TECHNICAL GUIDANCE

AM series & VM series
FLOWMETERS FOR STEAM APPLICATIONS

RATIONALIZATION OF CONVERSION TO SOURCES OF POWER AND HEAT

OUTLINE

The steam has widely been used as the sources of both heat and power. In an air-conditioning line, the temperature adjustment is influenced by the steam. The amount of steam supplied determines the quality of the whole air-conditioning. In the utility line, too, where the steam is used as the heat source, the accurate measurement of the steam flow rate is an important element indispensable for energy saving. Because of the trouble by high temperature and measurement error due to the drain, it is generally difficult to measure the flow rate of steam. The following elements have made it difficult to make actual measurement of the flow rate: Narrow measuring range, Expensive equipment, Peripheral equipment, and the required straight pipe length directly related to heat loss and pressure loss. Considering these elements, Tokyo Keiso has launched the flowmeter for the simple and accurate measurement of steam flow rate.

APPLICABLE PRODUCTS

- AM series Variable Area Flowmeter
- V-Cone VM series Differential Pressure Type Flowmeter

STANDARD SPECIFICATION

	AM series	VM series
Type	Variable Area Flowmeter	Differential Pressure Type Flowmeter
Connection size	15mm(1/2") to 150mm (6")	15mm (1/2") to 300mm (12") Larger than 350mm (14") on request
Rangeability	10:1 (Std.)	10:1 (Std.) Consult factory for details.
Max. fluid temp.	400°C (A cooling fin is to be provided in case fluid temp. is more than 150°C.)	190°C Consult factory for details.
Pressure rating	10K (150lb) class, 20K (300lb) class, 600lb*	10K (150lb) class
Flow direction	Bottom side to Top side or Horizontal	Horizontal
Material	Carbon steel, SUS304, SUS316, SUS316L, or Other metallic material (Consult factory for details.)	V cone, Bypass piping SUS304 Manifold, Transmitter SUS316 Transmitter diaphragm Hastelloy C Gasket PTFE
Accuracy	±1.5% (F.S.)	±2.0% (F.S.)
Power supply	Unnecessary (Local indication type)	DC11.4~50.4V
Option (Transmitter)	• Pneumatic transmitter AM-131□ • Electric transmitter AM-152□ • Pulse transmitter AM-169□ (with local integrator) • Alarm transmitter AM-174□	Mass flow rate and Pressure (By using Multifunction converter EDB500M) Output DC4 to 20mA of mass flow rate (Std.)
Required straight runs	Not required	Elbows, Reducers : Upstream 0D, Downstream 3D Valves, Other fittings : Upstream 2D, Downstream 5D
Change in temperature and pressure of steam to be measured	Compensating calculation is required.	Automatic compensation (Only saturated steam)

*Consult factory for details.

AM series

VM series

AM series METAL TUBE TYPE VARIABLE AREA FLOWMETER

FEATURES

- ❑ Flow rate can be indicated at site without power supply.
- ❑ Straight pipe run is not required.
- ❑ Various transmitters can be selected as option.
- ❑ Easy installation
- ❑ Range ability 1:10 (Std.)
- ❑ Accuracy ±1.5% (Std.)
- ❑ Max. fluid temperature: 400°C (300°C for JIS10K class)
- ❑ A cooling fin is to be provided in case fluid temperature is more than 150°C.
- ❑ Meter sizes: Available from 15mm to 150mm.
- ❑ Damper is to be provided to prevent vibration of float.

MODEL CODE

Model code								Description
		AM-1			–		–	
Construction								Waterproof (IP54 equivalent)
	EP-							Pressure tight explosion proof
	IS-							Intrinsically safe *1
Function			40					Local indication
			31					Local indication + Pneumatic transmission
			52					Local indication + Electric transmission (DC4~20mA)
			69					Local indication + Local integration + Pulse output
			74					Local indication + Alarm output
Flow direction				3	–			Bottom side to Top side
				6	–			Right to Left
				7	–			Left to Right
Additional function						D		Liquid damper
						DF	–	Liquid damper + Cooling fin
Pressure rating							–	10K (150lbs) class
							– M	20K (300lbs) class
							– H	High pressure

*1 Intrinsically safe version is available for AM-1700 (Alarm output) version.

