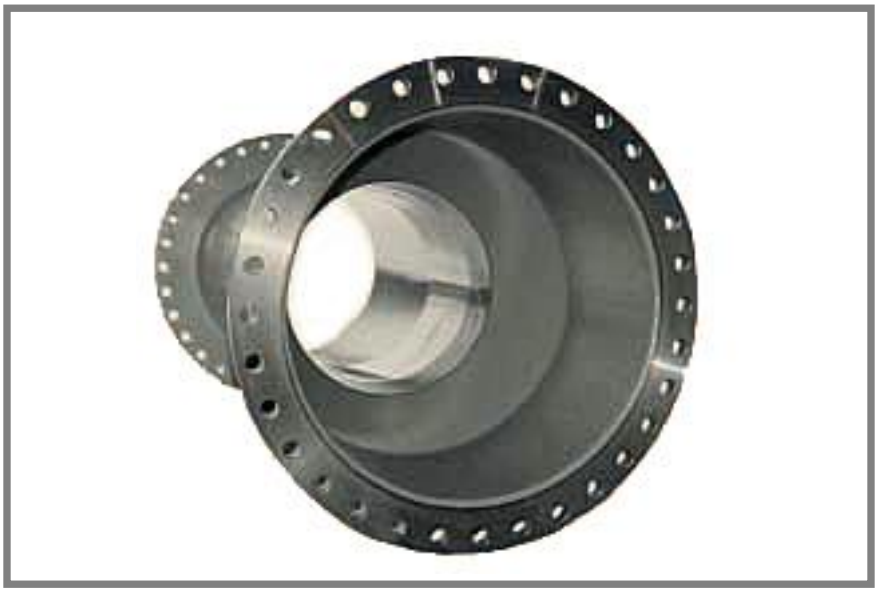
LVM-U TECHbrief

Wyatt Engineering Liberty Venturi Meters
Fabricated Primary Elements



FEATURES:

- **High Accuracy**
- **Low Pressure Loss**
- **Custom Designed**
- **Low Signal-to-Noise Ratio**
- **Documented Performance**

LVMU 06/2019 6M

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 a wide 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 a particular material 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
Water and Wastewater Plants
Steam Custody Transfer
Fiscal Metering

High Accuracy

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

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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 QS9001 calibrated 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.

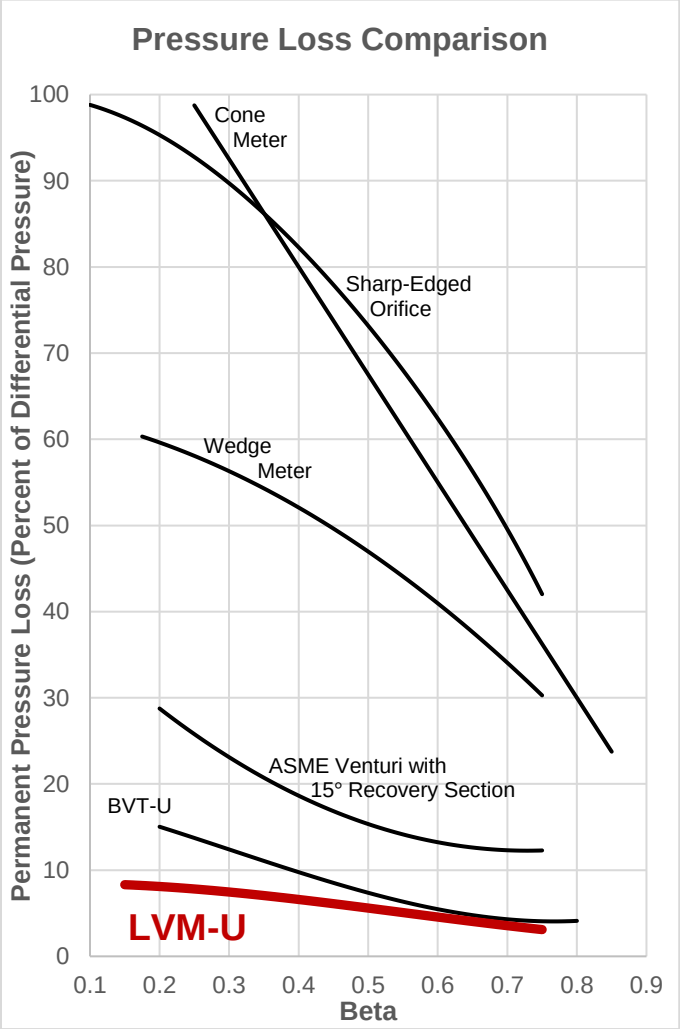


Figure 1

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

With properly chosen materials, 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 or 16.47 for 150 PSIG through 2500 PSIG service, are available. Various end connections are also available, including plate, slip-on, weld neck, Van Stone, RTJ, and others. Beveling for butt-welding is also available.

