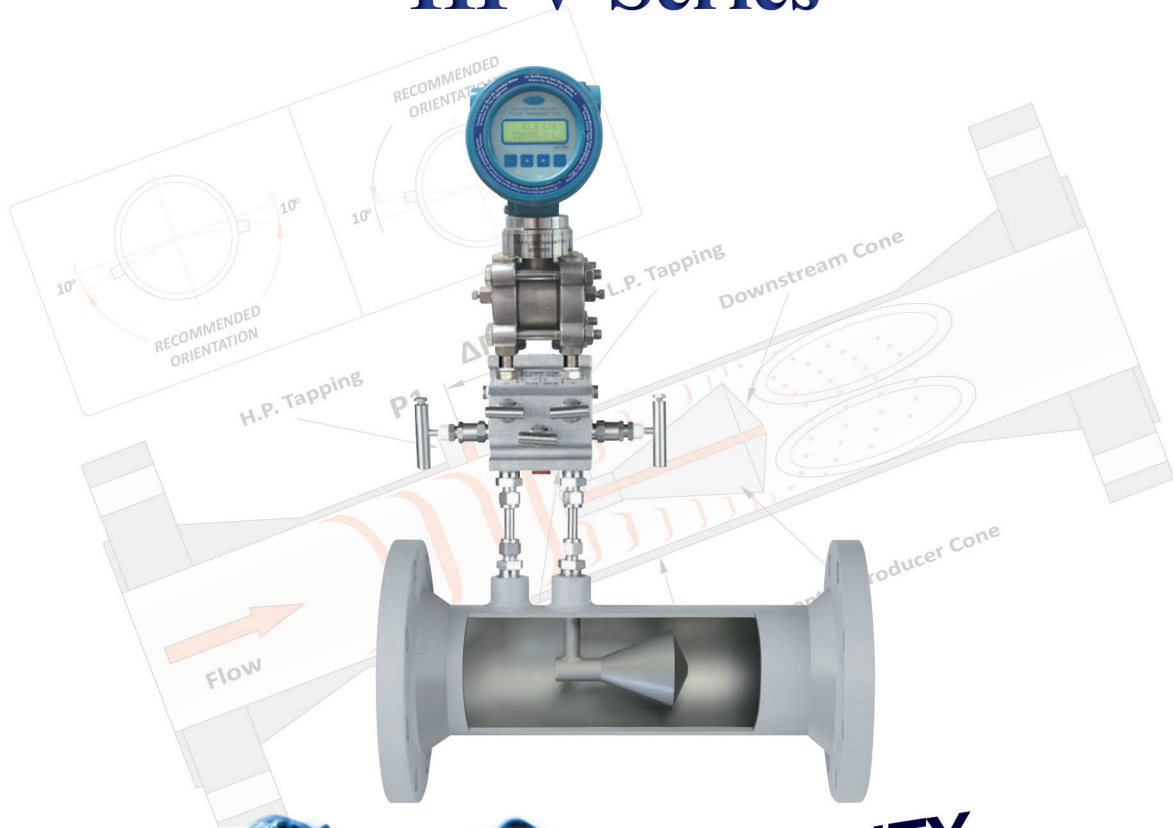


Cone Meter

HFV Series



2 YEARS WARRANTY



ASME



www.hitrol.com



Always The Best Solution
HITROL CO., LTD.

CONE METER

Model : HFV Series

Introduction

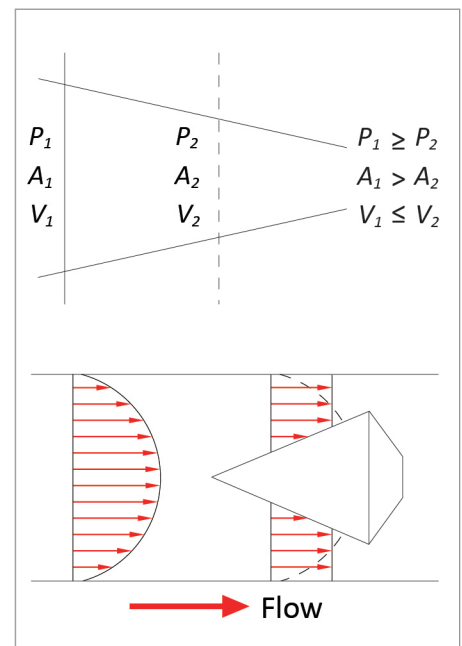
HFV Series is a differential pressure type flow meter which can control the flow rate and measures various fluids, and it provides accurate, repeatable and cost-optimized measurement solution.

HFV Series is designed to work in various process applications and is ideal to apply for a wide range of measurement environments. HFV Series has a unique solution outside the scope of traditional technologies due to the hydrodynamic shape of the cone.



