



Liquid Measuring Multipath Ultrasonic Flowmeter

Psonic-L4

MODEL UL4 series

GENERAL SPECIFICATION

GS.No.GBM007E-2

■ GENERAL

The Psonic-L4 is an ultrasonic flowmeter achieving the highest level of accuracy as a flowmeter for measuring liquid volume by the combination of multipath (4 beams) opposing sensor and the latest signal processing technology. It is best suited for highly accurate flow metering systems such as volumetric metering for liquid transactions and liquid control. and liquid control. Its compact body and unexposed sensor cable construction give an organized appearance while complying with OIML (International Organization of Legal Metrology) R117 standard.

■ FEATURES

1. Wide flow range and high accuracy.
2. Periodic replacement of parts due to wear, etc. is not necessary because the flowmeter has no moving parts. Its durability is excellent.
3. Nearly zero pressure loss.
4. Installation of strainer is unnecessary.
5. Forward and backward measurements are possible.
6. In principle, zero drift does not occur.
7. Periodic calibration is unnecessary.



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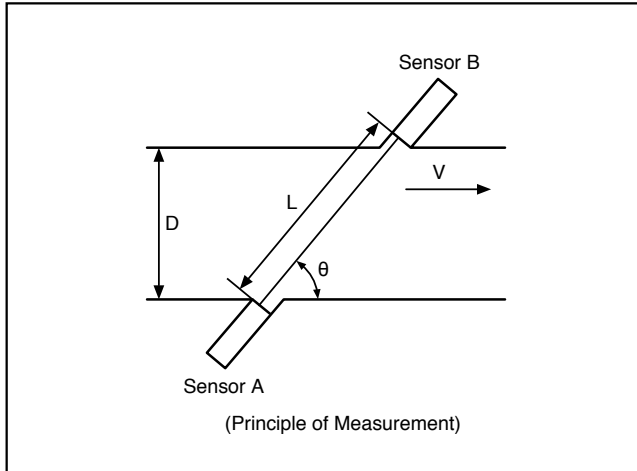
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■ PRINCIPLE OF MEASUREMENT

Inverse Propagation Time Difference Method (Frequency Difference Method)

An ultrasonic wave is transmitted/received alternately from Sensor A to Sensor B, or from Sensor B to Sensor A by arranging the transducer (ultrasonic sensor) in the piping as shown in the following figure. (Z method)



Formula

Assume the following:

T_{ab} : Time for propagation from Sensor A to Sensor B

T_{ba} : Time for propagation from Sensor B to Sensor A

L : Propagation distance of ultrasonic wave

C : Sonic speed in measuring liquid

V : Flow velocity in measuring liquid

θ : Angle between inner pipe center axis and course of ultrasonic wave

When liquid is flowing,

$$T_{ab} = \frac{L}{(C + V \cos \theta)} \quad T_{ba} = \frac{L}{(C - V \cos \theta)}$$

From the above formula,

$$\therefore V = \frac{L}{2 \cos \theta} \left(\frac{1}{T_{ab}} - \frac{1}{T_{ba}} \right)$$

From the above, the volume flow rate Q can be obtained by the flow velocity multiplied by pipe section area A and coefficient K , i.e. $Q = V \times A \times K$. As this flowmeter is a multipath type, its performance is enhanced by measuring the flow velocity at several points in the pipe.

