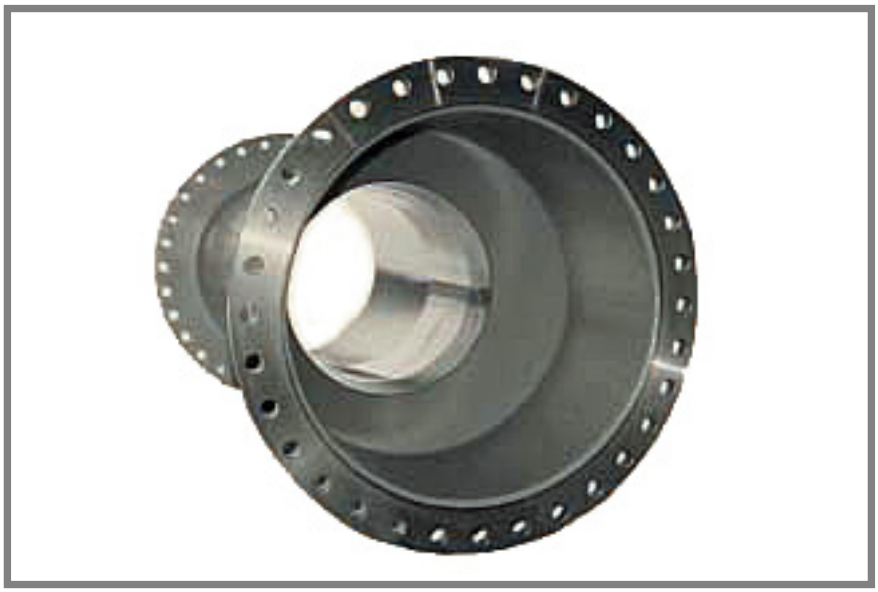
LVM-U

TECHbrief

Wyatt Engineering Liberty Venturi Meters
Fabricated Primary Elements



FEATURES:

- **High Accuracy**
- **Low Pressure Loss**
- **Application Specific Design**
- **Static Pressure Sensation**
- **Documented Performance**

LVM

03/2018

Description

Wyatt Engineering's Liberty Venturi Meters are available as a fabricated series of modified venturi flow elements that can be used to measure the flow of gases and liquids over an extreme range of temperatures and pressures in full pipes. The fabricated LVM maintains its accuracy over a greater range of flow rates, and incurs lower permanent pressure loss than either the ISO or ASME venturi designs. Wyatt's fabricated LVM series can be manufactured from virtually any metal or alloy. Each unit, therefore, can be designed specifically for your application.

Application

The fabricated series of LVMs are most often used in industrial applications where the flow stream demands specific material selection due to pressure and/or temperature, or the corrosive/erosive properties of the fluid being measured. LVM installations are found in:

Power Plants
Refineries
Petrochemical Plants
Cryogenic Processes
Coal Gasification Plants
Steam Custody Transfer

Flow Measurement Accuracy

For pipe Reynolds numbers greater than 75 000 and with a normalized piping configuration, the Wyatt-Badger LVM-U provides a flow measurement accuracy of ± 0.50% without flow calibration. With independent flow calibration, Wyatt Engineering's venturi meters will provide the user with ± 0.25% accuracy.

Technical Specifications

Accuracy

For pipe Reynolds numbers greater than 75 000 and with 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 fabricated LVM product line is significantly lower than that of short-form venturis, and, for most beta ratios, lower than that of long-form venturis as well. Call Wyatt Engineering for detailed headloss information on the design and process data for your application.