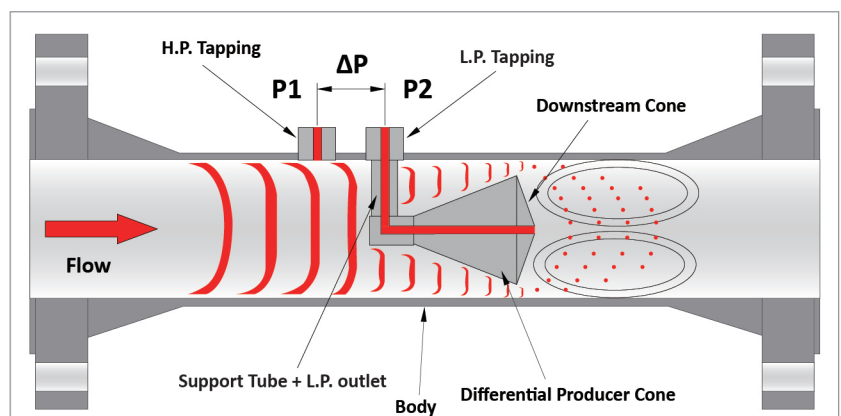
Principle of Differential Pressure Measurement

When a cross section area of a pipe is reduced by a diametric change or by the use of flow element which generates differential pressure, the velocity of fluids passing through the pipe is increased across the boundary change area (Continuity Equation), pressure is decreased (Bernoulli Equation) and a differential pressure is generated across the reduction or producer (A1-A2 shown in the diagram at right).



Differential pressure (ΔP) and flow rate (Q_v) have a proportional relationship such that $Q_v \propto \sqrt{\frac{\Delta P}{\rho}}$. Once differential pressure is measured, flow rate can be determined by this universal relationship.

While this principle is used by other differential pressure flow meters, HFV Series generates a differential pressure by creating an area of reduction using a cone-shaped flow element located on the center line of a pipe section as opposed to a reduced diameter pipe wall or orifice.



Calibration and Discharge Coefficient Determination

All of HFV Series that is manufactured and supplied by Hitrol is calibrated with water at our liquid flow calibration system to determine the Discharge Coefficient (C_d) to verify the performance of the flow meter.



Basic Equations

1.0 Effective Area Ratio (A_t), Velocity of Approach (E) and Beta Ratio (β) are defined as :

$$A_t = \frac{\pi}{4}(D^2 - d^2)$$

$$E = \frac{1}{\sqrt{1 - \beta^4}}$$

$$\beta = \frac{\sqrt{D^2 - d^2}}{D}$$

2.0 Volumetric Flow is defined as :

$$Q_V = C_d A_t E \epsilon \sqrt{\frac{2\Delta P}{\rho}}$$

3.0 Mass Flow is defined as :

$$Q_m = C_d A_t E \epsilon \sqrt{2\rho \times \Delta P}$$

Q_V = Volumetric Flow

Q_m = Mass Flow

C_d = Discharge Coefficient

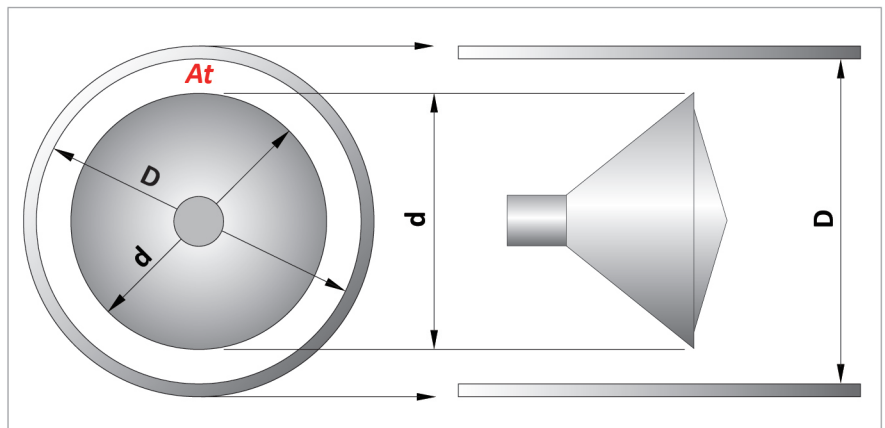
E = Velocity of Approach

A_t = Effective Area Ratio

ϵ = Expansibility Coefficient (gas only)

ρ = Fluid Density

ΔP = Differential Pressure ($P_1 - P_2$)