■ GENERAL SPECIFICATIONS

Item		Description
Structure		Probe integral with transmitter, flange mounted connection
Applicable fluids		Oil, heavy oil, other liquids (Homogeneous liquid through which an ultrasonic wave propagates) ※ For corrosive liquids such as chemical or medical solutions, consult OVAL.
Nominal size		100, 150, 200, 250, 300mm
Number of lines measured		4
Max. operating pressure		Depends on flange rating (Design pressure: 8MPa at 120°C)
Flange standard		JIS 10, 20, 30K RF / JPI 150, 300 RF / ASME 150, 300 RF
Body material		SCS13A
Fluid temperature range		-20 to +120°C ※ (For explosionproof type, refer to page 7.)
Kinetic viscosity		0.1 to 400mm ² /s (0.1 to 400cSt)
Ambient temperature range		-20 to +60°C
Flow velocity measuring range		-10 to +10m/s
Low cut		Flow velocity 0.1m/s (standard setting) ※ (Settable at discretion)
Accuracy		±0.15%RD (For details, see P.3.)
Output	Analog output	Insulated active output 4 to 20mA Outputtable range: 3.8 to 20.5mA (3.6mA or 21.6mA output at alarm) Conforms to NAMUR standard. Maximum load resistance: 600Ω
	Pulse output	Insulated open collector output (max. 30VDC, 50mA) (Voltage pulse output is also available optionally (15V±5%)) Two outputs (For the detail of pulse 2, see P.7.) Max. frequency: 10kHz, Voltage at ON: 1.5V max. Pulse width: Duty 50% (1 : 1) provided ON width is fixed at 50ms for 10Hz or below.
	Status output	Insulated photo MOS relay output (max. 30VDC, 50mA) Alarm output / reverse flow detection / zero point adjustment in process
	Communication	Bell202 (Compliant with HART Version 7)
Output transmission distance		Max.1km (Analog output, Status output) Pulse output varies in transmission length by the frequency. Example) At 10kHz: 250m max.
Display		7 segments 8 digits 1 line LCD Instantaneous flow rate, flow velocity, total flow (forward direction), percent flow rate, and sonic speed are displayed in turn.
Power supply		85 to 240VAC 50/60Hz, 20 to 30VDC
Power consumption		Max. 10W
Finish of transmitter		Melamine baking finish Case: Munsell 10B8/4, Cover (Front and rear): Munsell 2.5PB4/10
Waterproof construction		IP66
Explosionproof construction		TIIS Transmitter terminal part: Ex d IIB T4 Transmitter operation part: Ex d[ia] IIB T4 Transducer part: Ex ia IIB T4 ATEX: II1/2G Exdia IIB T4 Ga/Gb
Applicable EU directives		EMC Directive: 2004/108/EC, ATEX Directive: 94/9/EC
Applicable EN directives		EMC: EN55011: 2009+A1: 2010, EN61000-6-2: 2005 ATEX: EN60079-0: 2012, EN60079-1: 2007, EN60079-11: 2012, EN60079-26: 2007
Other standards		OIML R117-1: 2007 OIML D11: 2004 High Pressure Gas Safety Act

■ FLOW RANGE TABLE

(1) Min. flow

Nominal size (mm)	Measurable lower limit flow rate (m ³ /h) Standard low cut (0.1m/s)	Guaranteed min. flow rate (m ³ /h)	
		Condition 1	Condition 2
100	2.7	13	2.20 × v
150	6.0	30	3.24 × v
200	10.0	50	4.32 × v
250	16.0	80	5.37 × v
300	23.0	110	6.42 × v

Note 1) Guaranteed minimum flow depends on Condition 1 or Condition 2, whichever is larger.

v: kinematic viscosity (mm²/s = cSt)

Note 2) By changing the low cut setting, the lower limit of measurement can be decreased. However, this may cause the output to stop at that time depending on the process condition. Consult OVAL beforehand.

(2) Max. flow

Nominal size (mm)	Guaranteed max. flow rate (m ³ /h)
100	270
150	600
200	1000
250	1600
300	2300

■ ACCURACY

Accuracy	Accuracy warranty conditions
± 0.15% RD	① With an upstream pipe with OVAL-specified flow conditioner and a downstream pipe ② Calibration at the same Reynolds number as operating condition (high accuracy calibration)
± 0.5% RD	① With an upstream pipe with OVAL-specified flow conditioner and a downstream pipe ② Calibration with the same Reynolds number as operating condition is not carried out
± 1.0% RD	Only with single flowmeter

Note: The above accuracy is for total flow in pulse output. In case of analog output, 0.1% FS is added.

