



TECHNICAL GUIDANCE

Integral type Wafer-Cone®
Differential pressure flowmeter

VT Series

Explosionproof

OUTLINE

Wafer-Cone® differential pressure flowmeter and one from a variety of differential pressure transmitters are integrated into one flowmeter. It can measure mass flow rate of liquids, gases, and saturated steam. It also serves in the hazardous area of chemical plants. You can make use of existing transmitters by combining them to the models without transmitters.

FEATURES

□ Simple installation

Wafer connection makes installation simple. Flowmeter body flanges are designed to match the pipe flanges by guiding the flowmeter in the center line by fastening bolts.

□ Short straight runs

The required straight runs are less than 1/5 of those required for orifice and vortex flowmeters. The narrow installation space allows simple and flexible piping arrangement plan. It leads to space and cost saving.

□ Low pressure loss

A proper selection of β ratio allows lower pressure loss than orifice plate with the same flow rate. It improves energy efficiency of the plant.

□ Wide Rangeability

Since the differential pressure created by the meter is stable at low flow rate, it can measure the flow rate with the turn down ratio 14:1 covering guaranteed accuracy. This flowmeter is best suited for the measurement of saturated steam line for air conditioning system whose flow rate is fluctuated at every change-over of cooling and heating and other process lines with flow fluctuation.

□ Wear and adhesion resistant

V shape cone has a durable structure against wear or adhesion. It can measure challenging slurry or flue-gas process lines that ordinary orifice could not deal with.

□ No impulse piping work required

Direct mounting of a compact differential transmitter requires no impulse piping to save installation cost.

□ 3-way stopcock installed

By operating its handle a newly developed 3-way stopcock can switch isolation, equalizing or measuring mode. This stopcock prevents mechanically such wrong operations as running off seal liquid in the impulse piping and over-pressurizing to the one side of differential transmitter which might occur with the traditional three way manifold.

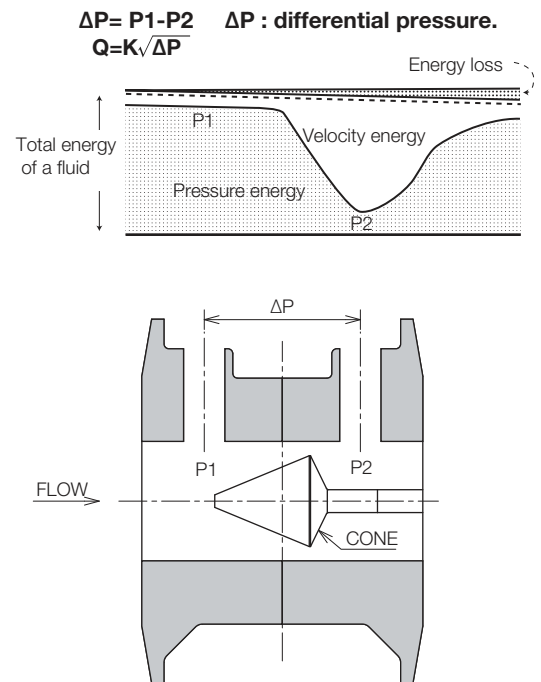
□ Available in all direction

Either vertical or horizontal lines with short straight runs and easy to install.



MEASURING PRINCIPLE

The principle of Wafer-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 a fluid energy. As shown in Fig.1, the pressure P_1 at the approaching point to V shaped cone decreases to P_2 at the edge point with increasing fluid velocity by throttling the flow path along the contoured shape of V-Cone. Flow rate (Q) can be measured by calculating the difference of the two pressures (ΔP):



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STANDARD SPECIFICATION

- Meter size 25, 40, 50, 65, 80, 100 mm
1, 1-1/2, 2, 2-1/2, 3, 4 inch
- Connection Wafer type
- Rating JIS10K, 20K
ANSI Class150, 300
DIN PN16, 40
GB PN1.6, 4.0
- Connection size Same as meter size
- Materials Wet part metal SUS316 (SCS14A)
Gasket PTFE and Fluorocarbon rubber
Ethylene propylene rubber is also available.
- Measuring fluid Liquids, Gases, Saturated steam
- Fluid pressure and temperature

Fluids	Liquids	Gases	Saturated steam
Pressure	0 MPa to 2 MPa	0 MPa to 1 MPa	0 MPa to 1.6 MPa
Temperature	-20°C to 120°C	-20°C to 120°C	Max. 204.3°C

- Ambient temperature -20°C to +60°C
- Measuring range Liquids : up to 10 m/s
Gases : up to 80 m/s
Saturated steam : up to 80 m/s
- Low cutoff 0% as standard or selectable from 4, 5, 7 %.
Except for VTG series (without differential pressure transmitters)
- Flow direction Horizontal or vertical (left to right, right to left, bottom to top, top to bottom)
- Required straight runs
[Measuring fluid : Liquids, both Gases and Saturated steam with Reynolds No. < 200,000]

Type of joints	Upstream	Downstream
1 piece of 90° bend	0 D	0 D
2 pieces of 90° bend	0 D	0 D
T joint	0 D	0 D
Butterfly valve (Flow control valve)	3 D	3 D
Butterfly valve (Fully open)	3 D	0 D
Gate valve (Fully open)	0 D	0 D
Expander (Diameter 0.67 D expands to 1 D, length 2.5 D)	1 D	1 D
Reducer (Diameter 3 D reduces to 1 D, length 3.5 D)	1 D	1 D

[Measuring fluid :Both Gases and Saturated steam with Reynolds No. >200,000]

Type of joints	Upstream	Downstream
1 piece of 90° bend	1 D	1 D
2 pieces of 90° bend	1 D	1 D
T joint	1 D	1 D
Butterfly valve (Flow control valve)	10 D	5 D
Butterfly valve (Fully open)	5 D	3 D
Gate valve (Fully open)	1 D	1 D
Expander (Diameter 0.67 D expands to 1 D, length 2.5 D)	2 D	2 D
Reducer (Diameter 3 D reduces to 1 D, length 3.5 D)	1 D	1 D

[Notes]

- D shows the nominal size of V-Cone® flowmeter.
- The required straight runs are the distance from the flange faces of V-Cone® flowmeter.
- Add 1 D to the above mentioned figures for the service β ratio is 0.65 or more.