Piping Requirements

Designed for full-pipe flow, LVM flow meters may be mounted horizontally, vertically, or at an angle. For recommended upstream piping, refer to Wyatt Engineering TECHspec for the LVM design.

Energy Considerations

Figure 1 compares the headloss of the **LVM-U** with that of other primary flow elements. The pressure recovery of the LVM reduces pumping costs. The Wyatt **LVM-U** has a shorter laying length and exhibits better recovery than standard classical and modified Venturi meters.

Design Concepts

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-U Sizing Table

Inlet Diameter		Throat Diameter		Beta Ratio	Overall Length		Outlet Diameter		ΔP = Differential Pressure of 100.00" wc (24.864 kPaD) Water Flow at 60° F (16° C)					ΔH = Headloss	
(inches)	(mm)	(inches)	(mm)		(inches)	(mm)	(inches)	(mm)	US GPM	CFS	LPM	m^3/d	$R_D(10^{-3})$	PSI	kPa
3.068	78	1.500	38.10	0.4889	17.70	450	3.05	77	130.25	0.290	493.05	710.00	120	0.68	0.17
3.068	78	1.750	44.45	0.5704	16.60	422	3.05	77	182.05	0.406	689.14	992.37	168	0.57	0.14
3.068	78	2.100	53.34	0.6845	15.30	389	3.05	77	280.59	0.625	1062.16	1529.5	258	0.49	0.12
4.026	102	2.000	50.80	0.4968	20.85	530	4.00	102	232.02	0.517	878.29	1264.7	163	0.65	0.16
4.026	102	2.400	60.96	0.5961	19.40	493	4.00	102	346.39	0.772	1311.21	1888.1	243	0.53	0.13
4.026	102	2.800	71.12	0.6955	17.95	456	4.00	102	503.51	1.122	1906.01	2744.7	353	0.47	0.12
6.065	154	3.000	76.20	0.4946	28.30	719	6.05	154	521.76	1.162	1975.07	2844.1	243	0.62	0.15
6.065	154	3.600	91.44	0.5936	26.10	663	6.05	154	778.41	1.734	2946.60	4243.1	363	0.51	0.13
6.065	154	4.200	106.7	0.6925	23.90	607	6.05	154	1130.0	2.518	4277.41	6159.5	526	0.45	0.11
7.981	203	4.000	101.6	0.5012	35.10	892	7.95	202	929.17	2.070	3517.29	5064.9	329	0.59	0.15
7.981	203	4.800	121.9	0.6014	32.20	818	7.95	202	1389.2	3.095	5258.58	7572.3	492	0.49	0.12
7.981	203	5.500	139.7	0.6891	29.60	752	7.95	202	1932.2	4.305	7314.11	10532.3	684	0.44	0.11
10.02	255	5.000	127.0	0.4990	41.50	1054	10.00	254	1451.0	3.233	5492.56	7909.3	409	0.58	0.14
10.02	255	6.000	152.4	0.5988	37.90	963	10.00	254	2167.7	4.830	8205.81	11816.4	611	0.47	0.12
10.02	255	7.000	177.8	0.6986	34.20	869	10.00	254	3155.7	7.031	11945.6	17201.7	890	0.42	0.10
12.00	305	6.000	152.4	0.5000	48.65	1236	12.00	305	2090.0	4.656	7911.39	11392.4	492	0.56	0.14
12.00	305	7.200	182.9	0.6000	44.30	1125	12.00	305	3123.4	6.959	11823.4	17025.7	735	0.46	0.12
12.00	305	8.400	213.4	0.7000	39.85	1012	12.00	305	4549.9	10.14	17223.3	24801.5	1071	0.41	0.10
13.25	337	6.625	168.3	0.5000	53.55	1360	13.25	337	2548.1	5.677	9645.44	13889.4	543	0.56	0.14
13.25	337	8.000	203.2	0.6038	48.55	1233	13.25	337	3863.4	8.608	14624.4	21059.2	824	0.46	0.11
13.25	337	9.250	235.0	0.6981	43.90	1115	13.25	337	5508.0	12.27	20850.0	30024.0	1174	0.41	0.10
15.25	387	7.625	193.7	0.5000	59.75	1518	15.25	387	3375.3	7.520	12777.0	18398.9	625	0.55	0.14
15.25	387	9.000	228.6	0.5902	54.80	1392	15.25	387	4857.2	10.82	18386.7	26476.8	900	0.46	0.11
15.25	387	10.625	269.9	0.6967	48.80	1240	15.25	387	7258.2	16.17	27475.3	39564.5	1345	0.40	0.10
17.25	438	8.625	219.1	0.5000	67.00	1702	17.25	438	4318.7	9.622	16348.1	23541.3	707	0.54	0.13
17.25	438	10.500	266.7	0.6087	60.20	1529	17.25	438	6672.2	14.87	25256.8	36369.9	1093	0.44	0.11
17.25	438	12.000	304.8	0.6957	54.65	1388	17.25	438	9249.6	20.61	35013.7	50419.7	1515	0.40	0.10
19.25	489	9.625	244.5	0.5000	73.45	1866	19.25	489	5378.2	11.98	20358.8	29316.6	789	0.53	0.13
19.25	489	11.500	292.1	0.5974	66.70	1694	19.25	489	7958.0	17.73	30124.3	43379.0	1168	0.44	0.11
19.25	489	13.375	339.7	0.6948	59.75	1518	19.25	489	11482	25.58	43465.1	62589.7	1685	0.39	0.10
23.25	591	11.625	295.3	0.5000	86.65	2201	23.25	591	7845.5	17.48	29698.6	42766.0	953	0.52	0.13
23.25	591	14.000	355.6	0.6022	78.05	1982	23.25	591	11822	26.34	44750.6	64440.9	1437	0.43	0.11
23.25	591	16.250	412.8	0.6989	69.75	1772	23.25	591	17011	37.90	64393.8	92727.1	2067	0.38	0.09
29.25	743	14.625	371.5	0.5000	104.10	2644	29.25	743	12417	27.67	47004.8	67686.9	1199	0.51	0.13
29.25	743	17.500	444.5	0.5983	93.70	2380	29.25	743	18436	41.08	69788.8	100496	1781	0.42	0.10
29.25	743	20.375	517.5	0.6966	83.05	2109	29.25	743	26688	59.46	101024	145475	2578	0.37	0.09
35.25	895	17.625	447.7	0.5000	124.30	3157	35.25	895	18034	40.18	68266.6	98304.0	1445	0.50	0.12
35.25	895	21.250	539.8	0.6028	111.15	2823	35.25	895	27246	60.70	103136	148516	2184	0.41	0.10
35.25	895	24.625	625.5	0.6986	98.65	2506	35.25	895	39052	87.01	147828	212872	3130	0.36	0.09
41.25	1048	20.625	523.9	0.5000	144.20	3663	41.25	1048	24696	55.02	93484.2	134617	1691	0.49	0.12
41.25	1048	24.750	628.7	0.6000	129.30	3284	41.25	1048	36907	82.23	139710	201182	2528	0.40	0.10
41.25	1048	28.875	733.4	0.7000	114.00	2896	41.25	1048	53764	119.8	203517	293065	3682	0.36	0.09
47.25	1200	23.625	600.1	0.5000	164.40	4176	47.25	1200	32403	72.19	122657	176627	1937	0.48	0.12
47.25	1200	28.500	723.9	0.6032	146.75	3727	47.25	1200	49017	109.2	185548.3	267190	2931	0.39	0.10
47.25	1200	33.000	838.2	0.6984	130.10	3305	47.25	1200	70122	156.2	265440	382233	4193	0.35	0.09

