

BVT-IP

TECHbrief

Wyatt-Badger Venturi Tubes
Insert-Type Composite Primary Elements



FEATURES:

- High Accuracy
- Economical Design
- Low Pressure Loss
- Reliable Performance

Description

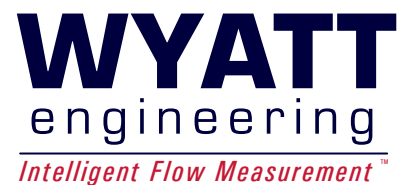
The Wyatt-Badger BVT insert venturi is available in two configurations: The standard BVT-IP, made entirely of engineered materials, and the BVT-IL, which uses a metallic throat and mounting flange and a fiberglass reinforced body. The BVT-IP and BVT-IL are designed for insertion within the interior of a pipeline and are secured by adjacent pipe flanges. Wyatt-Badger insert venturis are low-weight and cost effective alternatives to other meter geometries and designs.

Application

The BVT insert venturi design provides higher accuracy over a wider range of flow rates, and lower permanent pressure loss than orifice plates, flow nozzles, or conventional venturi meters. Designed to measure clean liquids and gases in full pipes, the insert BVT can be manufactured to fit virtually any pipe size. In applications where solids contaminate the line fluid, an auxiliary high pressure tap can be provided for installation in the upstream pipe.

Flow Measurement Accuracy

For pipe Reynolds numbers greater than 75 000 and with a normalized piping configuration, the Wyatt-Badger BVT-IP and BVT-IL provide a flow measurement accuracy of $\pm 0.25\%$ with independent flow calibration. Without independent flow calibration, the Wyatt-Badger BVT-IP and BVT-IL provide a flow measurement accuracy of $\pm 0.50\%$.



Technical Specifications

Accuracy

For pipe Reynolds numbers greater than 75 000 and a normalized piping configuration, the Wyatt-Badger BVT-IP and BVT-IL provide a flow measurement uncertainty of:

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

Pressure Loss

The permanent pressure loss of Wyatt-Badger insert meters is considerably lower than that of short-form venturis, and for most beta ratios, lower than that of long-form venturis as well. (See Figure 1)

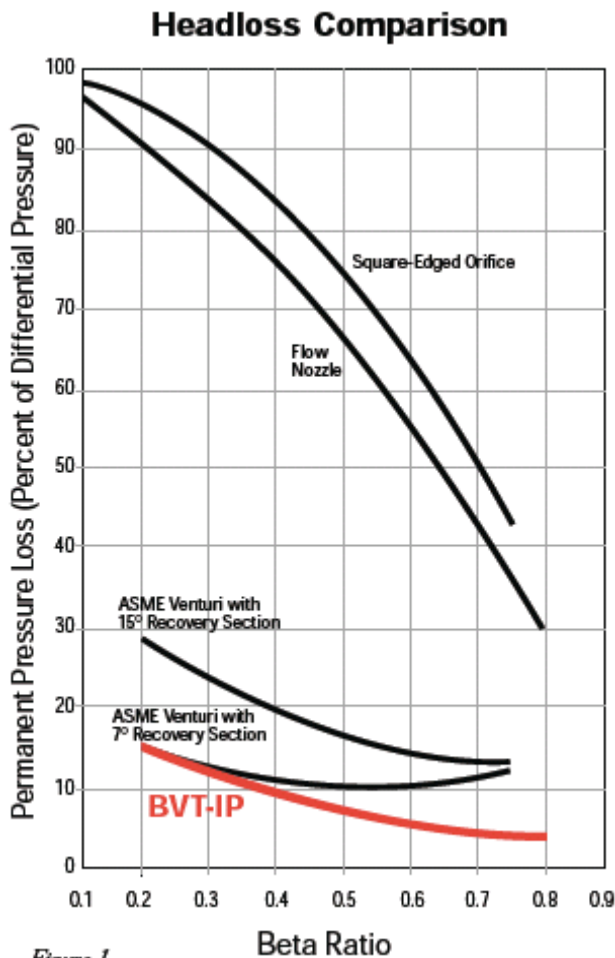


Figure 1

Beta Ratio

Wyatt-Badger insert meters can be furnished in a wide range diameter ratios (d/D), providing accurate and reliable primary elements with low permanent pressure loss.

Temperature Range

The composite design insert BVT series of primary devices is designed to operate within process temperature range of 0 °F to +300 °F (-18 °C to +150 °C).