SELECTION OF METER SIZE

Steam flow rate is to be converted into water flow rate by the following formula for size determination;

$QW = Qs \times 0.03 \times \sqrt{\gamma}$

Where QW: Water converted flow rate (m^3/h)
Qs : Steam flow rate (m^3/h)
γ : Specific weight of steam (kg/m^3)

Example

Fluid Saturated	Steam
Pressure	9kgf/cm²G
Flow rate	1t/h
Flowmeter to be used	AM-1□□6-D

First, specific weight of the steam is to be obtained from"Steam graph" etc. In this application, specific weight (γ) of 9kgf/cm²G steam is 5.05kg/m³. Saturated steam curve (by temperature) is shown on Table 1 and Saturated steam curve (by pressure) is on table 2 for reference. Normally, flow rate of steam is described in weight unit, which is to be converted to volume unit (Qs) as follows:

1t/h = 1000kg/h Qs = 1000 (kg/h) /5.05kg/m³
= 198 (m^3/h)

Then, all these figures are to be put into the formula:

$QW = 198 \times 0.03 \times \sqrt{5.05}$
$= 13.3 m^3/h$

Referring to Table 4, the suitable meter size is 65mm.

■ **Specific weight of saturated Steam**

Table 1

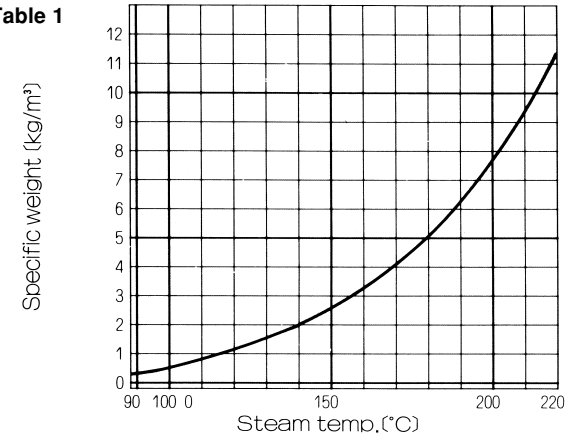
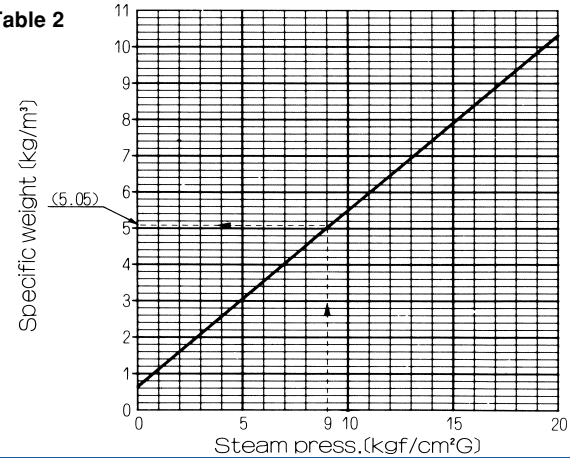
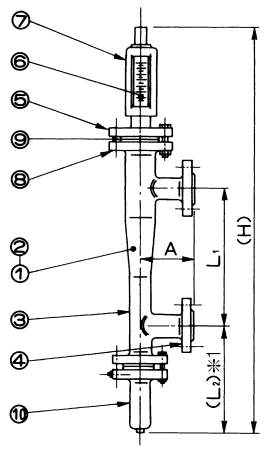


Table 2



DIMENSIONS, MATERIAL, PRESS, DROP & FLOW RATE TABLE

● **Type AM-1□□3-D**
(Flow direction:Bottom side-Top side, with damper)