• VTF Series

FCX-A IV (Model FKC) differential pressure transmitter made by Fuji Electric Co. is installed in this series.

- Power supply : 16.1 to 45 VDC
- Output : 2 wire 4-20 mADC
- Load resistance : 250 Ω to 1.2 kΩ
- Flow rate display : 5 digits LCD with measuring unit
- Accuracy of flow output : ±1.0 to 1.5%(F.S.)
- Enclosure : Protected against water immersion JIS C 0920 (IEC IP66, Equivalent to NEMA 6/6P)
- Explosionproof : JPEX Ex db IIC T4 Gb
- Cable entry : G1/2
Use explosionproof packing type cable gland for T11S flameproof with cable diameter 11 mm.
- Sealing liquids : Silicone oil as standard
- Terminals : M 3.5 thread
- Painting : Polyester resin, Color silver for case and blue for cover

• VTG Series

Transmitters are not provided; please use your own ones.

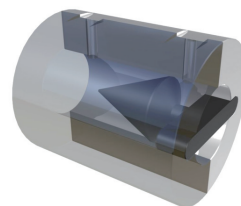
- Connecting differential pressure taps
When connecting to oval flanges :
PTFE gaskets are attached
When connecting by screw :
Select thread requirements from the attached oval flange code, with PTFE gaskets and SUS304 bolts.
- Differential pressure output accuracy
Uncertainty of discharge coefficient ±1.0% standard
Turndown ration 10:1 standard
Reynolds No. ≥ 8000, Differential pressure ≥ 0.025kPa
- When 3-way stopcock provided
Fluid temperature depends on that of the 3-way stopcock.
Do not introduce steam into the 3-way stopcock.
Liquid temperature in the table below is applied to sealing liquids.

	Liquid	Gas
Temperature	-20°C to 60°C	-20°C to 60°C

SIZING

If meter size and fluid properties are given, the β ratio can be selected by the VT series Wafer-Cone® sizing program which presents a solution to meet your requirements for selection of the most suitable sizing and model.

You can check the accuracy and measuring range of your services using this program.



Configuration of Wafer-Cone® detector

MAXIMUM FLOW RANGE

- Maximum flow range when measuring 20°C water

Meter size and connection size			Maximum flow rate [m ³ /h]	
25A	1"	DN25	Min.	5.51
			Max.	7.50
40A	1-1/2"	DN40	Min.	8.62
			Max.	19.03
50A	2"	DN50	Min.	11.24
			Max.	31.10
65A	2-1/2"	DN65	Min.	13.42
			Max.	42.64
80A	3"	DN80	Min.	16.71
			Max.	68.79
100A	4"	DN100	Min.	22.15
			Max.	119.73

- Each table shows the maximum measurable flow range at each size and pressure. Please check the maximum flow rate is within the minimum and maximum flow rate.
- When pressure and temperature compensation is required for gas measurement and saturated steam or checking detail flow range and accuracy is required, use the VT series Wafer-Cone® sizing program.

- Maximum flow range when measuring 0°C air with gage pressure

Meter size and connection size			Maximum flow rate [m ³ /h (nor.)]											
			Fluid pressure [MPa]	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.99
25A	1"	DN25	Min.	77	108	108	108	108	108	108	108	108	108	108
			Max.	99	198	296	381	430	475	515	553	588	621	649
40A	1-1/2"	DN40	Min.	120	168	168	168	181	169	168	178	189	200	208
			Max.	252	502	753	969	1094	1206	1309	1404	1493	1578	1650
50A	2"	DN50	Min.	155	217	217	217	230	252	272	291	309	326	340
			Max.	412	821	1231	1585	1788	1971	2139	2295	2441	2579	2697
65A	2-1/2"	DN65	Min.	186	261	260	301	337	369	399	427	453	478	499
			Max.	565	1126	1688	2173	2452	2703	2933	3147	3347	3536	3698
80A	3"	DN80	Min.	232	328	403	466	522	572	619	662	702	740	773
			Max.	912	1818	2724	3505	3956	4361	4732	5077	5400	5705	5966
100A	4"	DN100	Min.	308	570	701	811	908	996	1076	1151	1222	1288	1346
			Max.	1587	3164	4742	6102	6886	7591	8238	8837	9400	9930	10385

- Maximum flow range when measuring saturated steam with gage pressure

Meter size and connection size			Maximum flow rate [kg/h]											
			Fluid pressure [MPa]	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6
			Density [kg/m ³]	1.136	1.658	2.170	2.676	3.176	3.674	4.662	5.644	6.623	7.602	8.581
25A	1"	DN25	Min.	103	107	110	112	114	116	120	122	126	127	128
			Max.	151	250	329	369	404	437	496	548	595	639	680
40A	1-1/2"	DN40	Min.	161	167	172	176	187	202	228	251	272	292	310
			Max.	384	635	836	937	1028	1112	1261	1393	1513	1625	1729
50A	2"	DN50	Min.	223	219	252	280	306	330	372	410	444	476	506
			Max.	628	1027	1351	1515	1662	1798	2038	2252	2446	2626	2794
65A	2-1/2"	DN65	Min.	263	321	369	411	449	484	546	601	652	699	743
			Max.	862	1359	1788	2005	2199	2379	2697	2979	3237	3475	3698
80A	3"	DN80	Min.	407	497	572	637	695	749	846	932	1010	1083	1151
			Max.	1391	2231	2935	3292	3611	3905	4428	4892	5314	5705	6071
100A	4"	DN100	Min.	708	865	995	1108	1210	1304	1472	1621	1758	1884	2003
			Max.	2421	3952	5199	5831	6396	6918	7843	8665	9413	10106	10754