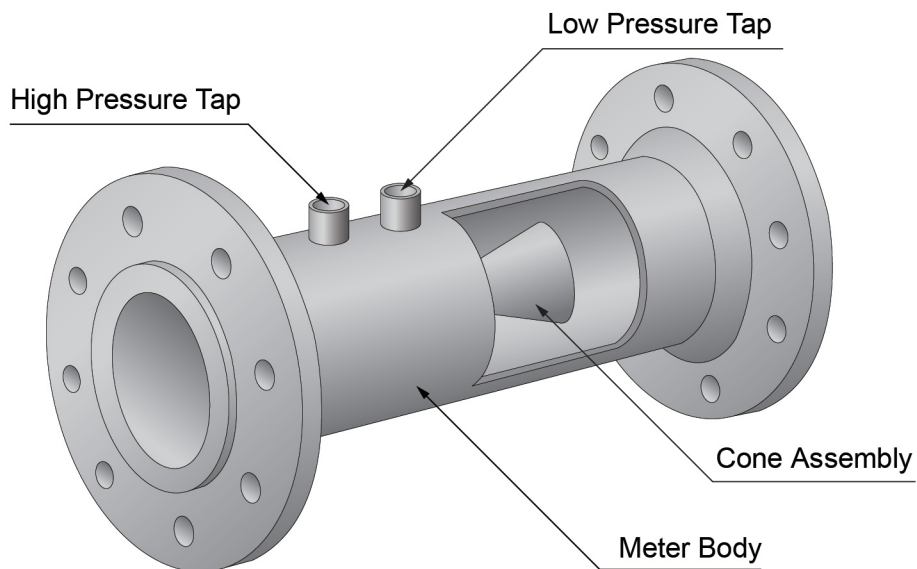
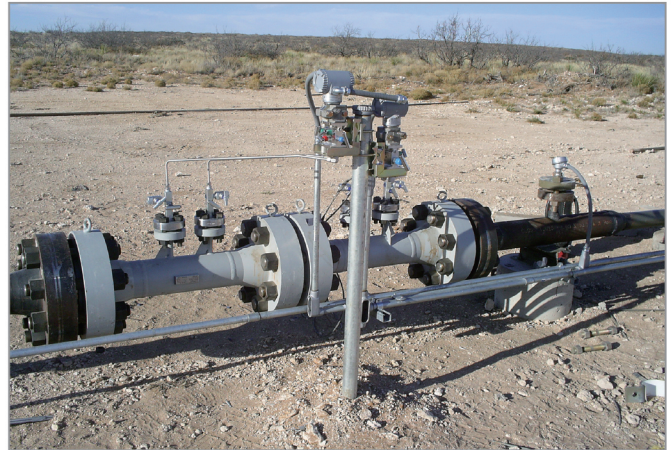


Meter Components

HFV Series is comprised of three primary elements as below.