■ **Table 3**

Meter size		Q	△P	10K Class AM-1□□□-□					20K Class AM-1□□□-M				
(mm)	(inch)	Water (m^3/h)	(mmH_2O)	(H) (mm)	L1 (mm)	L2 (mm)	A (mm)	Weight (kg)	(H) (mm)	L1 (mm)	L2 (mm)	A (mm)	Weight (kg)
15	1/2	0.1～0.69	1000	800	220	190	100	11	830	220	210	100	13
20	3/4	1.6	1220	810	220	190	100	11	850	220	220	100	13
25	1	4.19	1770	830	220	210	100	14	880	220	240	100	17
40	1-1/2	7.73	1100	860	220	220	100	18	930	220	280	100	22
50	2	15.1	1580	960	220	310	100	21	1050	220	370	100	28
65	2-1/2	29.3	1950	1080	350	300	150	29	1180	350	370	150	38
80	3	40.8	1800	1130	350	310	150	35	1220*	350	380	180	46
100	4	70.8	1950	1160*	350	320	150	53	1280*	350	400	180	70
125	5	110	2200	1220*	370	360	250	68	-	-	-	-	-
150	6	150	2700	1330*	480	360	250	90	-	-	-	-	-

No.	Description	Class 1	Class 2	Class 3	Class 4
1.	Tapered tube	SUS304	SUS304	SUS316	SUS316L
2.	Float ass'y	SUS304	SUS304	SUS316	SUS316L
3.	Body	SGP*	SUS304	SUS316	SUS316L
4.	Flange	SS400	SUS304	SUS316	SUS316L
5.	Upper flange	SS400	SS400	SS400	SS400
6.	Lead pipe	SUS304	SUS304	SUS316	SUS316L
7.	Indicator	ADC12	ADC12	ADC12	ADC12
8.	Bolt&nut	SS400	SS400	SS400	SS400
9.	Gasket	Non-asbestos/ PTFE	Non-asbestos/ PTFE	Non-asbestos/ PTFE	Non-asbestos/ PTFE
10.	Damper	SUS304	SUS304	SUS316	SUS316L

"H"dimension will be extended by 130mm if a cooling fin is provided

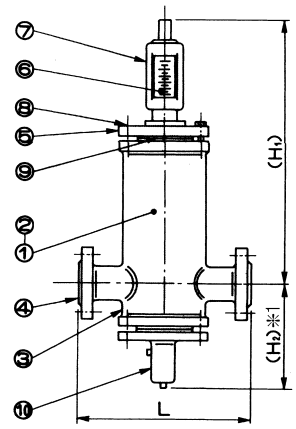
"H"dimension will be extended by 30mm with pneumatic transmitter without fin.

*STPG 370 for Medium press. 300 lbs (20k) class.

Other special metallic material available on request.

※1 In case of overheated steam, the length may be longer.

● **Type AM-1□□6-D, AM-1□□7-D**
(Flow direction:Left-Right, Right-Left, with damper)



■ **Table 4**

Meter size		Q	△P	10K Class AM-1□□□-□				20K Class AM-1□□□-M			
(mm)	(inch)	Water (m^3/h)	(mmH_2O)	(H1) (mm)	(H2) (mm)	L (mm)	Weight (kg)	(H1) (mm)	(H2) (mm)	L (mm)	Weight (kg)
15	1/2	0.1～0.7	1200	440	200	160	15	440	210	160	17
20	3/4	1.6	1480	470	200	160	15	500	210	160	17
25	1	3.5	2100	480	210	180	19	500	240	180	22
40	1-1/2	6.5	1550	510	200	240	24	520*	240	240	28
50	2	13	1900	540	270	260	30	550*	280	260	36
65	2-1/2	25	2210	570	280	340	42	580	290	340	52
80	3	35	2100	610	290	360	50	620	310	360	62
100	4	60	2400	650*	300	360	70	660*	310	360	90
125	5	90	2600	670*	320	440	105	-	-	-	-
150	6	155	3150	720*	340	440	125	-	-	-	-