MODEL CODE

MODEL CODE													CONTENTS			
VT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Differential pressure transmitter installed	G												No transmitter*1			
	F												FCX-A IV differential pressure transmitter installed*2			
Explosionproof	A												General purposes (Non explosionproof)			
	B												Flameproof by TIIS			
3-way stopcock	W												With			
	N												Without Only applied when no transmitter is installed.			
Oil free treatment	G												Not required			
	D												Required			
Material of detector													- 1 SUS316 or SCS14A			
Meter size and connection size													3	25A	1"	DN25
													4	40A	1-1/2"	DN40
													5	50A	2"	DN50
													6	65A	2-1/2"	DN65
													7	80A	3"	DN80
													8	100A	4"	DN100
Connection rating													J 1	JIS 10K		
													J 2	JIS 20K		
													A 2	ANSI Class 150		
													A 5	ANSI Class 300		
													G 1	GB PN1.6		
													G 4	GB PN4.0		
													D 1	DIN PN16		
													D 4	DIN PN40		
Ratio of orifice (β ratio) of detector													- 4 5	0.45		
													- 5 0	0.50		
													- 5 5	0.55		
													- 6 0	0.60		
													- 6 5	0.65		
													- 7 0	0.70		
													- 7 5	0.75		
													- 8 0	0.80		
Flow direction													- 1	Bottom to top (Vertical type)		
													- 6	Left to right (Horizontal type)		
													- 7	Right to left (Horizontal type)		
													- 8	Top to bottom (Vertical type)		
Range of differential pressure transmitter													0 0	No transmitter installed with the code "G" above		
													3 2	32 kPa*5		
Measuring fluids													L	Liquids		
													G	Gases		
													S	Saturated steam		
Attached oval flanges, applicable when transmitter is not required*1													- N N	With oval flanges without thread, with gaskets		
													- R 2	With oval flanges Rc1/2 thread, gaskets, bolts		
													- R 4	With oval flanges Rc1/4 thread, gaskets, bolts		
													- N 2	With oval flanges 1/2 NPT thread, gaskets, bolts		
													- N 4	With oval flanges 1/4 NPT thread, gaskets, bolts		
Other accessories (special order)*7													- Z	Add other accessories not mentioned above following		

*1 Applicable when no transmitter is installed. In this case select one of the code numbers of the attached oval flanges.

*2 FCX-A IV differential pressure transmitter is made by Fuji Electric Co. Ltd.

*5 Applicable for FCX-A IV differential pressure transmitter.

*7 Specify "EPDM" as other accessories (special order) when using ethylene propylene rubber for the O-ring of a 3-way stopcock (standard material is FPM).

STUD BOLT SIZE

Following sizes of stud bolts for mounting are recommended.

Connection rating			JIS		ANSI		DIN		GB	
			10K (mm)	20K (mm)	Class150 (inch)	Class300 (inch)	PN16 (mm)	PN40 (mm)	PN1.6 (mm)	PN4.0 (mm)
25A	1"	DN25	M16×130	M16×140	1/2×5	5/8×5-1/4	M12×130	M12×130	M12×130	M12×130
40A	1-1/2"	DN40	M16×160	M16×160	1/2×6	3/4×6-3/4	M16×160	M16×160	M16×160	M16×160
50A	2"	DN50	M16×170	M16×170	1/2×6-1/2	5/8×6-3/4	M16×170	M16×170	M16×170	M16×170
65A	2-1/2"	DN65	M16×190	M16×190	5/8×7-1/2	3/4×8	M16×190	M16×190	M16×190	M16×190
80A	3"	DN80	M16×210	M20×220	5/8×8-1/4	3/4×9	M16×210	M16×220	M16×210	M16×220
100A	4"	DN100	M16×240	M20×260	5/8×9-1/2	3/4×10-1/2	M16×240	M20×260	M16×240	M20×260

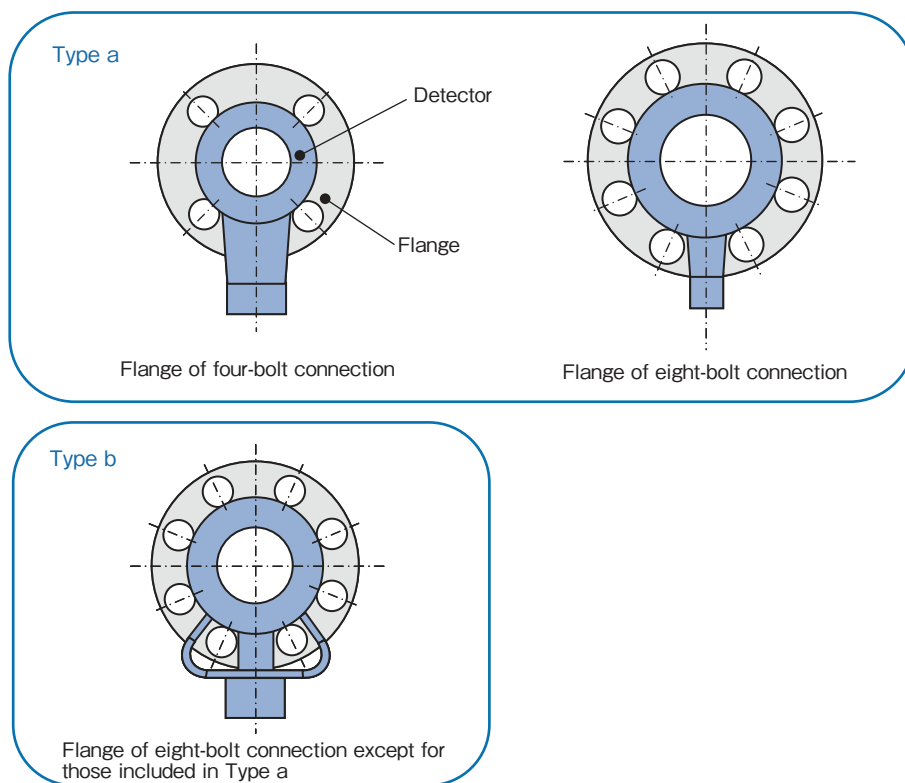
DIMENSIONS

Dimensions are given separately for detectors with Type a and Type b connections.

Type a: All flanges of four-bolt connection and some flanges of eight-bolt connection

Type b: All flanges of eight-bolt connection except for those included in Type a

The figures below show Type a and Type b connections. For details, see the Table of Connection Type for Each Detector.



CONNECTION TYPE FOR EACH DETECTOR

Determine a detector type depending on the connection size and rating.