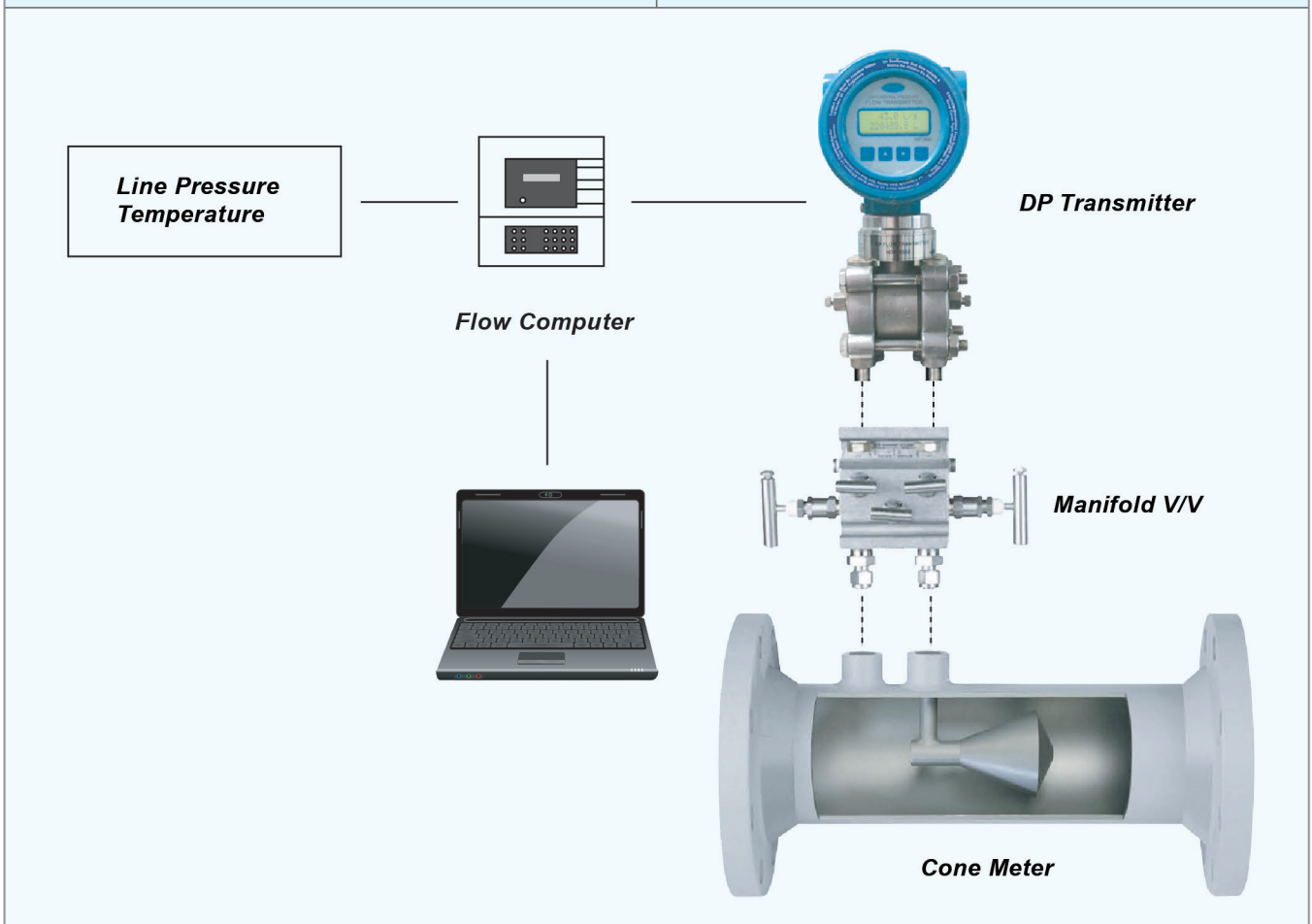
- Meter Body
Flange, screw and welding type
- Cone Assembly
It is produced by the welding of plate or machining of round bar, and is located at the centerline of the cone meter.
- Pressure Taps
Two pressure taps to read a differential pressure, upstream tap is for high pressure and downstream tap connected to the cone is for low pressure.

HFV Series can be manufactured with various materials such as carbon steel, stainless steel, hastelloy and duplex, etc. to meet requirements for the measurement of various fluids such as liquid, gas, steam and oil, etc.

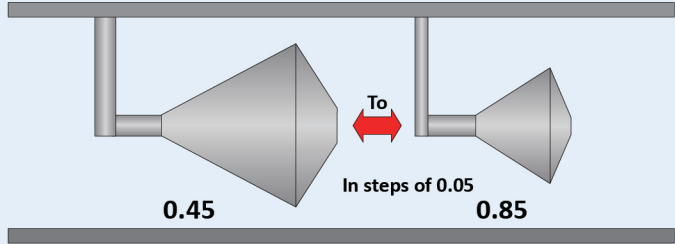


Components of Flow Measurement System

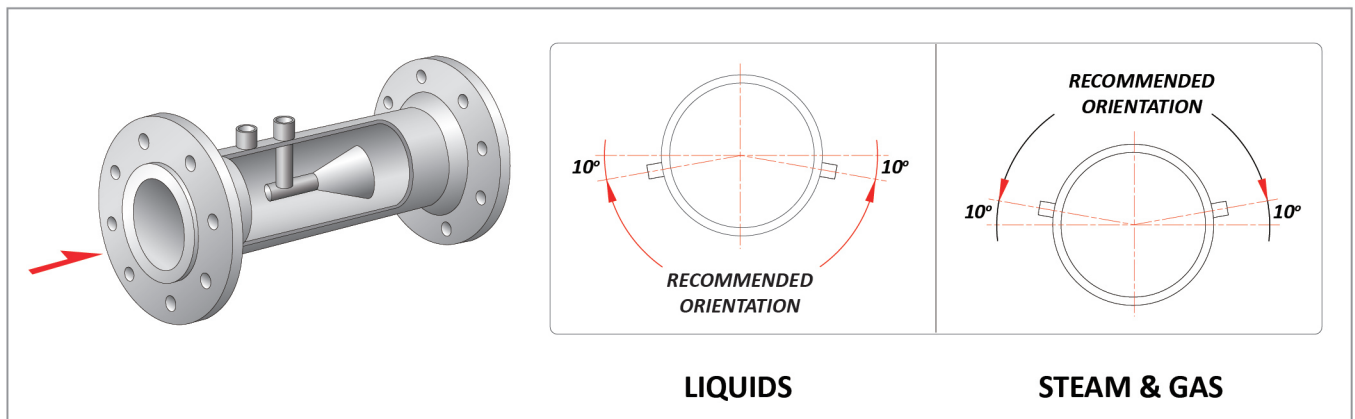
Measurement of incompressible fluids	Measurement of compressible fluids
① Cone Meter	① Cone meter
② 3-way or 5-way manifold valve	② 3-way or 5-way manifold valve
③ Differential pressure transmitter	③ Differential pressure transmitter
④ Flow computer or flow indicator	④ Flow computer or flow indicator
	⑤ Pressure transmitter
	⑥ Temperature sensor (Pt 100Ω) or transmitter