No.	Description	Class 1	Class 2	Class 3	Class 4
1.	Tapered tube	SUS304	SUS304	SUS316	SUS316L
2.	Float ass'y	SUS304	SUS304	SUS316	SUS316L
3.	Body	SGP*	SUS304	SUS316	SUS316L
4.	Flange	SS400	SUS304	SUS316	SUS316L
5.	Upper flange	SS400	SS400	SS400	SS400
6.	Lead pipe	SUS304	SUS304	SUS316	SUS316L
7.	Indicator	ADC12	ADC12	ADC12	ADC12
8.	Bolt&nut	SS400	SS400	SS400	SS400
9.	Gasket Teflon	Non-asbestos/ PTFE	Non-asbestos/ PTFE	Non-asbestos/ PTFE	Non-asbestos/ PTFE
10.	Damper	SUS304	SUS304	SUS316	SUS316L

"H"dimension will be extended by 130mm if a cooling fin is provided

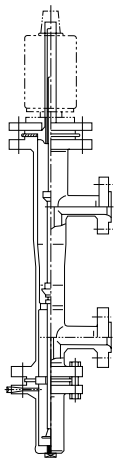
"H"dimension will be extended by 30mm with pneumatic transmitter without fin.

*STPG 370 for Medium press. 300 lbs (20k) class.

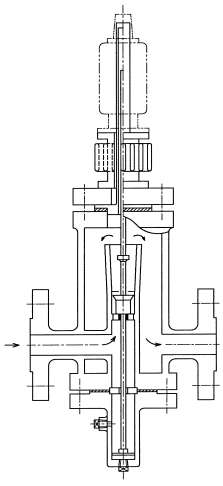
Other special metallic material available on request.

※1 In case of overheated steam, the length may be longer.

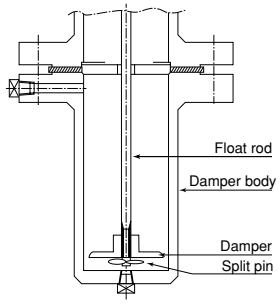
INTERNAL STRUCTURE



AM-1□□3-D



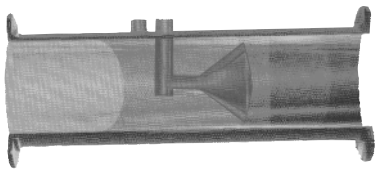
AM-1□□6-DF



Damper

Differential Pressure Type Mass V-Cone Flowmeter

V-Cone Flowmeter is the differential pressure type flow sensor. Although the structure resembles the orifice, the structure of contraction is completely different. V-shape cone is put on a straight pipe, and the pressure generated by flow before and behind the cone is to be detected by the two taps to extract the differential pressure as shown in the following figure, and then the flow rate is measured. Detected differential pressure is outputted in an extraction-of-a-square-root by the loaded transmitter.



V-Cone has solved such problems as the conventional differential pressure type flowmeter like Orifice had.

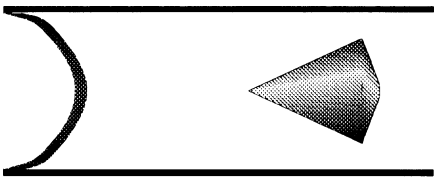
FEATURES

● Contributing to saving of cost and energy due to short straight runs upstream and downstream.
(The extension to the established piping has become easier.)

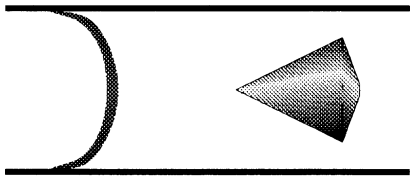
Required straight run

Piping condition	Upstream	Downstream
Elbows, Reducers	0D	3D
Valves, Other fittings	2D	5D

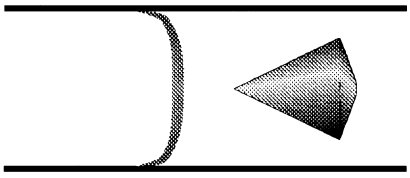
The short straight run has become possible since the cone has the self-rectification action. Even if disorder is in the flow velocity distribution, when fluid approaches a cone and passes the inclination portion of cone, it is adjusted and rectified. It has been verified that the piping structure downstream may have some influence because there is a tap of low pressure side in the central part of cone, and so some straight runs may be required downstream.



