# LVM TECHbrief

Liberty Venturi Meter
Cast Iron Primary Elements

## FEATURES:

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

LVM

03/2018

## 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 ± 0.50% without flow calibration. With independent flow calibration, Wyatt's LVMs provide the user with ± 0.25% accuracy.

# 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.

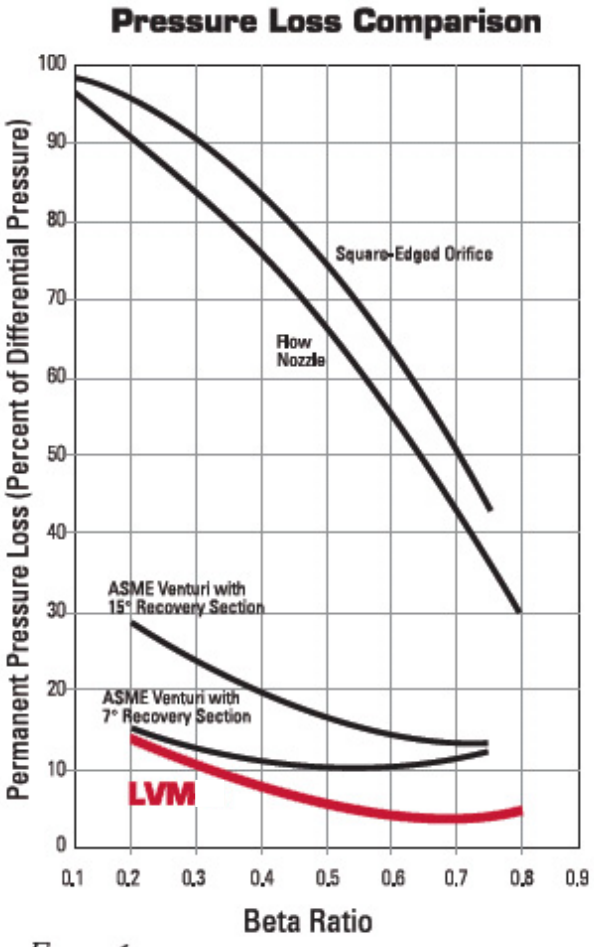



*Figure 1*

## 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) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Water Flow at 60 °F (16 °C) | | | | | ΔH = Headloss | |
| (inches) | (mm) | (inches) | (mm) | | (inches) | (mm) | (inches) | (mm) | US GPM | US CFS | LPM | $m^3/d$ | $R_D(10^3)$ | 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

$\Delta P$ at 20 000 US GPM

$\Delta H$ at 20 000 US GPM

$Q_N$ at 750" wc

**Solutions:**
Found using the "Incompressible Flow Relationships"

$\Delta P_N = 100 (20\,000 / 12\,639)^2 = 250.40$" wc

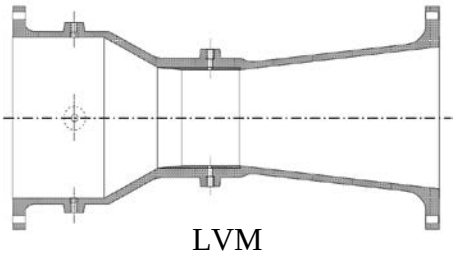
$\Delta H_N = 5.0 (20\,000 / 12\,639)^{1.88} = 11.8$" wc

$Q_N = 12\,639 (750 / 100)^{0.5} = 34\,613$ 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.

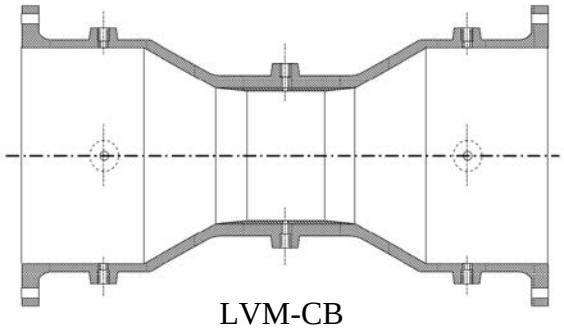


LVM

**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.*

WYATT ENGINEERING
Intelligent Flow Measurement

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

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