This sizing table can be used as a guide in choosing the proper **LVM-U** for a given application and reflects standard pipe schedules 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 representatives, or call us directly, for definitive sizing information.

Incompressible Flow Relationships:

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

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

$Q_N = Q\ (\Delta P / 100)^{0.5}$

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"

$\Delta P_N = 100\ (20\ 000 / 11\ 822)^2 = 286.21$" wc

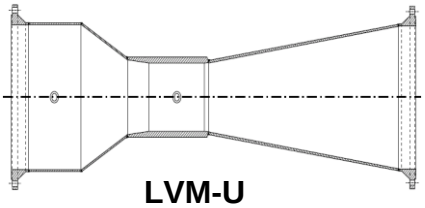
$\Delta H_N = 0.43\ (20\ 000 / 11\ 822)^{1.88} = 1.16$ PSI

$Q_N = 11\ 822\ (750 / 100)^{0.5} = 32\ 375$ US GPM

Available Options

Fabricated LVM units are available in different styles:

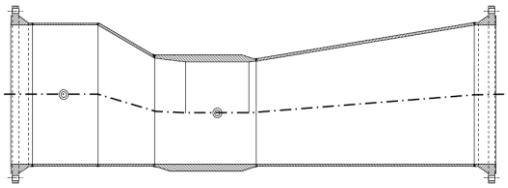
LVM-U is designed to the ASME Boiler and Pressure Vessel Code. It is typically used at operating pressures less than 6 000 PSIG (41 350 kPaG) and temperatures less than +1 000 °F (+535 °C). The unique construction of the **LVM-U** allows for custom designs. For example, the throat can be manufactured 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 ASME B31.1, B31.3, or B31.8. The **LVM-F** is available in flanged and plain-end designs.

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 hydro-transport applications, Wyatt Engineering has a meter specific for these critical applications. With an uncertainty of ±0.50% and comparatively 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-U** design can be constructed from almost any material, including:

Carbon Steel	Inconel	Cr-Mo Alloy
300-Series Stainless Steel	Hastelloy B & C	Nickel
400-Series Stainless Steel	Monel	Tantalum
Duplex and Super Duplex	Titanium	Zirconium

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

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