Connection rating			JIS 10K	JIS 20K	ANSI Class 150	ANSI Class 300	GB PN 1.6	GB PN 4.0	DIN PN 16	DIN PN 40
25 A	1"	DN25	a-4	a-4	a-4	a-4	a-4	a-4	a-4	a-4
40 A	1-1/2"	DN40	a-4	a-4	a-4	a-4	a-4	a-4	a-4	a-4
50 A	2"	DN50	a-4	b-8	a-4	b-8	a-4	a-8	a-4	a-4
65 A	2-1/2"	DN65	a-4	b-8	a-4	b-8	a-4	b-8	a-4	b-8
80 A	3"	DN80	b-8	b-8	a-4	b-8	b-8	b-8	b-8	b-8
100 A	4"	DN100	a-8	a-8	a-8	a-8	a-8	a-8	a-8	a-8

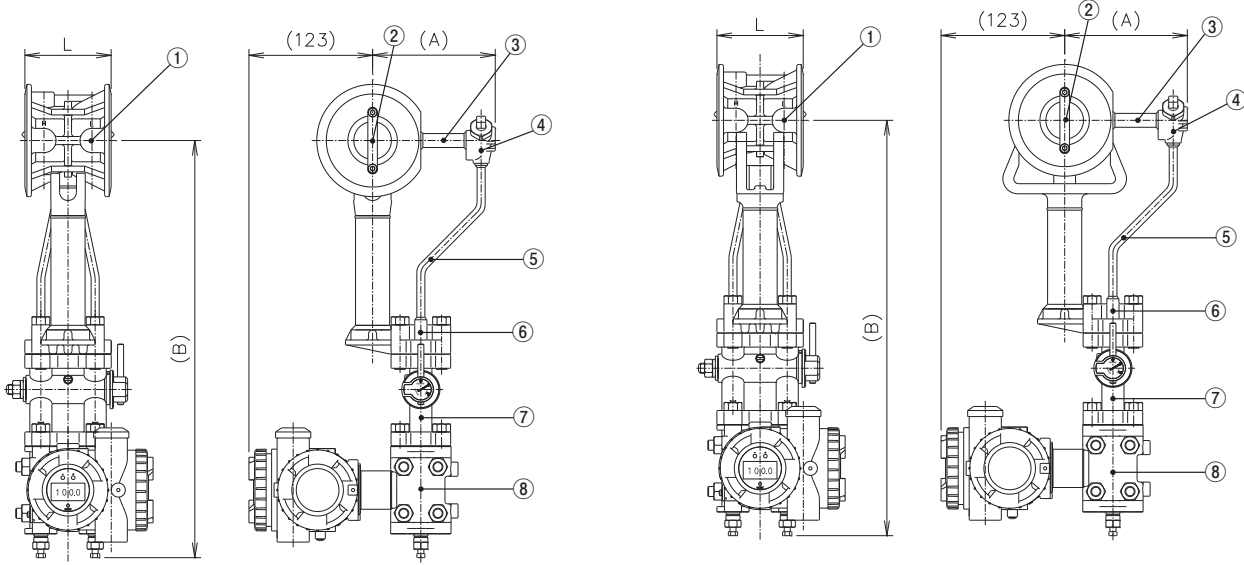
DIMENSIONS (horizontal type VTF)

(with the FCX-A IV differential pressure transmitter)

Dimensions are given separately for detectors with Type a and Type b connections.
For details, see the Table of Connection Type for Each Detector on page 5.

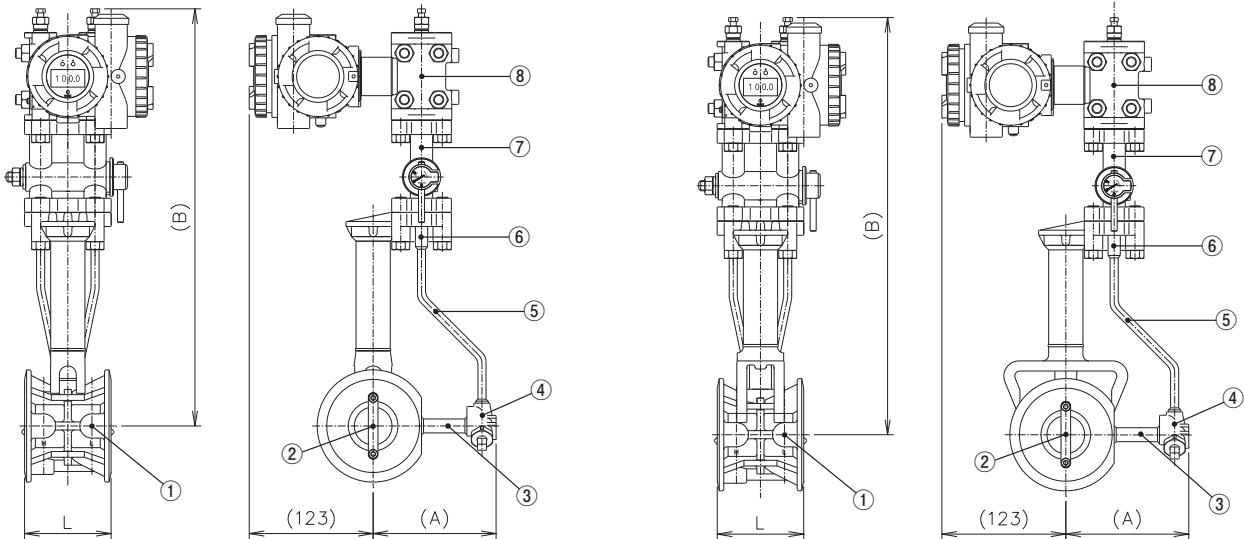
For liquid (Type a)

For liquid (Type b)



