

LVM

TECHbrief

Liberty Venturi Meter
Cast Iron Primary Elements



FEATURES:

- High Accuracy
- Reliable Operation
- Energy Efficient
- Flexible Design for a Variety of Applications

Description

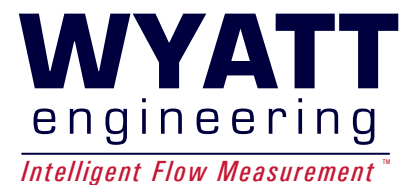
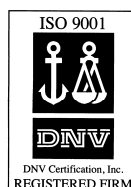
Wyatt Engineering's Liberty Venturi Meter is a differential-producing primary flow element that accurately and repeatably measures the flows of liquids or gases in closed, full-pipe conditions. The cast iron Wyatt LVM incorporates an efficient hydraulic shape with static pressure taps in the throat and inlet sections. The LVM can be provided with either 125 or 250 PSI flanges.

Application

The cast iron series is often used in municipal water and wastewater applications. Known for longevity of service with minimal maintenance, LVM meters are ideal for metering potable water, sludge, slurries, as well as gases and clean fluids. The Model LVM-C is uniquely designed for rate-of-flow control applications, while the LVM-S is designed to prevent clogging of the pressure taps for applications with solids-bearing fluids.

Flow Measurement Accuracy

For pipe Reynolds numbers greater than 75 000 and with a normalized piping configuration, the Liberty Venturi Meter provides a flow measurement accuracy of $\pm 0.50\%$ without flow calibration. With independent flow calibration, Wyatt's LVMs provide the user with $\pm 0.25\%$ accuracy.



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Technical Specifications

Accuracy

For pipe Reynolds numbers greater than 75 000 and a normalized piping configuration, the Liberty Venturi Meter provides a flow measurement uncertainty of:

- ± 0.50% for standard meters and
- ± 0.25% for flow calibrated meters.

Pressure Loss

The permanent pressure loss of the Wyatt's Liberty Venturi Meter is shown in Figure 1.

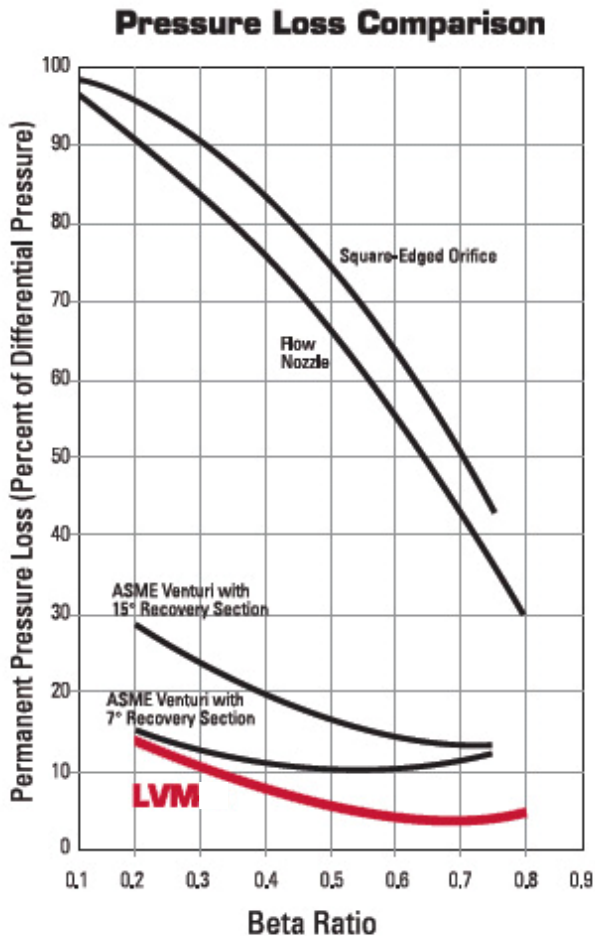


Figure 1

Beta Ratio

Liberty Venturi Meters are available with a wide range of diameter ratios (d/D). This provides users with accurate flow measurement over a broad range of flow rates for a given line size.

Temperature Range

Cast iron LVMs can handle process temperatures between -20 °F and +350 °F (-30 °C and +175 °C).