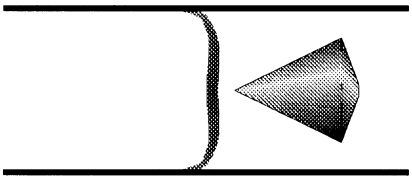
(1)



(2)



(3)



(4)

● Low pressure loss and indispensable for energy saving
The signal stability of V-Cone is more stable than that of orifice plates. Thus, the required ΔP and permanent pressure loss are also much lower than orifice system. This saves total energy consumption in plants.

● Easy installation and wiring
All required devices are already mounted in one piece. Just by installing onto process piping and connecting 2 core cables, the system can be started. No additional cable for mass flow compensation is required.

● Wide range ability
V-Cone sensor offers 1:10 range ability which is much wider than orifice and Vortex flowmeters. Wide range ability of V-Cone covers seasonal load variation.

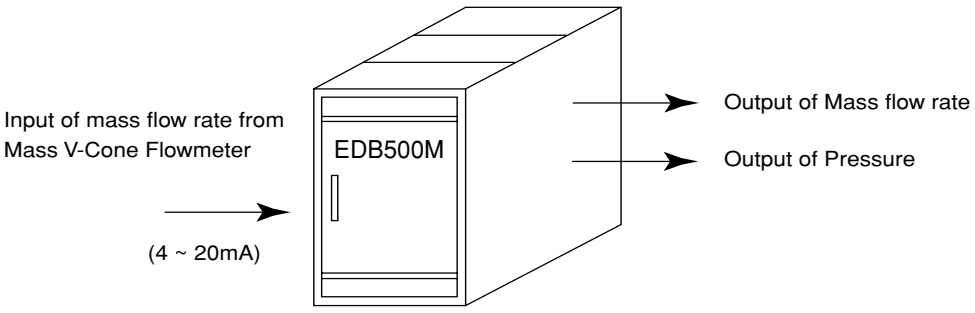
● Durable against wear and sticking
V-Cone has “self-cleaning” capability because the fluid runs off from the beta edge of the Cone.

An automatic pressure compensating function is mounted in the transmitter of VM series, and even if the pressure changes, the flow rate of saturated steam is automatically compensated and the mass flow rate is correctly outputted. The pressure gauge, thermometer and computer are not needed.

- Even if the pressure of saturated steam varies, VM series compensates automatically and measures correctly.
- Computing unit, or Thermometer, or Pressure gauge is not required.
- Just by installing onto process piping and connecting 2 cables, the system can be started. No additional cable for mass flow compensation is required.

Furthermore, when EDB500M Converter with optional multifunction is used, the signals for mass flow rate and pressure can independently be outputted.

Independent output of 2 signals: Mass flow rate (1 to 5V) and pressure (1 to 5V)



EDB500M
Converter with multifunction

MODEL CODE

													Description	
			VM	–					–		–			
Construction			VM										General use	
	EP	–	VM										Ex-proof	
Combination *1				–	5								V-Cone sensor + transmitter	
				–	6								V-Cone sensor + transmitter (Degrease treatment)	
				–	7								V-Cone sensor + 3 way manifold + transmitter	
				–	8								V-Cone sensor + 3 way manifold + transmitter (Degrease treatment)	
Measuring fluid						4							Saturated Steam	
Process connection							1						JIS10K RF flange	
							2						ANSI#150 flange	
Flow direction								6					Left to Right (Horizontal)	
								7					Right to Left (Horizontal)	
Size									–	01			15mm	1/2"
									–	02			20mm	3/4"
									–	03			25mm	1"
									–	04			40mm	1 1/2"
									–	05			50mm	2"
									–	06			65mm	2 1/2"
									–	08			80mm	3"
									–	10			100mm	4"
									–	13			125mm	5"
									–	15			150mm	6"
									–	20			200mm	8"
									–	25			250mm	10"
									–	30			300mm	12"
ß-Ratio *2											–	85	ß=0.85	
											–	75	ß=0.75	
											–	65	ß=0.65	
											–	55	ß=0.55	
											–	45	ß=0.45	

NB : *1 Zero adjustment and maintenance of transmitter are not possible during operation in case type 5 and 6 are selected.
*2 Most suitable ß-Ratio willl be selected by Tokyo Keiso.