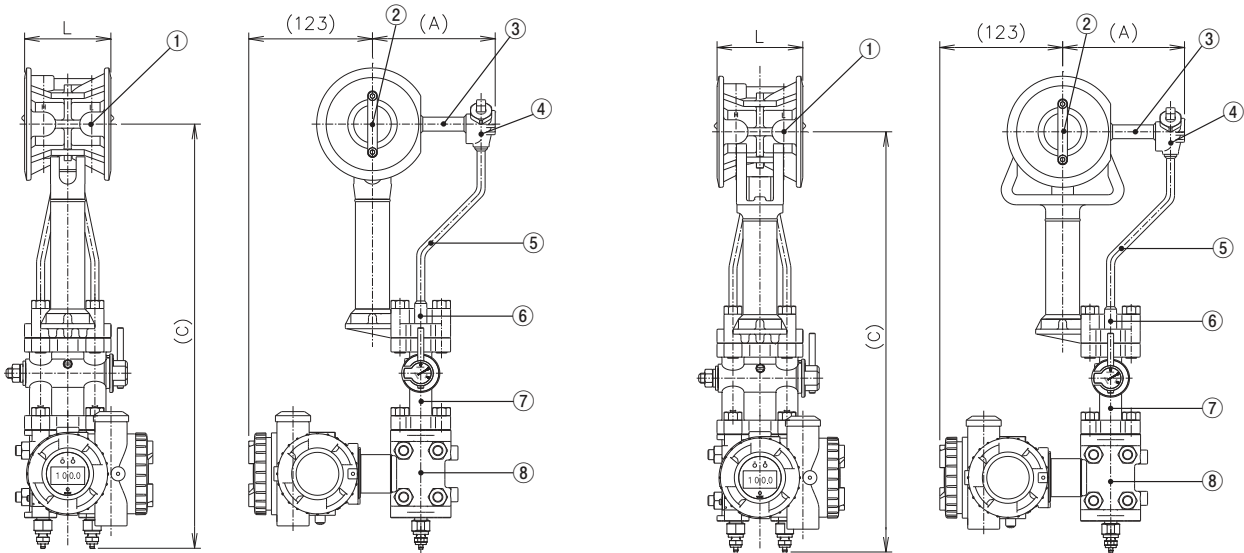
For gas (Type a)

For gas (Type b)



For saturated steam (Type a)

For saturated steam (Type b)



• Dimensions

Meter size (mm)	L (mm)	A (mm)	B (mm)	C (mm)	Mass (kg)
25	57	107	382	393	7.4
40	76	117	392	403	8.5
50	86	122	402	413	9.0
65	102	134	422	433	11.0
80	121	149	442	453	13.2
100	152	167	462	473	18.5

• Material

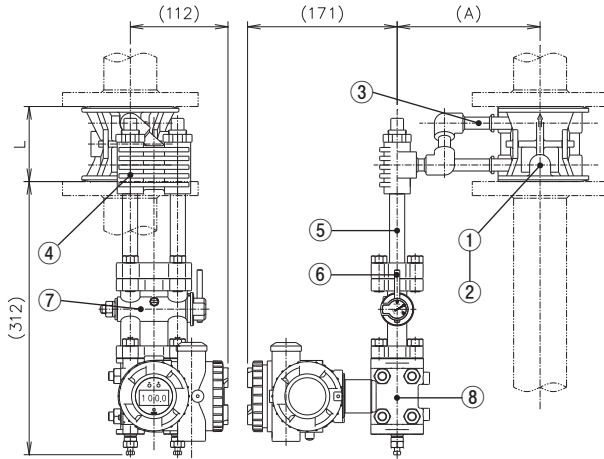
Item	Part name	Material
1	Body	SCS14A
2	Cone	SUS316
3	Impulse line horizontal	SUS316
4	Y-Connector	SCS14A
5	Impulse line vertical	SUS316
6	Oval flange body	SCS14A
	Oval flange gasket	PTFE
7	3-way stopcock	Body: SCS14A O-ring: Fluorocarbon rubber * Ethylene propylene rubber
	Oval flange gasket	PTFE
8	Differential pressure transmitter	FCX-A IV

*Available by special order

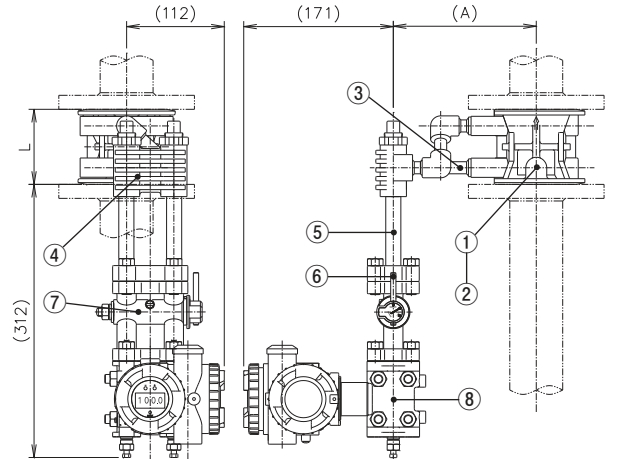
DIMENSIONS (vertical type VTF)

Dimensions are given separately for detectors with Type a and Type b connections. For details, see the Table of Connection Type for Each Detector on page 5.

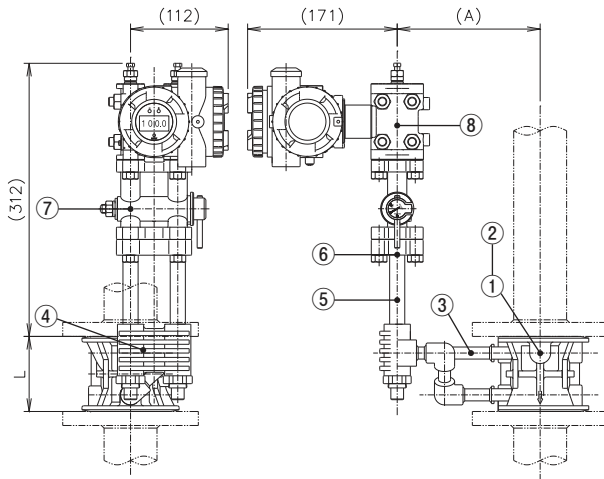
For liquid (Type a)



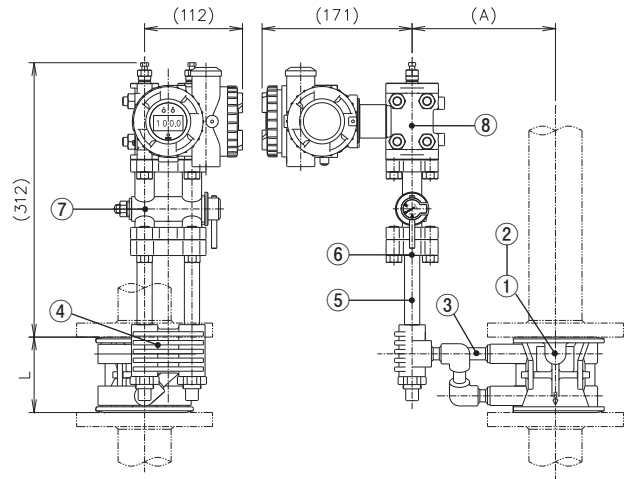
For liquid (Type b)