Pressure Range/Flange Connections

Depending on process conditions, the standard design BVT-IP can operate at pressures up to 750 PSIG (5175 kPaG). The BVT-IL, due to its metallic mounting flange, operates at pressures up to 4000 PSIG (27 500 kPaG).

Piping Requirements

Designed for full-pipe flow, BVT-IP and BVT-IL insert meters can be installed in horizontal or vertical lines. For recommended upstream piping, refer to Wyatt Engineering TechSpec for the BVT.

Design Concepts

The hydraulic design produces discharge coefficients that are highly predictable and independent of line size. The Wyatt-Badger design allows accurate calculation of expansibility factors that are necessary for compressible fluid flow measurement. The smooth transition section minimizes flow noise and erosion.

Signal-to-Noise Ratio

Within the specified flow range and piping conditions, the Wyatt-Badger design 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.

BVT-IP 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	1.609	40.9	0.5363	7.12	180.8	2.50	63.5	149.41	0.215	9.43	814.44	141	8.5	2.12
3.00	76.2	1.798	45.7	0.5993	6.53	165.8	2.60	66.0	189.51	0.273	11.96	1033.03	178	6.7	1.68
3.00	76.2	2.171	55.1	0.7237	5.36	136.2	2.70	68.6	289.10	0.416	18.24	1575.88	272	3.8	0.96
4.00	101.6	1.800	45.7	0.4500	10.57	268.5	3.30	83.8	184.47	0.266	11.64	1005.52	130	10.5	2.62
4.00	101.6	2.203	56.0	0.5508	9.31	236.5	3.40	86.4	280.96	0.405	17.73	1531.53	198	7.8	1.95
4.00	101.6	2.814	71.5	0.7035	7.40	188.0	3.60	91.4	481.79	0.694	30.40	2626.25	340	4.0	1.00
6.00	152.4	3.114	79.1	0.5190	14.65	372.1	5.10	129.5	557.74	0.803	35.19	3040.24	263	8.3	2.05
6.00	152.4	4.000	101.6	0.6667	10.65	270.5	5.20	132.1	959.47	1.382	60.53	5230.04	452	4.5	1.13
6.00	152.4	4.428	112.5	0.7380	10.45	265.4	5.60	142.2	1209.3	1.741	76.30	6592.11	569	3.4	0.84
8.00	203.2	3.466	88.0	0.4333	21.75	552.5	6.50	165.1	682.75	0.983	43.07	3721.67	241	10.2	2.52
8.00	203.2	4.018	102.1	0.5023	20.00	508.0	6.70	170.2	925.84	1.333	58.41	5046.76	327	8.4	2.08
8.00	203.2	4.919	124.9	0.6149	17.00	431.8	7.10	180.3	1425.1	2.052	89.91	7768.29	503	5.6	1.39
8.00	203.2	5.978	151.8	0.7473	13.40	340.4	7.40	188.0	2211.6	3.185	139.53	12055.3	781	3.2	0.80
10.00	254.0	3.991	101.4	0.3991	28.25	717.6	8.00	203.2	902.64	1.300	56.95	4920.29	255	11.0	2.73
10.00	254.0	4.919	124.9	0.4919	25.30	642.6	8.40	213.4	1385.3	1.995	87.40	7551.37	391	8.4	2.09
10.00	254.0	6.343	161.1	0.6343	19.00	482.6	8.50	215.9	2384.7	3.434	150.45	12999.1	674	5.0	1.24
10.00	254.0	6.907	175.4	0.6907	15.90	403.9	8.65	219.7	2887.7	4.158	182.19	15741.1	816	3.8	0.95
12.00	304.8	4.892	124.3	0.4077	33.60	853.4	9.70	246.4	1357.1	1.954	85.62	7397.37	320	10.4	2.60
12.00	304.8	5.675	144.1	0.4729	31.15	791.2	10.00	254.0	1838.8	2.648	116.01	10023.3	433	8.7	2.15
12.00	304.8	6.966	176.9	0.5805	26.90	683.3	10.35	262.9	2829.8	4.075	178.53	15425.0	666	6.2	1.53
12.00	304.8	8.000	203.2	0.6667	21.10	535.9	10.50	266.7	3837.9	5.527	242.13	20920.2	904	4.2	1.04
14.00	355.6	5.600	142.2	0.4000	39.50	1003.3	10.30	261.6	1777.3	2.559	112.13	9687.9	359	10.5	2.61
14.00	355.6	6.958	176.7	0.4970	33.80	858.5	10.45	265.4	2774.1	3.995	175.02	15121.3	560	8.0	1.98
14.00	355.6	8.044	204.3	0.5746	27.90	708.7	10.60	269.2	3767.5	5.425	237.69	20536.8	760	6.2	1.54