STANDARD FULL SCALE FLOW RATE

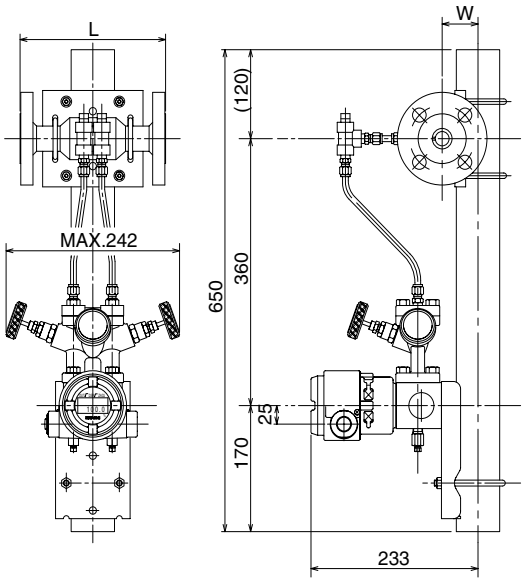
Full scale flow rate (standard) in measuring saturated steam. (Each flow rate shows Gauge Pressure.)

Unit of flow rate : kg/h

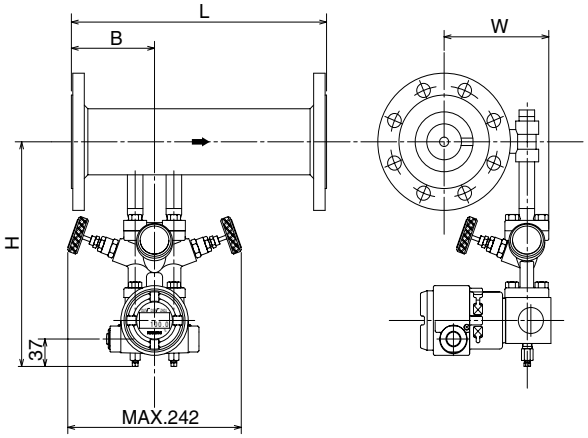
Fluid press. (Fluid temp.)			1kgf/cm² 98kPa (120°C)	2kgf/cm² 198kPa (133°C)	3kgf/cm² 294kPa (143°C)	4kgf/cm² 392kPa (151°C)	5kgf/cm² 490kPa (158°C)	6kgf/cm² 588kPa (164°C)	7kgf/cm² 686kPa (170°C)	8kgf/cm² 784kPa (175°C)	9kgf/cm² 882kPa (179°C)	10kgf/cm² 980kPa (183°C)
Size	15mm	1/2"	35	45	55	65	75	90	100	150	150	200
	20mm	3/4"	60	80	100	100	150	200	200	200	250	300
	25mm	1"	95	100	150	200	250	300	300	350	400	450
	40mm	1 1/2"	200	300	350	450	550	650	750	850	950	1000
	50mm	2"	350	500	600	800	950	1000	1500	1500	1500	1500
	65mm	2 1/2"	500	700	850	1000	1500	1500	2000	2000	2000	2500
	80mm	3"	800	1000	1500	1500	2000	2500	2500	3000	3500	3500
	100mm	4"	1500	2000	2500	3000	3500	4000	4500	5000	6000	6500
	125mm	5"	2000	3000	3500	4500	5500	6000	7000	8000	9000	10000
	150mm	6"	3000	4500	5500	7000	8000	9500	10000	10000	15000	15000
	200mm	8"	5500	7500	9000	10000	15000	15000	15000	20000	20000	25000
	250mm	10"	8500	10000	15000	15000	20000	25000	25000	30000	35000	40000
	300mm	12"	10000	15000	20000	25000	30000	35000	40000	45000	50000	55000