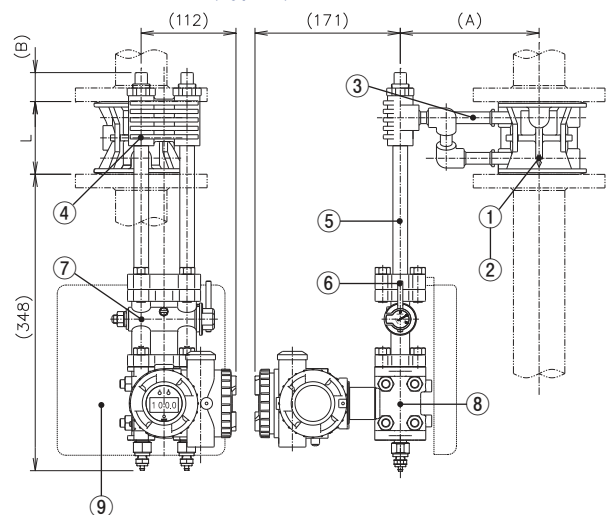
For gas (Type a)



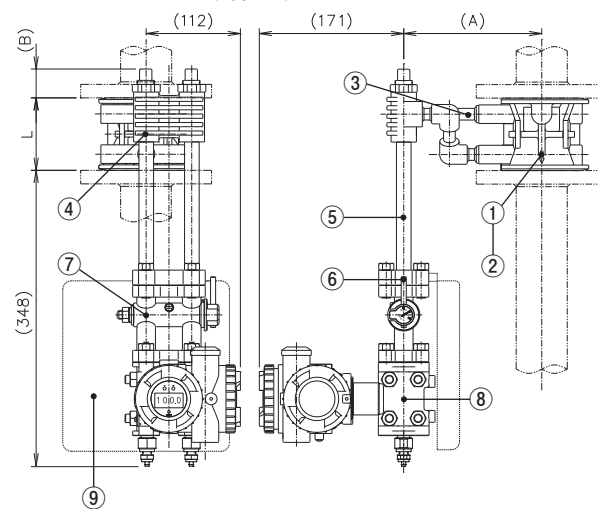
For gas (Type b)



For saturated steam (Type a)



For saturated steam (Type b)



• Dimensions

Meter size (mm)	L (mm)	A (mm)	B (mm)	Mass (kg)
25	57	143	(41)	7.9
40	76	159	(37)	8.7
50	86	164	(35)	9.4
65	102	176	(35)	11.4
80	121	186	(28)	13.7
100	152	209	(22)	18.9

• Materials

Item	Part name	Material
1	Body	SCS14A
2	Cone	SUS316
3	Impulse line horizontal	SUS316
4	H-Connector	SCS14A
5	Impulse line vertical	SUS316
6	Oval flange body	SCS14A
	Oval flange gasket	PTFE
7	3-way stopcock	Body: SCS14A O-ring: Fluorocarbon rubber * Ethylene propylene rubber Oval flange gasket: PTFE
8	Differential pressure transmitter	FCX-A IV
9	Heat insulation plate	SUS304/V6500

*Available by special order

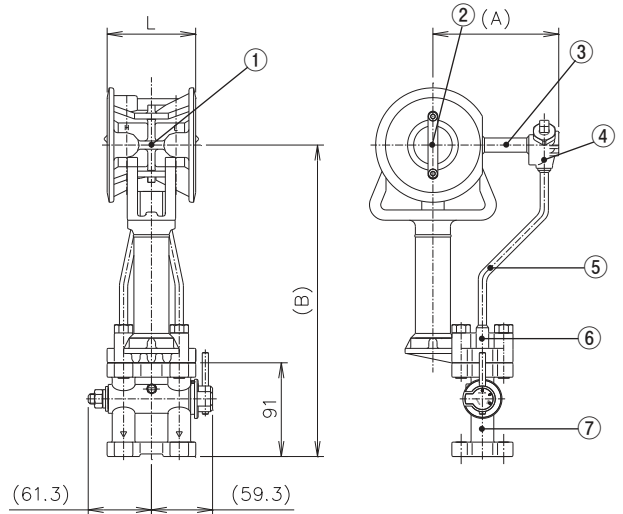
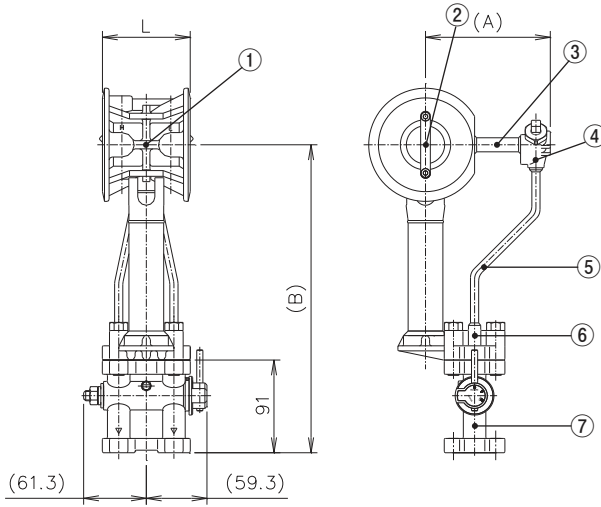
DIMENSIONS (horizontal type VTG)

(No differential pressure transmitter installed)

Dimensions are given separately for detectors with Type a and Type b connections.
For details, see the Table of Connection Type for Each Detector on page 5.