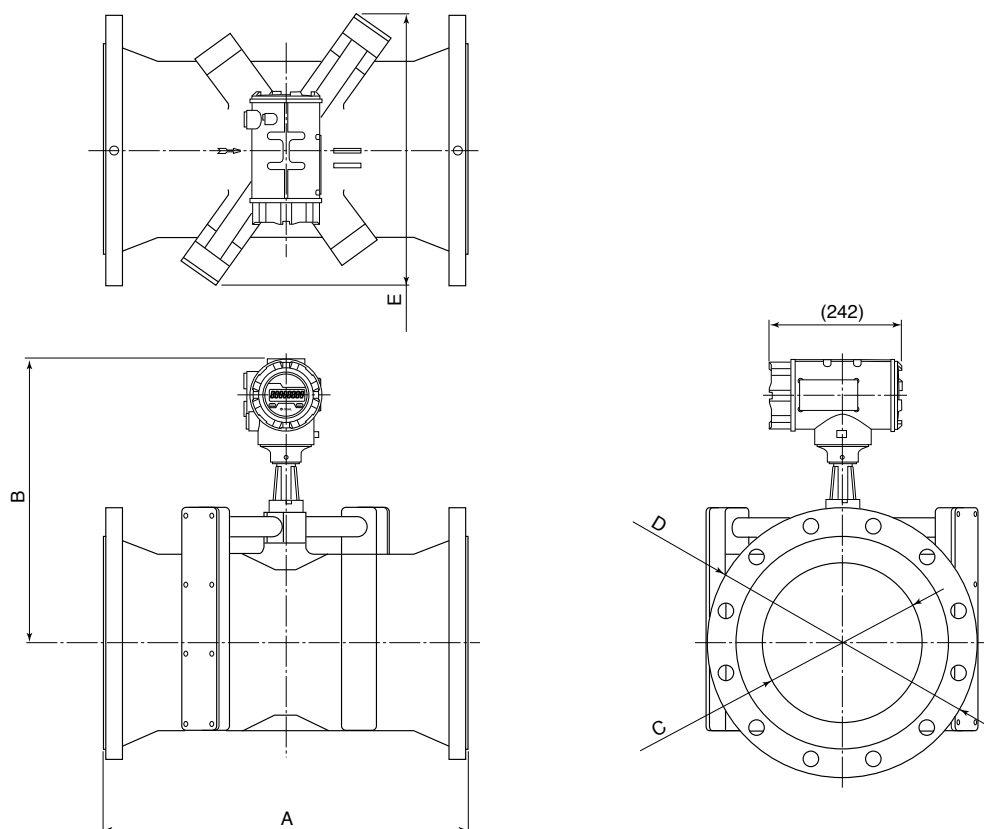
Guarantee condition for accuracy: Accuracy in actual flow calibration using OVAL's facilities or in third party's.

The flow range to assure accuracy is subject to the flow range table in page 2.

■ PRODUCT CODE EXPLANATION

Item	Type																	Description												
	①	②	③	④	⑤	⑥	—	⑦	⑧	⑨	⑩	—	⑪	⑫	⑬	⑭	⑮		⑯											
Model	U	L	4																Psonic-L4											
Nominal size				1	0	0	—												100mm (4")											
				1	5	0	—												150mm (6")											
				2	0	0	—												200mm (8")											
				2	5	0	—												250mm (10")											
				3	0	0	—												300mm (12")											
Body material								D											SCS13A											
								Z																Special						
Flange rating									1										JIS 10K											
									2															JIS 20K						
									3																JIS 30K					
									4																JPI 150					
									5																JPI 300					
									6																	ASME 150				
									7																	ASME 300				
									9																	Other special flange				
Applicable laws									1										None											
									3																Yes					
Explosionproof										0	—									Non-explosionproof										
										1	—															TIIS				
										2	—																ATEX			
Power supply												1										20 to 30VDC								
												2																85 to 240VAC 50/60Hz		
Accuracy (calibration)													0										±0.15% RD (OIML R117)							
													1																±0.15% RD	
													2																	±0.5% RD
													3																	±1.0% RD
Option													0										Always "0"							
Communication specification														1										Bell202 (Compliant with HART Version 7)						
Output specification															1										Analog + Pulse					
															2										Analog + Pulse + Reverse flow detection					
															3										Analog + Pulse + Alarm					
Version															A										Standard					

■ OUTLINE DIMENSIONS



	Flange	A (mm)	B (mm)	φC (mm)	φD (mm)	E (mm)	Approx Weight (kg)
100A	JIS 10K	450	411	97.1	210	308	52
	JIS 20K				225		56
	JIS 30K				240		62
	ASME 150/JPI 150				230		57
	ASME 300/JPI 300				255		66
150A	JIS 10K	490	436	143.2	280	352	82
	JIS 20K				305		90
	JIS 30K				325		104
	ASME 150/JPI 150				280		85
	ASME 300/JPI 300				320		102
200A	JIS 10K	540	462	190.9	330	398	111
	JIS 20K				350		121
	JIS 30K				370		139
	ASME 150/JPI 150				345		121
	ASME 300/JPI 300				380		144
250A	JIS 10K	590	487	237.2	400	442	148
	JIS 20K				430		169
	JIS 30K				450		199
	ASME 150/JPI 150				405		161
	ASME 300/JPI 300				445		201
300A	JIS 10K	650	513	283.7	445	486	178
	JIS 20K				480		205
	JIS 30K				515		252
	ASME 150/JPI 150				485		212
	ASME 300/JPI 300				520		258