DIMENSIONS

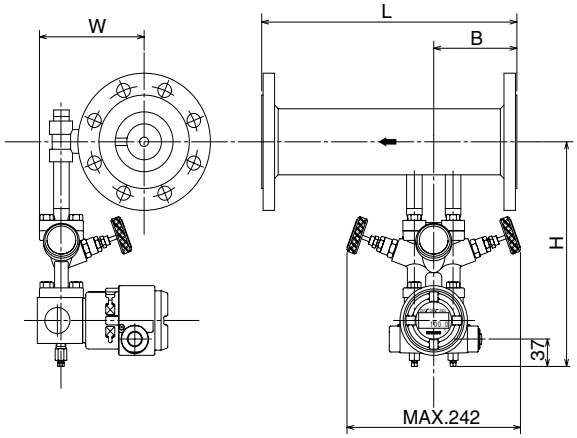
● Fig. a : 15mm (1/2") ~ 40mm (1-1/2")
Flow direction : Left to Right or Right to Left



● Fig. b : 50mm (2") ~ 300mm (12")
Flow direction : Left to Right



● Fig. c : 50mm (2") ~ 300mm (12")
Flow direction : Right to Left



Size		L	B	W	H (mm)		Fig.
mm	inches	(mm)	(mm)	(mm)	3 way manifold provided	3 way manifold NOT provided	
15	1/2	203	———	44	———		a
20	3/4	203	———	47	———		a
25	1	203	———	50	———		a
40	1 1/2	254	———	57	———		a
50	2	305	116	132	288	198	b, c
65	2 1/2	305	116	138	298	208	b, c
80	3	356	116	146	303	213	b, c
100	4	406	129	174	328	238	b, c
125	5	559	135	187	343	253	b, c
150	6	559	135	201	353	263	b, c
200	8	660	154	241	388	298	b, c
250	10	711	154	268	413	323	b, c
300	12	762	160	294	438	348	b, c

Note ● Fig. a~c show the VM flowmeters with 3 way manifold.
● SXBM-16B type pressure tight cable gasket made by Shimada Electric shall be used for cable connection for flameproof version.

RECEIVING INSTRUMENTS BY TOKYO KEISO

The signal from AM series Metal Tube type Area Flowmeter or V-Cone VM series Differential Flowmeter is received, and instantaneous flow and integrating flow rate are displayed. This meter is very light and compact, and since the high and low alarm contact output is equipped, flow surveillance can be performed easily. What is more, a wiring with flowmeter is also very easy as DC24V power supply for loops is built in,

● **IR-4500 series**

● **IR-6000 series**

MODEL CODE

IR-4500 series

Model						Description
IR–	4	5				
Power supply			1			AC85~264V
			2			DC12~24V
Sensor loop power supply			2			DC24V
Input signal				–1		Open collector pulse
				–2		Active voltage pulse
				–3		DC4-20mA
				–4		DC1-5V
				–5		DC-0-5V

IR-6000 series

Model							Description	
IR-	6							
Input		0					Pulse input	
		1					Analog input	
Input signal			0				Open collector pulse	IR-60□□
			1				Active voltage pulse	
			2				DC4 ~ 20mA	IR-61□□
			3				Others	
Sensor loop power supply				0			DC24V	
				1			Others	
Power supply					–1		DC24V	
					–2		AC85~264V	
Alarm function						0	No use	
						1	Flow rate alarm output (2 points)	
						2	Totalizing preset output (2 points)	

● Combination with AM-152□ (DC4 to 20mA output, 2-wire)
- IR-45□2-3
- IR-6120

● Combination with V-Cone VM series (DC4 to 20mA output, 2-wire)
- IR-45□2-3
- IR-6120

● Combination with EDB500 multi function converter of VM series (DC1 to 5V output)
- IR-45□2-4

* Specification is subject to change without notice

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