14.00	355.6	9.757	247.8	0.6969	27.30	693.4	12.10	307.3	5776.9	8.319	364.47	31489.9	1166	3.6	0.88
16.00	406.4	6.932	176.1	0.4333	43.35	1101.1	13.10	332.7	2731.0	3.933	172.30	14886.7	482	9.3	2.32
16.00	406.4	8.036	204.1	0.5023	38.90	988.1	13.20	335.3	3703.4	5.333	233.65	20187.1	654	7.7	1.92
16.00	406.4	9.838	249.9	0.6149	29.15	740.4	13.30	337.8	5700.5	8.209	359.64	31073.2	1007	5.2	1.28
16.00	406.4	11.255	285.9	0.7034	26.60	675.6	13.40	340.4	7707.1	11.10	486.24	42011.5	1361	3.4	0.85
18.00	457.2	8.984	228.2	0.4991	44.15	1121.4	14.90	378.5	4626.3	6.662	291.87	25217.9	726	7.7	1.91
18.00	457.2	9.849	250.2	0.5472	39.50	1003.3	15.00	381.0	5611.2	8.080	354.01	30586.9	881	6.6	1.65
18.00	457.2	11.350	288.3	0.6306	31.25	793.8	15.10	383.5	7625.9	10.98	481.12	41568.9	1197	4.7	1.18
18.00	457.2	12.592	319.8	0.6996	37.00	939.8	15.80	401.3	9631.9	13.87	607.68	52503.4	1512	3.4	0.85
20.00	508.0	8.959	227.6	0.4480	53.25	1352.6	16.50	419.1	4568.7	6.579	288.24	24903.9	645	8.7	2.17
20.00	508.0	9.839	249.9	0.4920	50.35	1278.9	16.70	424.2	5542.5	7.981	349.67	30211.9	783	7.7	1.92
20.00	508.0	11.377	289.0	0.5689	42.30	1074.4	16.80	426.7	7525.6	10.84	474.79	41021.8	1063	6.1	1.51
20.00	508.0	13.813	350.9	0.6907	36.50	927.1	16.90	429.3	11549.1	16.63	728.63	62954.0	1631	3.5	0.87
24.00	609.6	9.783	248.5	0.4076	66.80	1696.7	19.50	495.3	5427.1	7.815	342.40	29583.3	639	9.6	2.39
24.00	609.6	11.349	288.3	0.4729	61.90	1572.3	20.10	510.5	7353.9	10.59	463.96	40085.9	866	8.0	1.98
24.00	609.6	13.931	353.8	0.5805	50.65	1286.5	20.40	518.2	11317.3	16.30	714.01	61690.6	1332	5.7	1.41
24.00	609.6	16.000	406.4	0.6667	39.25	997.0	20.50	520.7	15351.5	22.11	968.53	83680.7	1807	3.8	0.96
30.00	762.0	12.645	321.2	0.4215	82.15	2086.6	24.50	622.3	9077.5	13.07	572.70	49481.4	855	9.0	2.23
30.00	762.0	16.086	408.6	0.5362	71.30	1811.0	25.80	655.3	14933.3	21.50	942.14	81401.1	1406	6.5	1.61
30.00	762.0	17.975	456.6	0.5992	65.15	1654.8	26.50	673.1	18939.8	27.27	1194.9	103240	1784	5.1	1.27
30.00	762.0	21.711	551.5	0.7237	50.40	1280.2	27.50	698.5	28913.0	41.63	1824.1	157605	2723	2.9	0.73
36.00	914.4	16.022	407.0	0.4451	92.20	2341.9	29.10	739.1	14607.2	21.03	921.6	79623.9	1146	8.2	2.04
36.00	914.4	19.705	500.5	0.5474	80.50	2044.7	30.40	772.2	22461.9	32.35	1417.1	122440	1763	6.1	1.51
36.00	914.4	22.004	558.9	0.6112	73.00	1854.2	31.30	795.0	28484.4	41.02	1797.1	155268	2235	4.8	1.18
36.00	914.4	25.183	639.6	0.6995	62.45	1586.2	32.40	823.0	38524.1	55.47	2430.5	209994	3023	3.1	0.78
42.00	1066.8	19.653	499.2	0.4679	108.63	2759.3	31.40	797.6	22038.1	31.73	1390.4	120130	1482	7.6	1.88
42.00	1066.8	22.023	559.4	0.5244	101.23	2571.3	33.70	856.0	27924.6	40.21	1761.8	152217	1878	6.4	1.60
42.00	1066.8	25.414	645.5	0.6051	90.64	2302.2	37.10	942.3	37926.5	54.61	2392.8	206737	2551	4.8	1.19
42.00	1066.8	30.664	778.9	0.7301	74.23	1885.6	41.60	1057	57820.3	83.26	3647.9	315178	3889	2.7	0.68
48.00	1219.2	21.957	557.7	0.4574	125.73	3193.5	35.30	896.6	27472.2	39.56	1733.2	149751	1617	7.7	1.90
48.00	1219.2	25.437	646.1	0.5299	114.86	2917.3	38.80	985.5	37294.1	53.70	2352.9	203290	2195	6.2	1.55
48.00	1219.2	31.045	788.5	0.6468	97.33	2472.3	44.40	1128	57374.0	82.62	3619.7	312745	3377	3.9	0.97
48.00	1219.2	35.353	898.0	0.7365	83.88	2130.4	47.60	1209.0	77045.0	110.94	4860.8	419972	4535	2.7	0.66