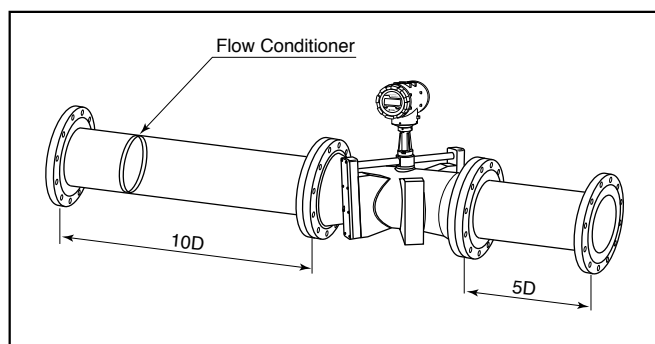
■ PRECAUTIONS ON USE

1. This flowmeter is developed, designed, and manufactured to be used as a flowmeter for general industrial application. Therefore, when it is used for the application where its operation is directly related to the safety of the relevant system or where the product is important in the facilities (such as process control and custody transfer), you are requested to secure sufficient safety including safety design, redundancy and duplication of the process, and implementation of periodic inspection. Do not use this flowmeter in the case where its operation and performance is directly related to human life.
2. If this flowmeter is used under appropriate conditions, it can demonstrate its stable performance without aging degradation of accuracy. However, malfunction or failure may occur due to various factors. Thus, considering the operating conditions, operating status, and importance in the process, you should study the cycle of periodic maintenance and its items of your flowmeter. In order to secure long-term and safe use, OVAL recommends the customer to verify the soundness of the flowmeter through periodic inspection every two years. For the details of inspection, contact our sales agent or person in charge.
3. This flowmeter is manufactured, adjusted, and inspected to meet the conditions of use. The fluid measured, flow range, pressure, temperature, or the like must be applied under the specified conditions. The conditions for use are stated in the nameplate attached to the flowmeter transmitter and specification sheet supplied with the product.

■ PIPING INSTRUCTIONS

When installing the Psonic-L4, set the following specified straight pipe before and after the flowmeter.

In order to keep stable performance, using an upstream pipe with OVAL flow conditioner (Honey Vane L) or a combination of upstream pipe (10D) and Honey Vane S, and downstream pipe (5D) is recommended. Depending on the structure of the flow conditioner, cavitation may occur, resulting in the failure of precise measurement. Be sure to keep sufficient line pressure so that the line pressure does not become lower than the vapor pressure of the fluid measured and cavitation may not occur.



● Rating of Pipe Used and Length of Straight Pipe

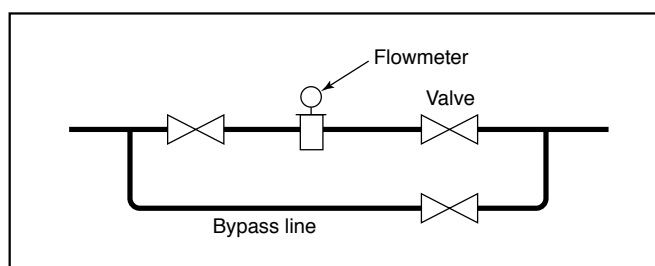
D=Nominal size

No.	Upstream piping status	Straight pipe length	Remarks
1	Reducer	Flow → 15D min.	Concentric reducer is present upstream.
2	Elbow	Flow → 23D min.	Elbow is present upstream.
		Flow → 25D min.	Two elbows are located horizontally upstream.
		Flow → 40D min.	Two elbows are located vertically upstream.
3	Fully open valve	Flow → 15D min.	Fully open valve is present upstream.
4	Partially open valve	Flow → 50D min.	Partially open valve or excessive narrow part that may cause significant turbulence is present upstream.

Note) Sch.40 pipe is used for the flow straightener. Therefore, Sch.40 pipe shall be used as a standard pipe.

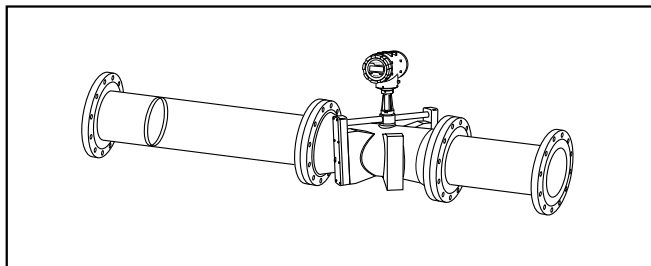
● Bypass Piping

We recommend to provide a bypass line to facilitate maintenance and inspection. For the upstream and downstream valves of the flowmeter, use a valve with a structure that may not cause disturbance in the flow. Ball valve (Full Bore) or the like is recommended.