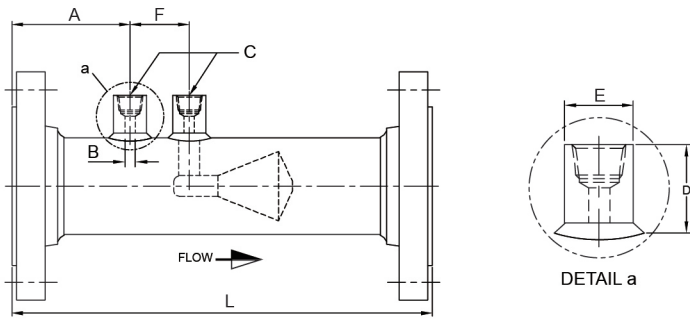
Specification

Operating Conditions	Line Fluid Capability	Liquids, Gas and Steam
	Temperature Rating	Depends on material of construction
	Pressure Rating	From full vacuum to the limits of materials.
Standard Beta Ratio	0.45 through 0.85 	
Installation Piping Requirements	Upstream : 3D, Downstream : 1D	
Materials of Construction Include	304 or 316 Stainless Steel, Duplex 2205, Hastelloy C-276, 254 Carbon Steels. Special materials on request.	
Line Sizes	0.5" to 60" or larger.	
End Fittings	Flanged, threaded, hub or weld-eng. Others on request.	
Standard Accuracy	Between $\pm 0.5\%$ to $\pm 1.0\%$ of full scale.	
Repeatability	$\pm 0.1\%$ or better.	
Rangeability	10:1 and greater.	
Approvals for the Cone Meter	<ul style="list-style-type: none"> ■ Manufactured under a quality management system that is certified to ISO 17025. ■ Meters in compliance with PED97/23/EC are available upon request. 	

Pressure Taps Orientation



Dimension Table

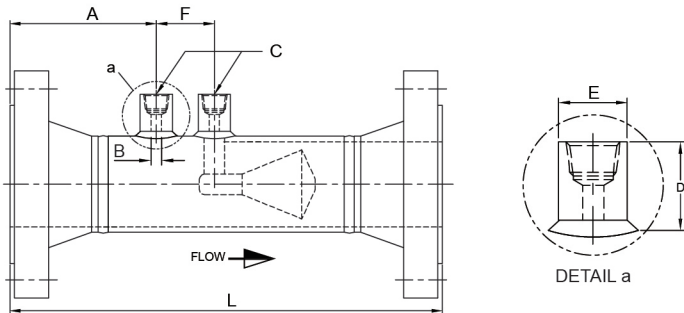


Tolerance

Size	1/2" to 1"	1-1/2" to 10"	12" to 24"
L	±3mm	±5mm	±6.35mm
	±1/8"	±3/16"	±1/4"