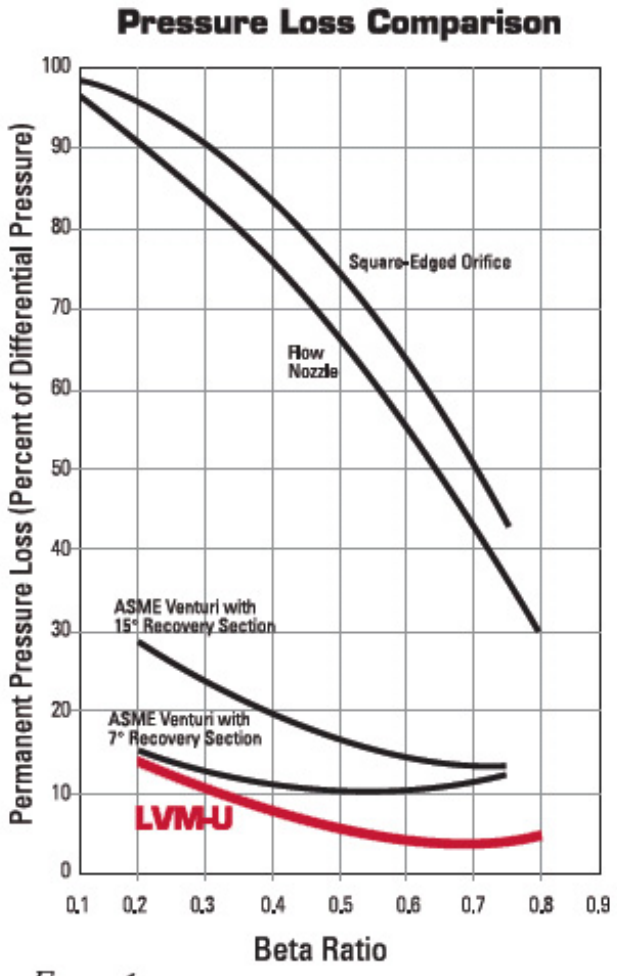


Figure 1

Beta Ratio

Wyatt Engineering can furnish fabricated LVM products with any beta ratio. This provides users with accurate flow measurement over a broad range of flow rates for a given line size.

Temperature Range

The fabricated LVM-U can operate over the fluid temperature range of -425 °F to +1200 °F (-250 °C to +650 °C).

Pressure Range/End Connections

Flanged end connections, per ANSI B16.5 for 150 PSIG through 2500 PSIG service, are available. Various end connections are also available, including plate, slip-on, weld neck, Van Stone, RTJ, or beveled (for butt-welding).

Piping Requirements

Designed for full pipe flow, LVM flow meters can be installed horizontally, vertically, or on an angle. For the recommended piping and installation requirements, refer to Wyatt Engineering Technical Manual for the LVM.

Signal to Noise Ratio

Within the specified flow range and piping conditions, the LVM will produce signal-to-noise ratios greater than 98%. This level of performance is essential for sensitive process control and reactive rate-of-flow control applications.

Design

The LVM hydraulic design produces a predictable and reliable discharge coefficient. The static pressure taps and smooth transition section minimize flow noise and lessen the effects of aging, corrosion, and/or erosion. Flow measurement of compressible fluids is performed accurately and reliably.

