

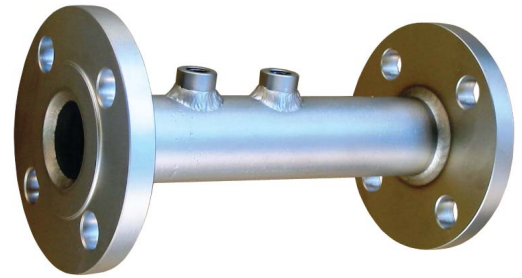
## OUTLINE

V-cone flowmeter containing a V-shape cone is a differential pressure type flowmeter which is designed by the data based on many flow experiments.

V-cone flowmeter has many features, such as self-straightening effect of flow, stable differential pressure output, and no retention of liquid.

## FEATURES

- ❑ Wide application  
V-cone flowmeter can measure almost all process fluids, i.e., liquids, slurries, gases, and steam.
- ❑ Short straight runs  
By the unique flow contraction theory, the required straight runs both for upstream and downstream are less than 1/5 of those required for traditional orifice plates and vortex flowmeters. The narrow installation space allows simple and flexible piping arrangement plan. It leads cost saving for plant design and construction.
- ❑ Stable differential pressure output signal  
The structure which takes out a secondary pressure from the cone central part realizes a stable differential pressure. Stable measurement is assured if the differential pressure across the meter is more than 0.025kPa.
- ❑ Wide rangeability  
Since the differential pressure created by V-cone flowmeter at low flow is stable, it can measure the flow rate in the range of the turn down ratio 10:1 with the standard maximum differential pressure value.
- ❑ Low pressure loss  
Since the differential pressure created by the meter is small, low pressure loss measurement is realized to save total energy consumption in the plants.
- ❑ High reliability  
V shape cone has durable structure against wear or adhesion. Moreover, it is maintenance-free because of structure without a moving part. For a long period of time, reliable flow rate measurement is assured.



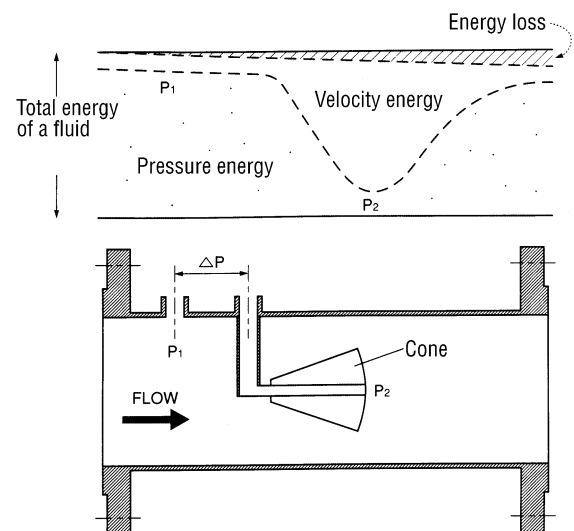
## MEASUREMENT PRINCIPLE

The principle of V-cone flowmeter is the same as that of a common differential pressure type flowmeter, and it is based on the Bernoulli's theorem of the conservation of energy of a fluid.

As shown in Fig.1, if a fluid approaches the V-cone, the fluid has the pressure of P1.

Moreover, when the fluid is restricted with a V type cone and the flow velocity increases in the edge portion, fluid pressure will decrease to P2.

P1 and P2 are measured from the differential pressure extraction taps of V-cone flowmeter, and the differential pressure ( $\Delta P$ ) becomes the output of the meter.



[Fig.1]

The relationship between differential pressure ( $\Delta P$ ) and flow rate (Q) is expressed by the following formula.

$$Q = \frac{3600 \times \pi \times \sqrt{2} \times \beta^2 \times D^2 \times C_d \times \sqrt{\Delta P \times 1000} \times Y}{4 \times \sqrt{\rho} \times \sqrt{(1 - \beta^4)}}$$

- Q : Flow rate [m<sup>3</sup>/h]
- $\beta$  : Beta ratio
- D : Inside diameter of the pipe [m]
- C<sub>d</sub> : Discharge coefficient
- $\Delta P$  : Differential pressure [kPa]
- $\rho$  : Density [kg/m<sup>3</sup>]
- Y : Gas expansion factor  
 $Y = 1 - (0.649 + 0.696 \times \beta^4) \times \Delta P / (k \times P)$
- k : Specific heat ratio
- P : Line pressure [kPa]

