

BVT-U

TECHbrief

Wyatt-Badger Venturi Tubes
Fabricated Primary Elements



FEATURES:

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

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Description

Wyatt-Badger Venturi Tubes 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 BVT 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-Badger's fabricated BVT series can be manufactured from virtually any metal or alloy. Each unit, therefore, can be designed specifically for your application.

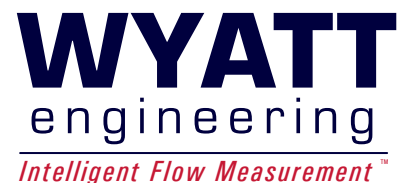
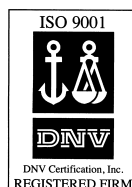
Application

The fabricated series of BVTs are often used in 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. BVT 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 BVT-U provides a flow measurement accuracy of $\pm 0.50\%$ without flow calibration. With independent flow calibration, Wyatt Engineering's venturi meters provide the user with $\pm 0.25\%$ accuracy.



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Technical Specifications

Accuracy

For pipe Reynolds numbers greater than 75 000 and with a normalized piping configuration, the Wyatt-Badger Venturi Tube 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 BVT 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..

Beta Ratio

Wyatt Engineering can furnish fabricated BVT 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 BVT-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, BVT flow meters may be mounted either horizontally or vertically. For recommended upstream piping, refer to Wyatt Engineering TechSpec for the BVT.

Signal to Noise Ratio

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

Design

The BVT 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.