LVM Sizing Table

Inlet Diameter		Throat Diameter		Beta Ratio	Overall Length		Outlet Diameter		ΔP = Differential Pressure of 100" wc (24.864 kPa) Water Flow at 60 °F (16 °C)					ΔH = Headloss	
(inches)	(mm)	(inches)	(mm)		(inches)	(mm)	(inches)	(mm)	US GPM	US CFS	LPM	m^3/d	$R_D(10^3)$	PSI	kPa
3.07	77.9	1.500	38.10	0.4889	17.70	450	3.05	77	130.251	0.290	493.1	710.0	119.95	0.68	0.17
3.07	77.9	1.750	44.45	0.5704	16.60	422	3.05	77	182.052	0.406	689.1	992.4	167.65	0.57	0.14
3.07	77.9	2.100	53.34	0.6845	15.30	389	3.05	77	280.594	0.625	1062	1529.5	258.39	0.49	0.12
4.03	102.3	2.000	50.80	0.4968	20.85	530	4.00	102	232.021	0.517	878.3	1264.7	162.82	0.65	0.16
4.03	102.3	2.400	60.96	0.5961	19.40	493	4.00	102	346.386	0.772	1311	1888.1	243.08	0.53	0.13
4.03	102.3	2.800	71.12	0.6955	17.95	456	4.00	102	503.515	1.12	1906	2744.7	353.35	0.47	0.12
6.07	154.1	3.000	76.20	0.4946	28.30	719	6.05	154	521.759	1.16	1975	2844.1	243.05	0.62	0.15
6.07	154.1	3.600	91.44	0.5936	26.10	663	6.05	154	778.410	1.73	2947	4243.1	362.61	0.51	0.13
6.07	154.1	4.200	106.68	0.6925	23.90	607	6.05	154	1129.97	2.52	4277	6159.5	526.38	0.45	0.11
7.98	202.7	4.000	101.60	0.5012	35.10	892	7.95	202	929.171	2.07	3517	5064.9	328.93	0.59	0.15
7.98	202.7	4.800	121.92	0.6014	32.20	818	7.95	202	1389.17	3.10	5259	7572.3	491.77	0.49	0.12
7.98	202.7	5.500	139.70	0.6891	29.60	752	7.95	202	1932.18	4.30	7314	10532.3	683.99	0.44	0.11
10.02	254.5	5.000	127.00	0.4990	41.50	1054	10.00	254	1450.98	3.23	5493	7909.3	409.12	0.58	0.14
10.02	254.5	6.000	152.40	0.5988	37.90	963	10.00	254	2167.75	4.83	8206	11816	611.23	0.47	0.12
10.02	254.5	7.000	177.80	0.6986	34.20	869	10.00	254	3155.70	7.03	11946	17202	889.79	0.42	0.10
12.00	304.8	6.000	152.40	0.5000	48.65	1236	12.00	305	2089.97	4.66	7911	11392	492.06	0.56	0.14
12.00	304.8	7.200	182.88	0.6000	44.30	1125	12.00	305	3123.40	6.96	11823	17026	735.37	0.46	0.12
12.00	304.8	8.400	213.36	0.7000	39.85	1012	12.00	305	4549.91	10.1	17223	24802	1071.2	0.41	0.10
13.25	336.6	6.625	168.28	0.5000	53.55	1360	13.25	337	2548.06	5.68	9645	13889	543.32	0.56	0.14
13.25	336.6	8.000	203.20	0.6038	48.55	1233	13.25	337	3863.37	8.61	14624	21059	823.78	0.46	0.11
13.25	336.6	9.250	234.95	0.6981	43.90	1115	13.25	337	5507.98	12.3	20850	30024	1174.5	0.41	0.10
15.25	387.4	7.625	193.68	0.5000	59.75	1518	15.25	387	3375.33	7.52	12777	18399	625.33	0.55	0.14
15.25	387.4	9.000	228.60	0.5902	54.80	1392	15.25	387	4857.24	10.8	18387	26477	899.87	0.46	0.11
15.25	387.4	10.625	269.88	0.6967	48.80	1240	15.25	387	7258.21	16.2	27475	39564	1344.7	0.40	0.10
17.25	438.2	8.625	219.08	0.5000	67.00	1702	17.25	438	4318.72	9.6	16348	23541	707.34	0.54	0.13
17.25	438.2	10.500	266.70	0.6087	60.20	1529	17.25	438	6672.15	14.9	25257	36370	1092.8	0.44	0.11
17.25	438.2	12.000	304.80	0.6957	54.65	1388	17.25	438	9249.64	20.6	35014	50420	1514.9	0.40	0.10
19.25	489.0	9.625	244.48	0.5000	73.45	1866	19.25	489	5378.22	12.0	20359	29317	789.35	0.53	0.13
19.25	489.0	11.500	292.10	0.5974	66.70	1694	19.25	489	7957.99	17.7	30124	43379	1168	0.44	0.11
19.25	489.0	13.375	339.73	0.6948	59.75	1518	19.25	489	11482.3	25.6	43465	62590	1685.2	0.39	0.10
23.25	590.6	11.625	295.28	0.5000	86.65	2201	23.25	591	7845.54	17.5	29699	42766	953.37	0.52	0.13
23.25	590.6	14.000	355.60	0.6022	78.05	1982	23.25	591	11821.9	26.3	44751	64441	1436.6	0.43	0.11
23.25	590.6	16.250	412.75	0.6989	69.75	1772	23.25	591	17011.0	37.9	64394	92727	2067.1	0.38	0.09
29.25	743.0	14.625	371.48	0.5000	104.10	2644	29.25	743	12417.3	27.7	47005	67687	1199.4	0.51	0.13
29.25	743.0	17.500	444.50	0.5983	93.70	2380	29.25	743	18436.3	41.1	69789	100496	1780.8	0.42	0.10
29.25	743.0	20.375	517.53	0.6966	83.05	2109	29.25	743	26687.8	59.5	101024	145475	2577.8	0.37	0.09
35.25	895.4	17.625	447.68	0.5000	124.30	3157	35.25	895	18034.1	40.2	68267	98304	1445.4	0.50	0.12
35.25	895.4	21.250	539.75	0.6028	111.15	2823	35.25	895	27245.7	60.7	103136	148516	2183.7	0.41	0.10
35.25	895.4	24.625	625.48	0.6986	98.65	2506	35.25	895	39052.0	87.0	147828	212872	3130	0.36	0.09
41.25	1047.8	20.625	523.88	0.5000	144.20	3663	41.25	1048	24695.9	55.0	93484	134617	1691.5	0.49	0.12
41.25	1047.8	24.750	628.65	0.6000	129.30	3284	41.25	1048	36907.4	82.2	139710	201182	2527.8	0.40	0.10
41.25	1047.8	28.875	733.43	0.7000	114.00	2896	41.25	1048	53763.6	120	203517	293065	3682.4	0.36	0.09
47.25	1200.2	23.625	600.08	0.5000	164.40	4176	47.25	1200	32402.7	72.2	122657	176627	1937.5	0.48	0.12
47.25	1200.2	28.500	723.90	0.6032	146.75	3727	47.25	1200	49016.7	109	185548	267190	2930.9	0.39	0.10
47.25	1200.2	33.000	838.20	0.6984	130.10	3305	47.25	1200	70121.8	156	265440	382233	4192.9	0.35	0.09