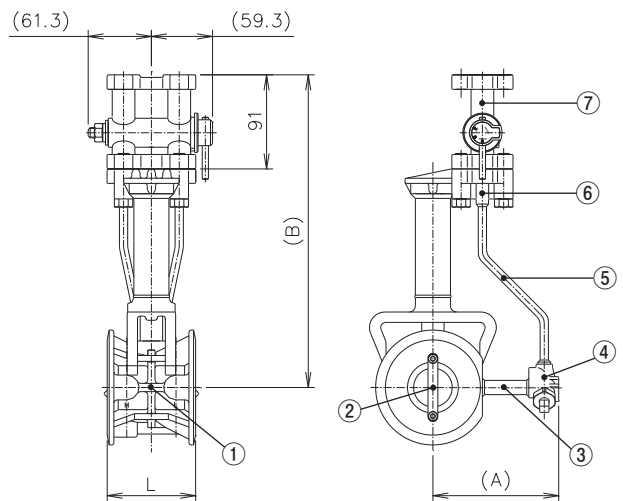
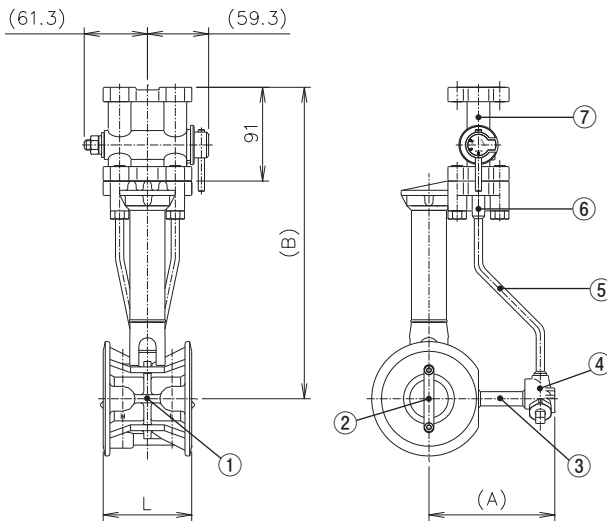
For liquid and saturated steam (Type a)

For liquid and saturated steam (Type b)



For gas (Type a)

For gas (Type b)



• Dimensions

Meter size (mm)	L (mm)	A (mm)	B (mm)	Mass (kg)
25	57	107	271	3.5
40	76	117	281	4.6
50	86	122	291	5.1
65	102	134	311	7.1
80	121	149	331	9.3
100	152	167	351	14.6

• Material

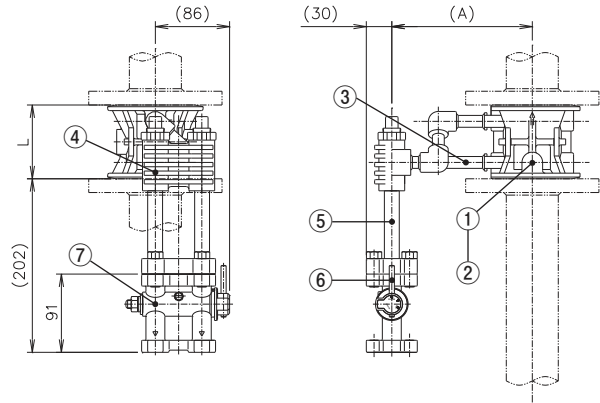
Item	Part name	Material
1	Body	SCS14A
	Cone	SUS316
2	Impulse line horizontal	SUS316
	Impulse line vertical	SUS316
3	Y-Connector	SCS14A
	Oval flange body	SCS14A
4	Oval flange gasket	PTFE
	Body	SCS14A
5	O-ring	Fluorocarbon rubber * Ethylene propylene rubber
	Oval flange gasket	PTFE

*Available by special order

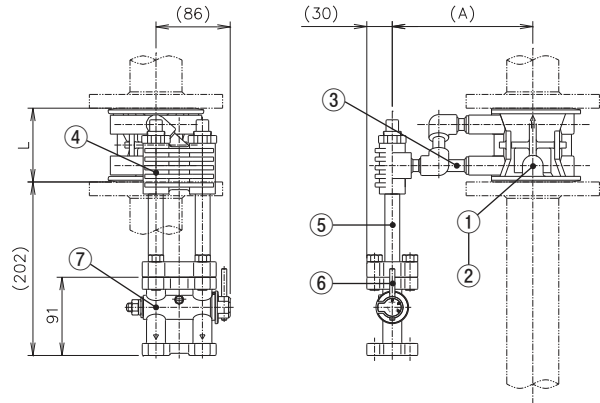
DIMENSIONS (vertical type VTG)

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 For details, see the Table of Connection Type for Each Detector on page 5.

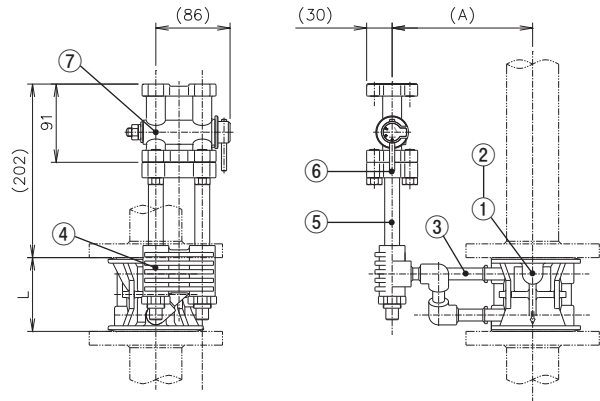
For liquid (Type a)



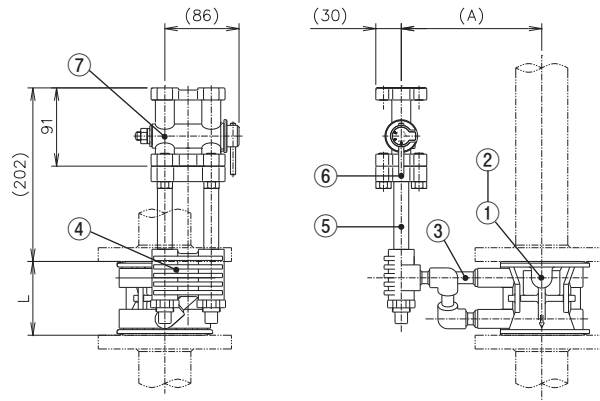
For liquid (Type b)