Pressure Loss Comparison

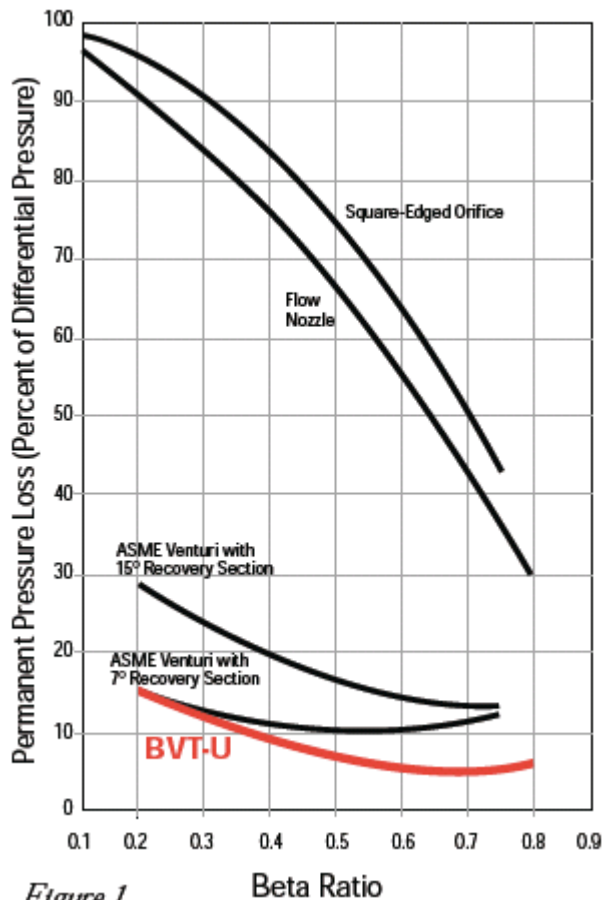


Figure 1

BVT-U 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 MGD	LPS	m³/d	Ro(10 ⁻³)	in. wc	kPa
3.00	76.2	1.500	38.1	0.5000	7.60	193.0	2.30	58.4	130.42	0.188	8.23	710.91	123	9.5	2.36
3.00	76.2	1.800	45.7	0.6000	7.70	195.6	2.60	66.0	194.77	0.280	12.29	1061.7	183	6.7	1.67
3.00	76.2	2.100	53.3	0.7000	7.70	195.6	2.80	71.1	283.53	0.408	17.89	1545.5	267	4.2	1.04
4.00	101.6	2.000	50.8	0.5000	10.10	256.5	3.00	76.2	231.86	0.334	14.63	1263.8	164	9.2	2.28
4.00	101.6	2.400	61.0	0.6000	10.20	259.1	3.40	86.4	346.26	0.499	21.85	1887.5	245	6.5	1.61
4.00	101.6	2.800	71.1	0.7000	10.30	261.6	3.80	96.5	504.05	0.726	31.80	2747.6	356	4.0	1.01
6.00	152.4	3.000	76.2	0.5000	15.20	386.1	4.60	116.8	521.68	0.751	32.91	2843.6	246	8.7	2.17
6.00	152.4	3.600	91.4	0.6000	15.30	388.6	5.20	132.1	779.09	1.122	49.15	4246.8	367	6.2	1.53
6.00	152.4	4.200	106.7	0.7000	15.40	391.2	5.70	144.8	1134.11	1.633	71.55	6182.0	534	3.9	0.96
8.00	203.2	4.000	101.6	0.5000	20.20	513.1	6.10	154.9	927.42	1.335	58.51	5055.4	328	8.4	2.10
8.00	203.2	4.800	121.9	0.6000	20.40	518.2	6.90	175.3	1385.0	1.994	87.38	7549.9	489	6.0	1.48
8.00	203.2	5.600	142.2	0.7000	20.60	523.2	7.60	193.0	2016.2	2.903	127.20	10990.3	712	3.7	0.93
10.00	254.0	5.000	127.0	0.5000	25.20	640.1	7.70	195.6	1449.1	2.087	91.42	7899.0	409	8.2	2.04
10.00	254.0	6.000	152.4	0.6000	25.50	647.7	8.70	221.0	2164.1	3.116	136.54	11796.7	611	5.8	1.44
10.00	254.0	7.000	177.8	0.7000	25.70	652.8	9.50	241.3	3150.3	4.536	198.75	17172.4	890	3.6	0.90
12.00	304.8	6.000	152.4	0.5000	30.30	769.6	9.20	233.7	2086.7	3.005	131.65	11374.6	491	8.0	2.00
12.00	304.8	7.200	182.9	0.6000	30.60	777.2	10.40	264.2	3116.3	4.488	196.61	16987.2	734	5.7	1.41
12.00	304.8	8.400	213.4	0.7000	30.80	782.3	11.40	289.6	4536.5	6.532	286.21	24728.2	1068	3.5	0.88
14.00	355.6	7.000	177.8	0.5000	35.30	896.6	10.80	274.3	2840.2	4.090	179.19	15482.1	573	7.9	1.96
14.00	355.6	8.400	213.4	0.6000	35.70	906.8	12.10	307.3	4241.7	6.108	267.61	23121.4	856	5.6	1.39
14.00	355.6	9.800	248.9	0.7000	36.00	914.4	13.30	337.8	6174.6	8.891	389.56	33657.8	1246	3.5	0.87
16.00	406.4	8.000	203.2	0.5000	40.30	1023.6	12.30	312.4	3709.7	5.342	234.05	20221.5	655	7.8	1.93
16.00	406.4	9.600	243.8	0.6000	40.80	1036.3	13.90	353.1	5540.2	7.978	349.53	30199.4	978	5.5	1.36
16.00	406.4	11.200	284.5	0.7000	41.10	1043.9	15.30	388.6	8064.8	11.61	508.81	43961.2	1424	3.4	0.85
18.00	457.2	9.000	228.6	0.5000	45.40	1153.2	13.80	350.5	4695.1	6.761	296.21	25592.8	737	7.6	1.90
18.00	457.2	10.800	274.3	0.6000	45.90	1165.9	15.60	396.2	7011.8	10.10	442.37	38221.2	1101	5.4	1.35
18.00	457.2	12.600	320.0	0.7000	46.20	1173.5	17.20	436.9	10207.0	14.70	643.96	55638.4	1602	3.4	0.84
20.00	508.0	10.000	254.0	0.5000	50.40	1280.2	15.40	391.2	5796.4	8.347	365.70	31596.1	819	7.6	1.88
20.00	508.0	12.000	304.8	0.6000	51.00	1295.4	17.40	442.0	8656.5	12.47	546.14	47186.6	1223	5.3	1.33
20.00	508.0	14.000	355.6	0.7000	51.30	1303.0	19.10	485.1	12601.3	18.15	795.02	68689.4	1780	3.3	0.83
24.00	609.6	12.000	304.8	0.5000	60.50	1536.7	18.50	469.9	8346.8	12.02	526.60	45498.4	983	7.4	1.84
24.00	609.6	14.400	365.8	0.6000	61.20	1554.5	20.90	530.9	12465.4	17.95	786.44	67948.7	1467	5.2	1.30
24.00	609.6	16.800	426.7	0.7000	61.60	1564.6	22.90	581.7	18145.8	26.13	1144.8	98912.8	2136	3.3	0.81
30.00	762.0	15.000	381.0	0.5000	75.60	1920.2	23.10	586.7	13041.9	18.78	822.82	71091.2	1228	7.2	1.79
30.00	762.0	18.000	457.2	0.6000	76.50	1943.1	26.10	662.9	19477.2	28.05	1228.8	106169.9	1834	5.1	1.27
30.00	762.0	21.000	533.4	0.7000	77.00	1955.8	28.70	729.0	28352.8	40.83	1788.8	154551.2	2670	3.2	0.79
36.00	914.4	18.000	457.2	0.5000	90.70	2303.8	27.70	703.6	18780.3	27.04	1184.9	102371.4	1474	7.0	1.75
36.00	914.4	21.600	548.6	0.6000	91.80	2331.7	31.30	795.0	28047.1	40.39	1769.5	152884.6	2201	5.0	1.24
36.00	914.4	25.200	640.1	0.7000	92.40	2347.0	34.40	873.8	40828.1	58.79	2575.9	222553.7	3204	3.1	0.77
42.00	1066.8	21.000	533.4	0.5000	105.80	2687.3	32.40	823.0	25562.1	36.81	1612.7	139338.8	1720	6.9	1.72
42.00	1066.8	25.200	640.1	0.6000	107.10	2720.3	36.50	927.1	38175.2	54.97	2408.5	208092.9	2568	4.9	1.22
42.00	1066.8	29.400	746.8	0.7000	107.80	2738.1	40.10	1019	55571.6	80.02	3506.0	302920.3	3738	3.1	0.76
48.00	1219.2	24.000	609.6	0.5000	120.90	3070.9	37.00	939.8	33387.2	48.08	2106.4	181993.6	1965	6.8	1.69
48.00	1219.2	28.800	731.5	0.6000	122.40	3109.0	41.80	1062	49861.5	71.80	3145.8	271794.9	2935	4.8	1.20
48.00	1219.2	33.600	853.4	0.7000	123.10	3126.7	45.90	1165.9	72583.3	104.52	4579.3	395651.0	4272	3.0	0.75