CLASS ANSI B16.5 RFSO FLANGE, B31.1 & B31.3 BODY

RATING		150#		300#		400#		600#		900#		1500#		2500#		B(inch)	TAP SIZE					
SIZE		L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)		C(NPT or PT)	D	E		F	
JIS	ANSI																			3000#	6000#	3000#
25A	1"	200	65	205	70	300	120	300	120	320	130	320	130	360	150	1/4"	1/4"	25	ø22	ø30	54	54
40A	1-1/2"	260	75	265	80	320	130	320	130	340	140	340	140	400	170	1/4"	1/4"	25	ø22	ø30	54	54
50A	2"	300	90	300	90	340	130	340	130	400	160	400	160	440	180	3/8"	1/2"	39	ø30	ø38	54	70
65A	2-1/2"	300	90	300	90	360	140	360	140	400	160	400	160	480	200	3/8"	1/2"	39	ø30	ø38	54	70
80A	3"	360	90	370	100	410	140	410	140	430	160	440	170	540	230	3/8"	1/2"	39	ø30	ø38	54	70
100A	4"	400	100	410	110	450	150	460	160	470	170	480	180	600	250	3/8"	1/2"	39	ø30	ø38	54	70
125A	5"	560	110	570	120	610	160	620	170	630	180	660	210	750	300	3/8"	1/2"	39	ø30	ø38	54	70
150A	6"	560	110	570	120	610	160	620	170	650	200	680	230	820	350	3/8"	1/2"	39	ø30	ø38	54	70
200A	8"	660	130	670	140	700	170	720	190	750	220	800	270	950	400	3/8"	1/2"	39	ø30	ø38	54	70
250A	10"	710	130	730	150	760	180	790	210	820	240	890	310	1300	550	3/8"	1/2"	39	ø30	ø38	54	70
300A	12"	760	130	780	150	820	190	840	210	890	260	970	340	1400	570	3/8"	1/2"	39	ø30	ø38	54	70
350A	14"	800	160	820	180	980	240	1000	250	1080	300	1250	390			3/8"	1/2"	39	ø30	ø38	54	70
400A	16"	900	180	920	200	1060	240	1090	270	1150	310	1350	410			3/8"	1/2"	39	ø30	ø38	54	70
450A	18"	1000	200	1020	220	1160	260	1170	270	1250	320	1450	430			3/8"	1/2"	39	ø30	ø38	54	70
500A	20"	1100	200	1120	220	1260	260	1280	280	1340	340	1550	450			3/8"	1/2"	39	ø30	ø38	54	70
600A	24"	1350	200	1370	220	1450	270	1470	290	1570	390	1800	510			3/8"	1/2"	39	ø30	ø38	54	70



Tolerance

Size	1/2" to 1"	1-1/2" to 10"	12" to 24"
L	±3mm	±5mm	±6.35mm
	±1/8"	±3/16"	±1/4"

CLASS ANSI B16.5 RFWN / RTJ WN FLANGE, B31.1 & B31.3 BODY

RATING		150#		300#		400#		600#		900#		1500#		2500#		B(inch)	TAP SIZE					
SIZE		L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)	L(mm)	A(mm)		C(NPT or PT)	D	E		F	
JIS	ANSI																			3000#	6000#	3000#
25A	1"	280	110	290	120	300	120	300	120	320	130	320	130	360	150	1/4"	1/4"	25	ø22	ø30	54	54
40A	1-1/2"	290	120	310	130	320	130	320	130	340	140	340	140	400	170	1/4"	1/4"	25	ø22	ø30	54	54
50A	2"	330	120	340	130	340	130	340	130	400	160	400	160	440	190	3/8"	1/2"	39	ø30	ø38	54	70
65A	2-1/2"	340	130	340	130	360	140	360	140	400	160	400	160	480	200	3/8"	1/2"	39	ø30	ø38	54	70
80A	3"	400	130	410	140	410	140	410	140	430	160	450	180	540	230	3/8"	1/2"	39	ø30	ø38	54	70
100A	4"	430	130	440	140	450	150	460	160	470	170	480	180	600	250	3/8"	1/2"	39	ø30	ø38	54	70
125A	5"	600	150	610	160	610	160	620	170	640	190	660	210	750	300	3/8"	1/2"	39	ø30	ø38	54	70
150A	6"	600	150	610	160	610	160	630	180	650	200	680	230	820	350	3/8"	1/2"	39	ø30	ø38	54	70
200A	8"	690	160	700	170	710	180	720	190	750	220	800	270	950	400	3/8"	1/2"	39	ø30	ø38	54	70
250A	10"	740	160	760	180	760	180	790	210	820	240	900	320	1300	550	3/8"	1/2"	39	ø30	ø38	54	70
300A	12"	800	170	820	190	830	200	840	210	890	260	980	350	1400	570	3/8"	1/2"	39	ø30	ø38	54	70
350A	14"	950	210	970	230	980	240	1000	250	1080	300	1250	390			3/8"	1/2"	39	ø30	ø38	54	70
400A	16"	1030	210	1050	230	1060	240	1090	270	1150	310	1350	410			3/8"	1/2"	39	ø30	ø38	54	70
450A	18"	1130	230	1150	250	1160	260	1170	270	1250	320	1450	430			3/8"	1/2"	39	ø30	ø38	54	70
500A	20"	1230	230	1250	250	1260	260	1280	280	1340	340	1550	450			3/8"	1/2"	39	ø30	ø38	54	70
600A	24"	1420	240	1440	260	1450	270	1470	290	1570	390	1800	510			3/8"	1/2"	39	ø30	ø38	54	70

Measurement Range of Liquid Flow Rate (Reference only)