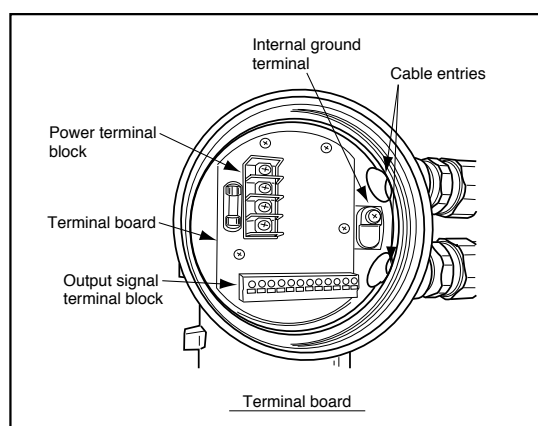


● Other Precautions on Piping

1. Install this flowmeter far away from pulsation-generating instruments such as motors and pumps.
2. When measuring the fluid requiring heat retention, consult OVAL beforehand.
3. In case of horizontal piping, install the flowmeter with its transmitter right side up as shown in the right figure.
4. Install the control valve downstream of this flowmeter.
If there is a probability of cavitation, place the control valve more than 5m away from the flowmeter.
5. Rapid temperature change may result in the degradation of flowmeter performance. Be careful to keep the fluid temperature as stable as possible to prevent sudden temperature change.



■ WIRING



● Power and Output Signal Terminal Identification

Item	Terminal No.	Label	Description	Remarks
Power (TB1)		LINE (+)	Power (with DC power: +)	Be sure to connect GND or EARTH terminal to ground.
		GND	Grounding	
		NEUT (-)	Power (with DC power: -)	
		EARTH	IS-Grounding	
Output Signal (TB2)	1	PULSE1+	Pulse 1 output (Open collector output)	① For output wiring, use shielded wire of twisted pair line AWG24 to 16. Peeling length of sheath is 11mm. ② Maximum load resistance of analog output is 600Ω. ③ Specifications for pulse 1, 2 outputs are: Max. DC30V, 50mA Voltage 1.5V max. at ON ④ Specifications for status output are: Max. DC30V, 50mA Voltage 1.5V max. at ON
	2	PULSE1-		
	3	STATUS+	Status output (Photo MOS relay output)	
	4	STATUS-		
	5	PULSE2+	Pulse 2 output (Open collector output)	
	6	PULSE2-		
	7	N.C	Unused	
	8	N.C	Unused	
	9	ANALOG+	4 to 20mA analog output (HART signal superimpose)	
	10	ANALOG-		
	11	N.C	Unused	
	12	N.C	Unused	

● Power Terminal

Connects to terminal LINE (+) and NEUT (-).

● Grounding Terminal

Connects to any one of EARTH terminal, GND terminal, internal grounding terminal and external grounding terminal.

Terminal using ground and grounding type are distinguished in connection depending on whether connection line is present or not in the power feed line.

a. In case grounding line is present in lead-in cable

Explosionproof	EARTH terminal with IS-grounding
Non-explosionproof	GND terminal or internal grounding terminal with grounding

b. In case grounding line is not present in lead-in cable

Non-explosionproof	External grounding terminal with grounding
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● Precautions on Wiring

- A shielded cable conforming to the specification shall be used.
- Cable end shall be round terminal or its sheath shall be peeled by appropriate length before use.
- Be sure to provide the transmitter with a grounding terminal. In case of explosionproof specification, IS-grounding is required.
- Cable from power connection port shall be laid downward so as to prevent rainwater or the like from entering inside along the cable.
- Use a cable with a diameter conforming to the cable ground (lead-in metal).
- Cable shall be installed away from high-tension wire, power line, heavy electrical equipment, etc. to avoid inductive interference.
- Installation of arrester is recommended to prevent equipment failure due to lightning strike.