Pressure Range/End Connections

Flanged end connections per ANSI B16.1 for 125 PSIG and 250 PSIG service are available. A variety of other end connections is also available including: Mechanical joint flanges per AWWA C110 or C111, as well as plain-end designs.

Piping Requirements

Designed for full-pipe flow, LVM flow meters may be mounted either horizontally or vertically. For recommended upstream piping, refer to the Wyatt Engineering TechSpec for the LVM.

Energy Considerations

Figure 1 compares the headloss of the LVM design with that of other primary flow elements. The pressure recovery of the Liberty Venturi Meter means reduced pumping costs. Wyatt Engineering's Liberty Venturi has a shorter laying length and exhibits better recovery than typical classical and modified venturi meters.

Design Concepts

The Liberty Venturi is designed to provide a high degree of accuracy with unquestionable and predictable performance. Key to this design is the following:

Accuracy: Static inlet and throat pressure sensation provides a highly accurate, stable, and predictable flow measurement signal for flow rates with pipe Reynolds numbers as low as 75 000.

Reliability: The Liberty Venturi Meter is free of protrusions and sharp-edged, debris-collecting annuli. Static pressure taps reduce flow noise. The internal contour is designed to minimize the buildup of solids and deter erosion, corrosion, and scaling.

Energy Savings: Wyatt Engineering's Liberty Venturi Meters operate with minimal headloss. This results in less energy consumption, lower operational costs, and a lower cost of ownership.