Model	Differential Pressure	Max. flowrate(m ³ /h)				
	(mmH ₂ O)	β=0.4	β=0.5	β=0.6	β=0.7	β=0.8
HFV-0015	250	0.241	0.384	0.573	0.835	1.237
	5000	1.077	1.715	2.564	3.734	5.533
HFV-0020	250	0.426	0.678	1.013	1.476	2.187
	5000	1.903	3.031	4.530	6.599	9.778
HFV-0025	250	0.677	1.087	1.611	2.347	3.478
	5000	3.027	4.822	7.206	10.498	15.555
HFV-0040	250	1.567	2.496	3.730	5.434	8.051
	5000	7.007	11.162	16.681	24.299	36.007
HFV-0050	250	2.471	3.936	5.883	8.570	12.699
	5000	11.051	17.604	26.309	38.325	56.790
HFV-0065	250	4.146	6.605	9.871	14.279	21.307
	5000	18.543	29.538	44.144	64.305	95.286
HFV-0080	250	5.679	9.046	13.518	19.639	29.180
	5000	25.395	40.453	60.456	88.068	130.499
HFV-0100	250	9.756	15.540	23.225	33.832	50.132
	5000	43.629	69.499	103.865	151.301	224.198
HFV-0150	250	20.796	33.127	49.507	72.118	106.864
	5000	93.002	148.148	221.403	322.522	477.912
HFV-0200	250	35.684	56.842	84.949	123.747	183.368
	5000	159.582	254.207	379.905	553.414	820.048
HFV-0250	250	55.876	89.008	133.021	193.774	287.133
	5000	249.887	398.058	594.888	866.582	1284.100
HFV-0300	250	80.578	128.357	191.826	279.436	414.068
	5000	360.356	574.030	857.873	1249.678	1851.770
HFV-0350	250	99.688	158.798	237.319	345.706	512.267
	5000	445.816	710.164	1061.323	1546.046	2290.927
HFV-0400	250	131.722	209.827	313.581	456.799	676.884
	5000	589.079	938.375	1402.379	2042.867	3027.116
HFV-0500	250	209.159	333.181	497.931	725.344	1074.813
	5000	935.389	1490.031	2226.814	3243.836	4806.708
HFV-0600	250	310.811	495.108	739.926	1077.862	1597.173
	5000	1389.990	2214.189	3309.050	4820.345	7142.776
HFV-0700	250	423.049	673.897	1007.122	1467.090	2173.930
	5000	1891.931	3013.757	4503.985	6561.025	9722.112
HFV-0750	250	485.642	773.606	1156.134	1684.159	2495.583
	5000	2171.859	3459.670	5170.390	7531.789	11160.588
HFV-0800	250	552.553	880.191	1315.424	1916.199	2839.419
	5000	2471.093	3936.335	5882.755	8569.502	12698.269
HFV-0900	250	699.325	1113.992	1664.834	2425.189	3593.640
	5000	3127.477	4981.925	7445.362	10845.776	16071.247

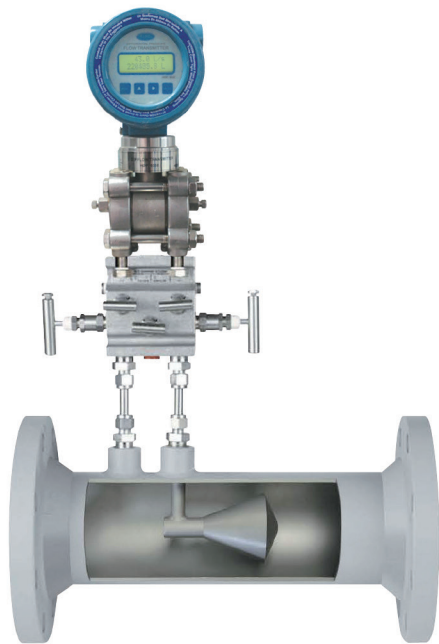
■ Fluid : Water

Measurement Range of Gas Flow Rate (Reference only)