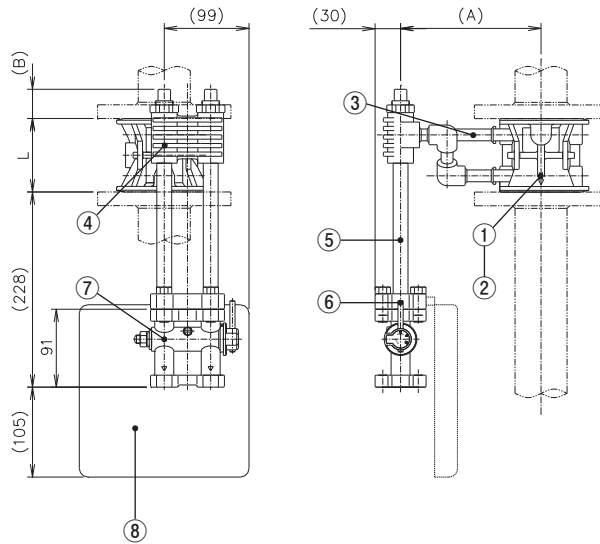
For gas (Type a)



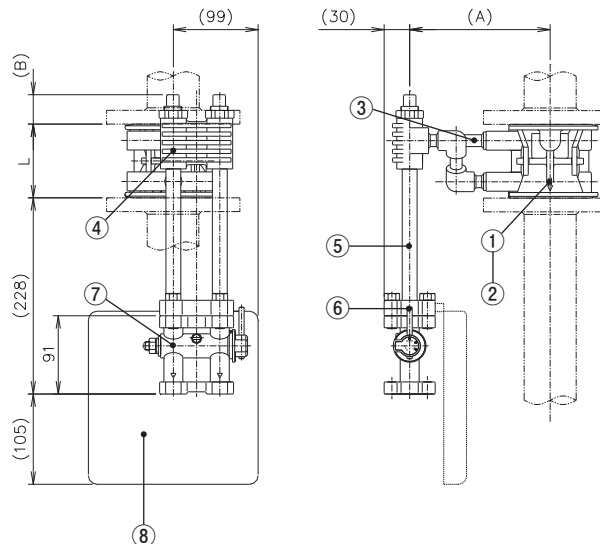
For gas (Type b)



For saturated steam (Type a)



For saturated steam (Type b)



• Dimensions

Meter size (mm)	L (mm)	A (mm)	B (mm)	Mass (kg)
25	57	143	(41)	3.9
40	76	159	(37)	4.7
50	86	164	(35)	5.4
65	102	176	(35)	7.4
80	121	186	(28)	9.7
100	152	209	(22)	14.9

PIPING PITCH

When mounting multiple units on adjacent pipes, allow sufficient spacing between them.

	Adjacent to a pipe of up to 65A	Adjacent to a pipe of 80A or larger
Horizontal type	300 mm	400 mm
Vertical type	250 mm	300 mm

• Materials

Item	Part name	Material
1	Body	SCS14A
2	Cone	SUS316
3	Impulse line horizontal	SUS316
4	H-Connector	SCS14A
5	Impulse line vertical	SUS316
6	Oval flange body	SCS14A
	Oval flange gasket	PTFE
7	Body	SCS14A
	O-ring	Fluorocarbon rubber * Ethylene propylene rubber
	Oval flange gasket	PTFE
8	Heat insulation plate	SUS304/V6500

*Available by special order

HOW TO CONNECT A TRANSMITTER WITH THE VTG SERIES

• Mounting a transmitter directly

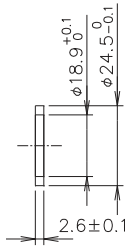
Use a gasket for the oval flange of the detector or a gasket for the 3-way stopcock to connect a transmitter directly with the flowmeter. Mounting bolts (UNF7/16) are not provided.

• Mounting a transmitter via an impulse line

Attach the oval flange to the flowmeter. Fasten an impulse line to the oval flange with screws. Connect a transmitter to the impulse line.

Dimensions of gasket for the supplied oval flanges

Material: PTFE

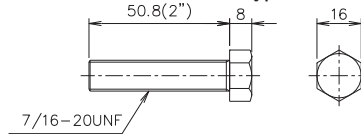


* Use 7/16-20UNF bolts with an appropriate length for the size of the transmitter and three-way manifold used.

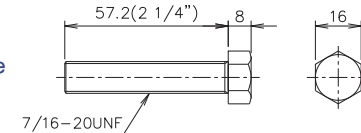
Dimensions of the supplied bolts

Material: SUS304

For the vertical type



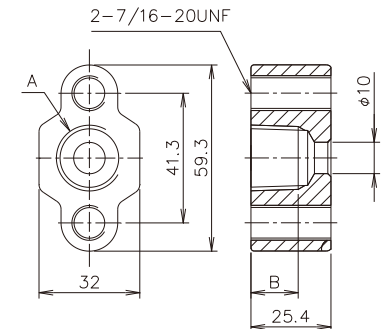
For the horizontal type



Dimensions of the supplied oval flanges

(See Model Code)

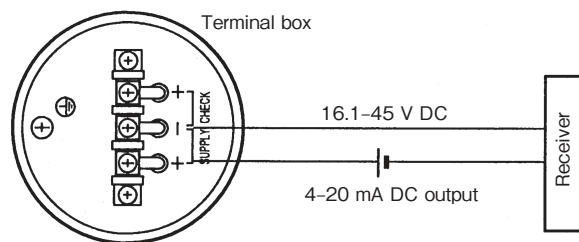
Material: SCS14A



12th digit of Model code	A	B
R2	Rc1/2	15
R4	Rc1/4	10
N2	1/2-14NPT	15
N4	1/4-18NPT	10

Wiring diagram of FCX-A IV differential pressure transmitter for the VTF Series

Open the cover of the transmission block of the transmitter to reveal the terminal box. Use M3.5 crimp-on terminals with insulating sleeve for the ends of wires.



VTF wiring diagram

* To satisfy the TIIS flameproof standard, use the supplied cable gland of the pressure-resistant explosionproof gasket type, which is applicable to $\phi 11$ -mm cables.

CAUTIONS REGARDING SATURATED STEAM MEASUREMENT

Before measuring saturated steam, fill the vertical impulse line with sealing liquid (water) at atmospheric pressure. Otherwise, the 3-way stopcock and transmitter may be damaged.

* Specification is subject to change without notice.

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