This sizing table can be used as a guide to aid the user in choosing the proper LVM-U for a given application and reflects standard pipe schedule in the most commonly-used pipe sizes. Other sizes and 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 23.25" x 14.000" LVM-U, 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"

$\Delta P_N = 100 (20\,000 / 11\,821.9)^2 = 286.21$" wc

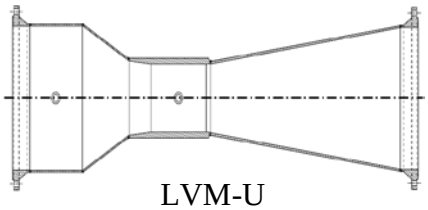
$\Delta H_N = 0.43 (20\,000 / 11\,821.9)^{1.88} = 1.16$ PSI

$Q_N = 11\,821.9 (750 / 100)^{0.5} = 32\,375.6$ US GPM

Available Options

Fabricated LVM units are available in different styles:

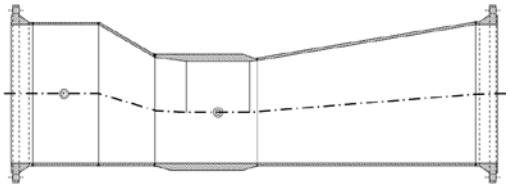
LVM-U is designed to the ASME Boiler and Pressure Vessel Code. It is typically used at operating pressures less than 400 PSIG (2 750 kPaG) and temperatures less than +500 °F (+260 °C). The unique construction of the LVM-U allows for custom designs. For example, the throat can be manufactured from a specific alloy for maximum abrasion resistance, while the exit cone can be constructed with a different alloy for corrosion resistance. For flexibility, multiple pressure connections are available.



LVM-U

LVM-F is used for more demanding process temperatures and pressures. Its pipe-shell design can be constructed and certified to meet the requirements of B31.1 and B31.3. The LVM-F is available in flanged and plain-end designs. While the most common sizes are 6 inches (150 mm) and less, the Wyatt-Badger bar stock design has been made from 27" (685 mm) diameter bar stock material.

LVM-EV is designed for clients needing accurate and reliable measurement of multiphase flows. Whether for oil-water-gas-sand mixtures at the wellhead, slurry flows in mining, or in hydrotransport applications, Wyatt Engineering has a meter specific for these critical applications. With an uncertainty of ±0.50% and extremely low headloss (much lower than wedges or segmental orifice meters), the Wyatt LVM-EV offers proven energy savings and long term reliability. With optional sealed diaphragm pressure sensation, plugged taps are no longer of concern, and our SlurryShield® brazed interior surface greatly extends meter life over conventional, abrasion-resistant, and clad materials.



LVM-EV

LVM-IF is designed for insertion within the interior of a pipeline and can be secured by companion flanges or welded directly into your pipeline. For more information on fabricated insert LVMs, see the Wyatt Engineering LVM-IF TechBrief.

Materials of Construction

The versatile LVM design can be constructed from almost any material, including:

Carbon Steel	Hastelloy B & C	Nickel
304 Stainless Steel	Monel	Tantalum
316 Stainless Steel	Titanium	Zirconium
Inconel	Chrome Molybdenum	

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

WYATT ENGINEERING
Intelligent Flow Measurement

ISO 9001:2015 Quality System CERTIFIED
2014/68/EU Pressure Equipment Directive

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