Model	Line Pressure (kgf/cm ²)	Differential Pressure (mmH ₂ O)	Max. flowrate (Nm ³ /h)				
			β=0.4	β=0.5	β=0.6	β=0.7	β=0.8
HFV-0015	0	100	3.68	5.84	8.68	12.51	18.09
	10	1250	35.32	56.08	83.26	119.72	172.49
	20	3000	81.94	130.00	192.72	276.26	395.48
HFV-0020	0	100	6.50	10.32	15.34	22.10	31.96
	10	1250	62.41	99.09	147.13	211.57	304.82
	20	3000	144.80	229.73	340.56	488.20	698.88
HFV-0025	0	100	10.34	16.42	24.41	35.16	50.84
	10	1250	99.28	157.64	234.06	336.56	484.89
	20	3000	230.34	365.45	541.75	776.62	1111.76
HFV-0040	0	100	23.93	38.01	56.49	81.38	117.69
	10	1250	229.80	364.88	541.78	779.06	1122.41
	20	3000	533.18	845.92	1254.02	1797.67	2573.44
HFV-0050	0	100	37.74	59.95	89.10	128.35	185.62
	10	1250	362.44	575.50	854.50	1228.74	1770.27
	20	3000	840.94	1334.20	1977.85	2385.29	4058.84
HFV-0065	0	100	63.33	100.60	149.50	215.36	311.44
	10	1250	608.14	965.61	1433.73	2061.66	2970.28
	20	3000	1410.99	2238.61	3318.58	4757.25	6810.22
HFV-0080	0	100	86.73	137.77	204.75	294.95	426.53
	10	1250	832.87	1322.45	1963.56	2823.53	4067.93
	20	3000	1932.41	3065.87	4544.93	6515.26	9326.88
HFV-0100	0	100	149.00	236.69	351.76	506.72	732.78
	10	1250	1430.87	2271.97	3373.41	4850.85	6988.72
	20	3000	3319.89	5267.18	7808.22	11193.26	16032.64
HFV-0150	0	100	317.61	504.54	749.82	1080.15	1562.04
	10	1250	3050.12	4843.06	7109.94	10340.33	14897.55
	20	3000	7076.85	11227.82	16644.44	23860.16	34156.88
HFV-0200	0	100	544.99	865.74	1286.62	1853.43	2680.29
	10	1250	5233.70	8310.20	12338.91	17742.95	25562.66
	20	3000	12143.15	19265.79	28560.15	40941.58	58609.70
HFV-0250	0	100	853.39	1355.65	2014.70	2902.25	4197.03
	10	1250	8195.37	13012.81	19321.29	27783.40	40028.15
	20	3000	19014.76	30167.98	44721.87	64109.75	91775.96
HFV-0300	0	100	1230.65	1954.95	2905.35	4185.27	6052.43
	10	1250	11818.34	18765.46	27862.78	40065.78	57723.64
	20	3000	27420.73	43504.52	64492.34	92451.15	132347.93
HFV-0350	0	100	1522.51	2418.58	3594.36	5177.83	7487.80
	10	1250	14621.13	23215.79	34470.59	49567.60	71413.13
	20	3000	33923.72	53821.86	79787.06	114376.46	163734.99
HFV-0400	0	100	2011.77	3195.79	4749.41	6841.72	9894.00
	10	1250	19319.62	30676.17	45547.70	65496.13	94361.71
	20	3000	44825.09	71117.50	105426.60	151131.28	216351.15
HFV-0500	0	100	3194.45	5074.54	7541.51	10863.86	15710.52
	10	1250	30677.32	48710.20	72324.46	104000.25	149835.43
	20	3000	71177.03	112926.32	167405.20	239978.93	343540.51
HFV-0600	0	100	4746.96	7540.78	11206.70	16143.71	23345.86
	10	1250	45586.55	72383.44	107474.27	154544.53	222655.70
	20	3000	105769.19	167808.70	248764.40	356609.07	510501.75
HFV-0700	0	100	6461.14	10263.84	15253.57	21973.38	31776.31
	10	1250	62048.36	98521.90	146284.42	210352.28	303059.14
	20	3000	143963.61	228406.29	338595.99	485384.57	694849.61
HFV-0750	0	100	7417.12	11782.47	17510.47	25224.55	36477.91
	10	1250	71228.98	113099.12	167928.54	241475.83	347899.52
	20	3000	165264.35	262201.10	388694.37	557201.67	797658.99
HFV-0800	0	100	8439.04	13405.83	19923.02	28699.93	41503.75
	10	1250	81042.75	12861.67	191065.36	274745.84	395832.35
	20	3000	188034.11	298326.58	442247.82	633971.68	907558.67
HFV-0900	0	100	10680.66	16966.75	25215.08	37394.50	52528.18
	10	1250	102569.73	162862.74	241817.10	355701.53	500975.31
	20	3000	237980.67	377569.58	559719.90	825293.06	1148628.95

■ Standard condition : 1 atm. at 20°C, Air

■ Normal condition : 1 atm. at 0°C, Air



Cone Meter

In order to calculate a differential pressure and design a Cone Meter, below information should be informed.

Tag No.			
Flow Data			
Fluid Name / Fluid State			
Max. / Nor. Flow Rate (m ³ /hr)			
Max. / Nor. Temperature (°C)			
Max. / Nor. Pressure (psia)			
Pipe Inside Diameter (mm)			
Density at Base (kg/m ³)			
Density at Operating (kg/m ³)			
Operating Viscosity (cP)			