**STANDARD SPECIFICATION**

- Connection size  
: 15A (1/2") to 400A (16")
- Materials  
: Stainless steel SS304 (Std.), SS316L
- Process connections  
: Flange
- D.P. tapings  
: Screw connection Rc1/2 or Rc1/4
- Contraction ratio ( $\beta$  ratio)  
: 0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80
- Fluid temperature / Maximum operating pressure It depends on the pressure and temperature rating of flange and its material. (The following table is for reference only.)

Flange rating	JIS 10K			JIS 20K			
	~120	220	300	~120	220	300	400
Fluid temperature (°C)							
Max. operating pressure (MPa)	1.4	1.2	1.0	3.4	3.1	2.9	2.3

- Uncertainty of discharge coefficient :  $\pm 2.0\%$  (Standard)
- Turn down ratio : 10:1 (Standard)
- Reynolds number :  $\geq 8000$
- Differential pressure :  $\geq 0.025\text{kPa}$  (Gas, Liquid)  
:  $\geq 0.05\text{kPa}$  (Steam)

- Required straight runs

[Measurement fluid : Liquids or Gases\*1 or steam\*1 (\*1:  $Re \leq 200,000$ )]

Joints	Upstream side	Downstream side
1pc of 90° bend	0D	0D
2pcs of 90° bends	0D	0D
T joint	0D	0D
Butterfly valve (Flow control valve)	*3	1D
Butterfly valve (Full open)	2D	0D
Gate valve (Full open) / Full port ballvalve (Full open)	0D	0D
Expander (Inner diameter 0.67D → D, Length 2.5D)	2D	1D
Reducer (Inner diameter : 3D → D, Length 3.5D)	0D	0D

\*3 Not Preferred Position

[Measurement fluid : Gases\*2 or steam\*2 (\*2 :  $Re > 200,000$ )]

Joints	Upstream side	Downstream side
1pc of 90° bend	1D	1D
2pcs of 90° bends	1D	1D
T joint	1D	1D
Butterfly valve (Flow control valve)	*3	1D
Butterfly valve (Full open)	2D	1D
Gate valve (Full open) / Full port ballvalve (Full open)	1D	1D
Expander (Inner diameter 0.67D → D, Length 2.5D)	2D	1D
Reducer (Inner diameter : 3D → D, Length 3.5D)	0D	0D

\*3 Not Preferred Position

[NOTES]

- D shows the nominal connection size of V-cone flowmeter.
- The required straight run is the distance from the flange face of V-cone flowmeter.
- When  $\beta$  ratio is 0.70 or more, add 1D to the above-mentioned value.
- Others: The products of non standard specifications are also available. Consult us for details.

**OPTION**

- 1) Differential pressure transmitters  
 FCX-AⅢ FKC type  
 Refer to the technical guidance of FKC differential pressure transmitters for detail specifications.
- 2) Three-way valve manifold  
 Material : SS316

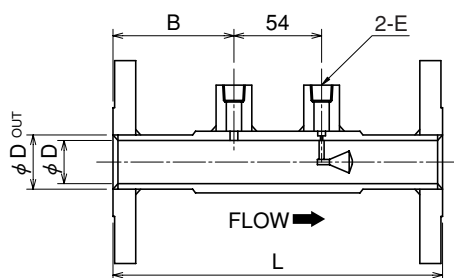
MODEL CODE

VC —					
Connection	1				JIS 10K RF SO Flange
	2				JIS 20K RF SO Flange
	3				ANSI CLASS 150 RF SO Flange
	4				ANSI CLASS 300 RF SO Flange
	9				Others
Material	2				Stainless steel SS304
	3				Stainless steel SS316L
	9				Special
Connection size	01	15A			1/2"
	02	20A			3/4"
	03	25A			1"
	04	40A			1 1/2"
	05	50A			2"
	06	65A			2 1/2"
	08	80A			3"
	10	100A			4"
	13	125A			5"
	15	150A			6"
	20	200A			8"
	25	250A			10"
	30	300A			12"
	35	350A			14"
	40	400A			16"
β ratio	-45	0.45			
	-50	0.50			
	-55	0.55			
	-60	0.60			
	-65	0.65			
	-70	0.70			
	-75	0.75			
	-80	0.80			