LVM Sizing Table



Inlet Diameter		Throat Diameter		Beta Ratio	Overall Length		Outlet Diameter		ΔP = Differential Pressure of 100" wc (24.864 kPa)						
(inches)	(mm)	(inches)	(mm)		(inches)	(mm)	(inches)	(mm)	Water Flow at 60 °F (16 °C)				ΔH = Headloss		
									US GPM	US CFS	LPM	m ³ /d	R ₀ (10 ³)	in. wc	kPa
3.00	76.2	1.500	38.10	0.5000	11.85	301	2.25	57	130.62	0.291	494.5	712.0	123.02	10.9	2.70
3.00	76.2	1.800	45.72	0.6000	11.85	301	2.55	65	195.21	0.435	739.0	1064.1	183.84	8.3	2.07
3.00	76.2	2.100	53.34	0.7000	11.85	301	2.85	72	284.37	0.634	1076	1550.1	267.81	5.1	1.28
4.00	101.6	2.100	53.34	0.5250	14.00	356	3.05	77	257.88	0.575	976.2	1405.7	182.15	9.9	2.47
4.00	101.6	2.400	60.96	0.6000	14.00	356	3.35	85	347.04	0.773	1314	1891.7	245.12	8.6	2.14
4.00	101.6	2.800	71.12	0.7000	14.00	356	3.70	94	505.55	1.13	1914	2755.7	357.08	5.1	1.27
6.00	152.4	3.000	76.20	0.5000	21.25	540	4.50	114	522.49	1.16	1978	2848.1	246.03	10.0	2.49
6.00	152.4	3.600	91.44	0.6000	21.25	540	5.05	128	780.85	1.74	2956	4256.4	367.69	8.2	2.04
6.00	152.4	4.200	106.68	0.7000	21.25	540	5.60	142	1137.48	2.53	4306	6200.4	535.61	4.8	1.20
8.00	203.2	4.200	106.68	0.5250	26.00	660	6.15	156	1031.52	2.30	3905	5622.8	364.29	9.1	2.27
8.00	203.2	4.800	121.92	0.6000	26.00	660	6.70	170	1388.2	3.09	5255	7567.0	490.25	7.9	1.97
8.00	203.2	5.600	142.24	0.7000	26.00	660	7.45	189	2022.2	4.51	7655	11022.9	714.15	4.7	1.17
10.00	254.0	4.800	121.92	0.4800	31.75	806	7.40	188	1330.9	2.97	5038	7254.8	376.02	9.8	2.44
10.00	254.0	5.800	152.40	0.5800	31.75	806	8.50	216	2008.0	4.47	7601	10945	567.31	8.0	1.99
10.00	254.0	7.000	177.80	0.7000	31.75	806	9.45	240	3159.7	7.04	11961	17223	892.69	4.2	1.05
12.00	304.8	6.000	152.40	0.5000	36.50	927	9.05	230	2090.0	4.66	7911	11392	492.06	9.2	2.29
12.00	304.8	7.000	177.80	0.5833	36.50	927	10.15	258	2929.1	6.53	11088	15967	689.64	7.6	1.89
12.00	304.8	8.400	213.36	0.7000	36.50	927	11.25	286	4549.9	10.1	17223	24802	1071.2	4.4	1.10
14.00	355.6	7.000	177.80	0.5000	41.55	1055	10.55	268	2844.7	6.34	10768	15506	574	9.0	2.25
14.00	355.6	8.400	213.40	0.6000	39.25	997	11.45	291	4251.3	9.47	16093	23174	858	7.1	1.76
14.00	355.6	9.800	248.90	0.7000	37.30	947	12.40	315	6192.9	13.8	23443	33758	1250	5.2	1.29
16.00	406.4	8.000	203.20	0.5000	46.65	1185	12.05	306	3715.5	8.28	14065	20253	656	8.9	2.21
16.00	406.4	9.600	243.80	0.6000	44.00	1118	13.10	333	5552.7	12.4	21019	30268	980	7.0	1.73
16.00	406.4	11.200	284.50	0.7000	41.75	1060	14.20	361	8088.7	18.0	30619	44092	1428	5.1	1.27
18.00	457.2	9.000	228.60	0.5000	51.70	1313	13.55	344	4702.4	10.5	17801	25633	738	8.8	2.18
18.00	457.2	10.800	274.30	0.6000	48.75	1238	14.70	373	7027.7	15.7	26603	38308	1103	6.9	1.71
18.00	457.2	12.600	320.00	0.7000	46.25	1175	15.95	405	10237.3	22.8	38752	55804	1607	5.0	1.25
20.00	508.0	10.000	254.00	0.5000	56.80	1443	15.10	384	5805.5	12.9	21976	31646	820	8.7	2.15
20.00	508.0	12.000	304.80	0.6000	53.50	1359	16.35	415	8676.1	19.3	32843	47294	1226	6.8	1.69
20.00	508.0	14.000	355.60	0.7000	50.70	1288	17.75	451	12639	28.2	47843	68893	1785	5.0	1.23
24.00	609.6	12.000	304.80	0.5000	66.95	1701	18.10	460	8359.9	18.6	31646	45570	984	8.5	2.10
24.00	609.6	14.400	365.80	0.6000	63.00	1600	19.65	499	12494	27.8	47294	68103	1471	6.6	1.65
24.00	609.6	16.800	426.70	0.7000	59.65	1515	21.30	541	18200	40.6	68893	99206	2142	4.9	1.21
30.00	762.0	15.000	381.00	0.5000	84.15	2137	22.65	575	13062	29.1	49446	71203	1230	8.2	2.05
30.00	762.0	18.000	457.20	0.6000	79.25	2013	24.55	624	19521	43.5	73896	106410	1838	6.5	1.61
30.00	762.0	21.000	533.40	0.7000	75.05	1906	26.60	676	28437	63.4	107646	155010	2678	4.7	1.18
36.00	914.4	18.000	457.20	0.5000	99.40	2525	27.15	690	18810	41.9	71203	102532	1476	8.1	2.00
36.00	914.4	21.600	548.60	0.6000	93.50	2375	29.45	748	28111	62.6	106410	153231	2206	6.3	1.57
36.00	914.4	25.200	640.10	0.7000	88.45	2247	31.95	812	40949	91.2	155010	223214	3214	4.6	1.15
42.00	1066.8	21.000	533.40	0.5000	114.65	2912	31.70	805	25602	57.0	96915	139557	1722	7.9	1.97
42.00	1066.8	25.200	640.10	0.6000	107.70	2736	34.35	872	38262	85.3	144836	208564	2574	6.2	1.54
42.00	1066.8	29.400	746.80	0.7000	101.85	2587	37.25	946	55736	124	210985	303819	3749	4.5	1.13
48.00	1219.2	24.000	609.60	0.5000	129.85	3298	36.25	921	33440	74.5	126582	182278	1968	7.8	1.94
48.00	1219.2	28.800	731.50	0.6000	121.95	3098	39.30	998	49975	111	189174	272411	2941	6.1	1.52
48.00	1219.2	33.600	853.40	0.7000	115.25	2927	42.60	1082	72799	162	275573	396825	4285	4.5	1.11

