</sup>	101.6
0.046	0.00344	4"	¼"	1300	1.30	0.00156	101.6
0.10	0.00749	8"	½"	2830	2.83	0.00339	203.2
0.18	0.0135	8"	½"	5100	5.10	0.0061	203.2
0.38	0.0285	8"	½"	10700	10.8	0.0129	203.2
0.70	0.0524	8"	½"	19800	19.8	0.0237	203.2
1.60	0.120	8"	½"	45300	45.3	0.0543	203.2
3.00	0.225	8"	¾"	85000	85.0	0.102	203.2
7.5	0.562	8"	1"	2.12 x 10 <sup>5</sup>	212	0.254	203.2
22	1.65	8"	1½"	6.23 x 10 <sup>5</sup>	623	0.746	203.2
40	3.00	8"	2"	1.13 x 10 <sup>6</sup>	1130	1.357	203.2
7.5	0.562	8"	1"	2.12 x 10 <sup>5</sup>	212	0.254	203.2
16	1.20	8"	1¼"	4.53 x 10 <sup>5</sup>	453	0.543	203.2
23	1.72	8"	1½"	6.51 x 10 <sup>5</sup>	651	.780	203.2
40	3.00	8"	2"	1.13 x 10 <sup>6</sup>	1130	1.35	203.2
90	6.74	8"	3"	2.55 x 10 <sup>6</sup>	2550	3.05	203.2
160	12.0	8"	4"	4.53 x 10 <sup>6</sup>	4530	5.43	203.2
250	18.7	8"	5"	7.08 x 10 <sup>6</sup>	7080	8.48	203.2
360	27.0	8"	6"	1.02 x 10 <sup>7</sup>	10200	12.2	203.2
640	47.9	8"	8"	1.81 x 10 <sup>7</sup>	18100	21.7	203.2
1000	74.9	8"	10"	2.83 x 10 <sup>7</sup>	28300	33.9	203.2
1440	108	8"	12"	4.07 x 10 <sup>7</sup>	40800	48.8	203.2
2250	168	8"	16"	6.37 x 10 <sup>7</sup>	63700	76.3	203.2

4. The catalog capacities refer to the following base conditions:

Air, 29.92" Hg Abs., 70° F, 181.87 micropoises.





Base Reynold's Number: 300 at 8" H<sub>2</sub>O, 150 at 4" H<sub>2</sub>O.

5. SCFM\* - Equivalent air flow at base conditions listed above.

6. All units are offered with optional integral filter on inlet side except those marked (x). Removal or replacement of filter necessitates recalibration.

7. Rated flow pressure and temperature for standard units are 30 psig and 150°F to maintain laminar flow, calibration, linearity and accuracy.

For higher pressure and temperature rating contact a Meriam Representative, or Meriam Process Technologies direct.

Model Number & Description	Pipe Size	NPT tapered thread	FISO 7/1 tapered thread	SAE J1926 straight thread w/ O-ring	DIN3852 Part 2 straight thread w/ O-ring
 <p>50MY15 All stainless steel welded unit with fused matrix. Line connections are 150 lb ANSI flanges. Differential pressure connections are ¼" NPT.</p>	2½"	50MY15-2 1/2	----	----	----
	3"	50MY15-3	----	----	----
	4"	50MY15-4	----	----	----
	5"	50MY15-5	----	----	----
	6"	50MY15-6	----	----	----
	8"	50MY15-8 (x)	----	----	----
	10"	50MY15-10 (x)	----	----	----
	12"	50MY15-12 (x)	----	----	----
16"	50MY15-16 (x)	----	----	----	
 <p>50MR2 Aluminum housing for low pressure applications. Line connections are 150 lb ANSI flanges. Differential pressure connections ¼" hose barb.</p>	2"	50MR2-2	----	----	----
	4"	50MR2-4	----	----	----
	6"	50MR2-6	----	----	----
	8"	50MR2-8	----	----	----
 <p>50MC2 Aluminum housing for low pressure applications. Inlet and outlet are for hose type connections. Differential pressure connections ¼" hose barb.</p>	2" I.D.	50MC2-2	----	----	----
	4" I.D.	50MC2-4	----	----	----
	6" I.D.	50MC2-6	----	----	----
	8" I.D.	50MC2-8	----	----	----
 <p>50MC2-4T / 50MC2-6T / 50MC2-8T Aluminum housing featuring inline filter for low pressure applications. No straight runs required on the inlet side. Outlet designed for a pipe or hose connection. Differential pressure connections 1/4" hose barb.</p>	4" I.D.	50MC2-4T	----	----	----
	6" I.D.	50MC2-6T	----	----	----
	8" I.D.	50MC2-8T	----	----	----

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Nominal Air Flow Range (29.92" Hg. Abs. & 70° F)		Max. DP In. H <sub>2</sub> O	Pipe Size	Nominal Air Flow Range (760 MM Hg. Abs. & 21.1° C)			Max DP MM H <sub>2</sub> O
SCFM*	PPM			CC/MIN*	LPM*	Kg/M	
60	4.50	8"	2½"	1.69 x 10 <sup>6</sup>	1700	2.03	203.2
90	6.74	8"	3"	2.55 x 10 <sup>6</sup>	2550	3.05	203.2
160	12.0	8"	4"	4.53 x 10 <sup>6</sup>	4530	5.43	203.2
250	18.7	8"	5"	7.08 x 10 <sup>6</sup>	7080	8.48	203.2
360	27.0	8"	6"	1.02 x 10 <sup>7</sup>	10200	12.2	203.2
640	47.9	8"	8"	1.81 x 10 <sup>7</sup>	18100	21.7	203.2
1000	74.9	8"	10"	2.83 x 10 <sup>7</sup>	28300	33.9	203.2
1440	108	8"	12"	4.07 x 10 <sup>7</sup>	40800	48.8	203.2
2250	169	8"	16"	6.37 x 10 <sup>7</sup>	63700	76.6	203.2
100	7.49	8"	2"	2.83 x 10 <sup>6</sup>	2830	3.39	203.2
400	30.0	8"	4"	1.13 x 10 <sup>7</sup>	11300	13.6	203.2
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400	30.0	8"	4" I.D.	1.13 x 10 <sup>7</sup>	11300	13.6	203.2
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4. The catalog capacities refer to the following base conditions:

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Base Reynold's Number: 300 at 8" H<sub>2</sub>O, 150 at 4" H<sub>2</sub>O.

5. SCFM\* - Equivalent air flow at base conditions listed above.

6. All units are offered with optional integral filter on inlet side except those marked (x). Removal or replacement of filter necessitates recalibration.

7. Rated flow pressure and temperature for standard units are 30 psig and 150°F to maintain laminar flow, calibration, linearity and accuracy.

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