This sizing table can be used as a guide to aid the user in choosing the proper insert BVT 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 13.813" BVT-IP or BVT-IL, find

$$\Delta P \text{ at } 20\,000 \text{ US GPM}$$

$$\Delta H \text{ at } 20\,000 \text{ US GPM}$$

$$Q_N \text{ at } 750" \text{ wc}$$

Solutions:

Found using the "Incompressible Flow Relationships"

$$\Delta P_N = 100 (20\,000 / 11\,549.08)^2 = 299.89" \text{ wc}$$

$$\Delta H_N = 3.3 (20\,000 / 11\,549.08)^{1.88} = 9.3" \text{ wc}$$

$$Q_N = 11\,549.08 (750 / 100)^{0.5} = 31\,628.46 \text{ US GPM}$$

Available Options

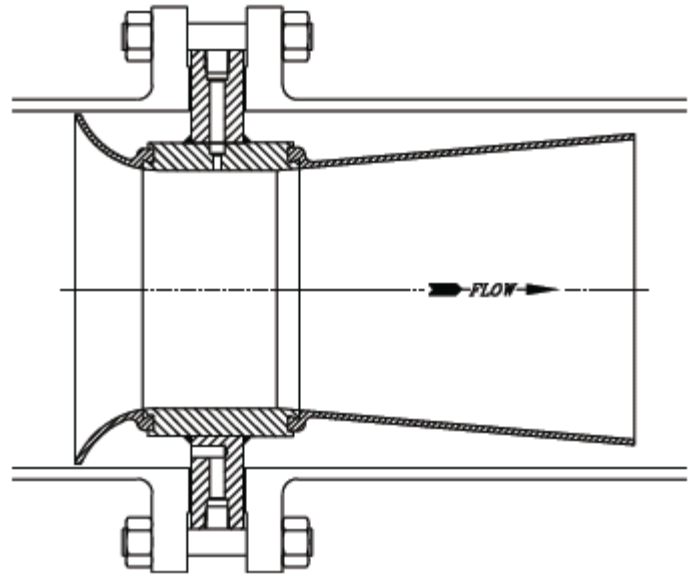


Materials of Construction

The Wyatt-Badger insert series of flow meters can be constructed of virtually any composite material, such as vinyl ester or isophthalic resin, reinforced with fiberglass or carbon fiber. Consult Wyatt Engineering for available materials.

Model BVT-IP: In the BVT-IP series, the body is typically constructed of vinyl ester resin reinforced with fiberglass (40% by weight). The throat can be constructed of polyvinyl chloride, FRP, or almost any other synthetic material.

Model BVT-IL: Like the BVT-IP, the meter body of the BVT-IL is generally constructed of vinyl ester resin reinforced with fiberglass (40% by weight). The BVT-IL typically incorporates a bronze, 304 stainless steel, or 316 stainless steel throat. Consult Wyatt Engineering for other available throat materials.



BVT-IL

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