This sizing table can be used as a guide to aid the user in choosing the proper BVT-U 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:

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

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

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

Examples:

For a 20.00" x 14.000" BVT-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"

$$\Delta P_N = 100 (20\ 000 / 12\ 601.27)^2 = 251.90" \text{ wc}$$

$$\Delta H_N = 3.3 (20\ 000 / 12\ 601.27)^{1.88} = 7.9" \text{ wc}$$

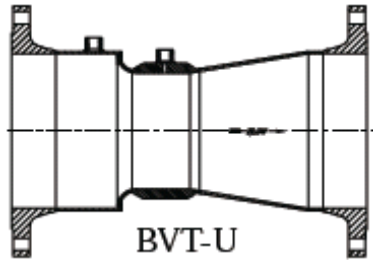
$$Q_N = 12\ 601.27 (750 / 100)^{0.5} = 34\ 510.00 \text{ US GPM}$$

Available Options

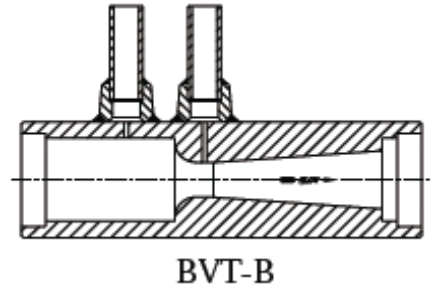


Fabricated BVT units are available in four styles:

Model BVT-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 BVT-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.



Model BVT-B is designed for service in which demanding process conditions require a uniquely rugged design. Machined from forged bar material, it is ideally suited for applications in which extreme temperature cycling and/or pressure cycling is encountered, such as the power industry. While the most common sizes are 6 inches (150mm) and less, the Wyatt-Badger bar stock design has been made from 26" (660mm) diameter bar stock material.



Model BVT-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 BVT-F is available in flanged and plain-end designs.

Model BVT-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 BVTs, see the Wyatt Engineering BVT-IF TechBrief.

Materials of Construction

The versatile BVT-U design can be constructed from almost any material, including:

Carbon Steel
300-Series Stainless Steel
400-Series Stainless Steel
Duplex and Superduplex

Inconel
Hastelloy B & C
Monel
Titanium

Cr-Mo Alloy
Nickel
Tantalum
Zirconium

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