This sizing table can be used as a guide to aid the user in choosing the proper LVM for a given application and reflects the most commonly-used sizes. Other sizes and special geometries are available, often at no additional cost. Depending on the details of your application, a more appropriate selection, or a more accurate estimation of the performance of a given selection, may be available. Wyatt Engineering encourages users to contact their local Wyatt-Badger representatives, or call us directly, for definitive sizing information.

Incompressible Flow Relationships:

$$\Delta P_N = 100 (Q_N / Q)^2$$

$$\Delta H_N = DH (Q_N / Q)^{1.88}$$

$$Q_N = Q (DP / 100)^{0.5}$$

Examples:

For a 20.00" x 14.000" LVM, find

ΔP at 20 000 US GPM

ΔH at 20 000 US GPM

Q_N at 750" wc

Solutions:

Found using the "Incompressible Flow Relationships"

ΔP_N = 100 (20 000 / 12 639)² = 250.40" wc

ΔH_N = 5.0 (20 000 / 12 639)^{1.88} = 11.8" wc

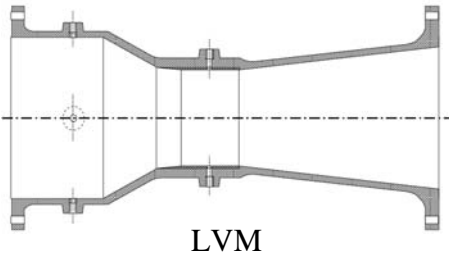
Q_N = 12 639 (750 / 100)^{0.5} = 34 613 US GPM

Available Options



The cast iron Liberty Venturi Meter is available in four styles for specific applications.

Model LVM is a flanged cast iron primary element designed for liquid and gas flow measurement. Typical throat materials are bronze and stainless steel. All valves, except butterfly valves, may be direct-coupled downstream for control purposes without loss of accuracy. The LVM can be supplied with flanges, mechanical joints, or plain ends. Typical throat materials are bronze or stainless steel.

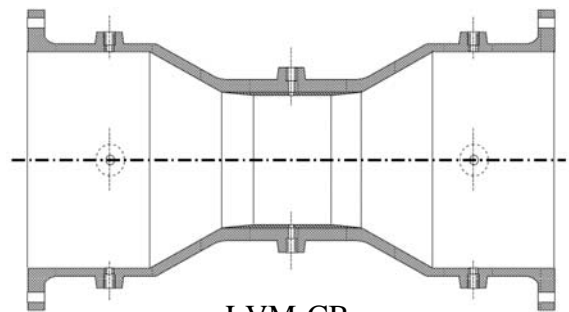


LVM

Model LVM-C is a flanged cast iron primary element designed to utilize a butterfly valve for rate-of-flow control in liquid or gas service. The Liberty Venturi Meter is constructed to accept a butterfly valve bolted directly to the downstream flange allowing the LVM-C to be utilized as a rate-of-flow controller. The butterfly valve does not affect the accuracy of the primary element. The meter outlet can be modified to accommodate a valve one or more line sizes smaller than the main piping run.

Model LVM-S is a flanged primary element designed for wastewater, sludge, slurry, or other fluids with suspended solids. Static pressure taps assure stable measurement and minimize solids buildup at the tap. Manual vent cleaners are provided as a standard; automatic vent cleaners or a sealed diaphragm system are available as options. An inspection port and water purge systems, either continuous or timed, are also available.

Model LVM-CB is for applications where the flow can reverse direction due to upset or as directed. The cast iron bidirectional Liberty Venturi Meter is provided with tap sets for monitoring the flow rate in both directions and can be provided instrumentation to determine the flow direction. The LVM-CB is field-verifiable and can be used in many applications where standard venturi or flow tubes, or other metering technologies, cannot be used.



LVM-CB

Consult your local representative or Wyatt Engineering for information on other materials of construction.