DIMENSIONS

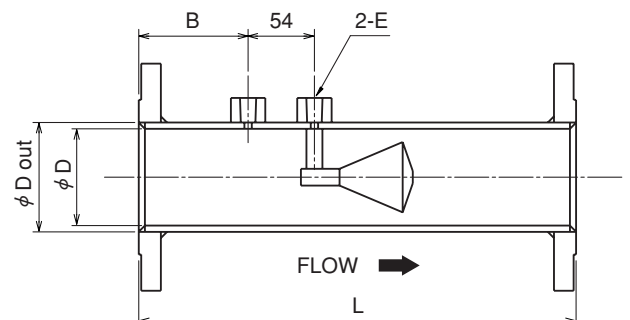
【Fig. A】

15A to 25A  
1/2" to 1"

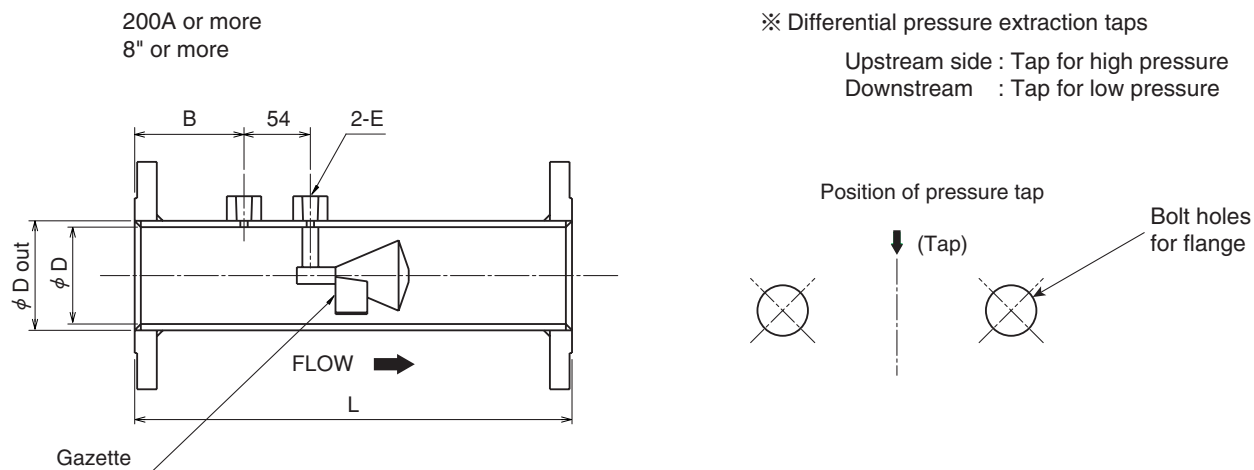


【Fig. B】

40A to 150A  
1 1/2" to 6"



[Fig. C]



Connection size (A)	L (mm)	φ D out (mm)	φ D (mm)	B (mm)	E (Rc)	Fig.	Approx. weight (kg) <sup>※1</sup>
15	203	21.3	15.8	74.5	1/4	A	3
20	203	26.7	20.9	74.5	1/4	A	4
25	203	33.4	26.6	74.5	1/4	A	5
40	254	48.3	40.9	76	1/4	B	7
50	305	60.3	52.5	89	1/2	B	9
65	305	73.0	62.7	89	1/2	B	12
80	356	88.9	77.9	89	1/2	B	13
100	406	114	102	102	1/2	B	18
125	559	141	128	108	1/2	B	32
150	559	168	154	108	1/2	B	36
200	660	219	203	127	1/2	C	65
250	711	273	255	127	1/2	C	79
300	762	324	305	133	1/2	C	98
350	762	356	337	152	1/2	C	112
400	762	406	387	152	1/2	C	137

※ 1 meter with JIS10K RF SO flanges

\* Specification is subject to change without notice.

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