■ PRECAUTIONS FOR EXPLOSIONPROOF TYPE

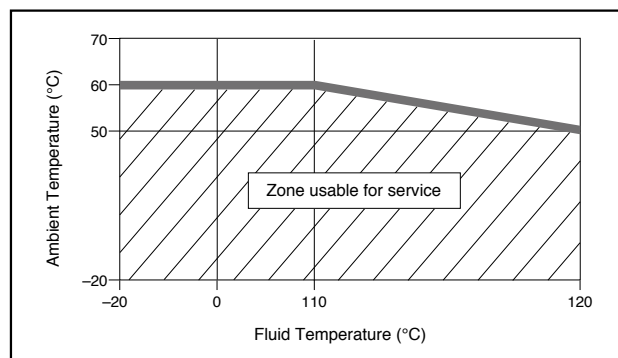
- Do not open the view cover with power turned on in the hazardous area.
- Regarding the grounding terminal in the terminal cover of the transmitter, IS-grounding shall be adopted for EARTH terminal.

In case of ATEX explosionproof

- Install a ground in the place where ambient temperature is within the usable range shown in the graph.

In case of TIIS

- Use the flowmeter within the following range.
Fluid temperature range -20 to +110°C
(Ambient temperature: -20 to +60°C)



■ ABOUT OUTPUTS (Pulse, Status, Alarm)

● Pulse Output

Pulse output is an open collector output. (Voltage pulse is also possible as an option.)

Spec. flow direction		Pulse 1		Pulse 2	
		At measurement of forward direction	At measurement of reverse direction	At measurement of forward direction	At measurement of reverse direction
Forward direction (※1 reverse direction)		Output	No output	180-reversed output of pulse 1 or no output	No output
Both directions (※2)	①	Output	No output	180-reversed output of pulse 1 or no output	No output
	②	Output	No output	No output	Output

※1: In case of the specification in inverse direction, operation is opposite to the operation of forward direction.

※2: In case of both directions, either ① or ② in the above table applies.

● Status Output

Status contact output can be selected from the following operations.

Setting	Description
NONE	When contact output is not used
Alarm	To be output at the occurrence of alarm
Zero point adjustment	To be output during zero point adjustment of flowmeter
Reverse flow detection	To be output during inverse direction flow (Only when flow specification is both directions)

● Alarm Output

Analog output complies with NAMUR standard.

Operation at the occurrence of alarm (BURN OUT) can be selected from the following operations.

Setting	Description	
	Analog output	Pulse output
HIGH	Outputs 21.6mA.	0Hz (Stopped)
LOW	Outputs 3.6mA.	0Hz (Stopped)
HOLD	Retains the value just before occurrence of abnormality until recovery of normal state.	
NONE	Outputs the measurement value of flowmeter.	

(Fill in the blanks. Tick the boxes ☐ that apply.)

Item	Specification					
1. Fluid to be metered						
2. Nominal size	<input type="checkbox"/> 100mm (4") <input type="checkbox"/> 150mm (6") <input type="checkbox"/> 200mm (8") <input type="checkbox"/> 250mm (10") <input type="checkbox"/> 300mm (12")					
3. Flange connection	<input type="checkbox"/> JIS 10K <input type="checkbox"/> JIS 20K <input type="checkbox"/> JIS 30K <input type="checkbox"/> JPI 150 <input type="checkbox"/> JPI 300 <input type="checkbox"/> ASME 150 <input type="checkbox"/> ASME 300 <input type="checkbox"/> Other ()					
4. Operating condition	Min.		Normal		Max.	
(1) Flow range						
	<input type="checkbox"/> m³/h <input type="checkbox"/> kg/h					
(2) Kinematic viscosity	mm²/s		mm²/s		mm²/s	
(3) Dynamic viscosity	mPa•s		mPa•s		mPa•s	
(4) Density	kg/m³		kg/m³		kg/m³	
(5) Flow velocity	m/s		m/s		m/s	
(6) Fluid temp.	°C		°C		°C	
(7) Fluid pressure	MPa		MPa		MPa	
(8) Ambient temp.	°C		°C		°C	
5. Straight pipe lengths	Upstream straight pipe length <input type="checkbox"/> _____ D <input type="checkbox"/> Honey Vane L					
	Downstream straight pipe length <input type="checkbox"/> _____ D					
6. 3a correction	<input type="checkbox"/> With correction <input type="checkbox"/> No correction					
7. Output signal	<input type="checkbox"/> Pulse output, Pulse unit _____ /P (Common to outputs 1 and 2) <input type="checkbox"/> Pulse 2 output (<input type="checkbox"/> Pulse 1 reversal <input type="checkbox"/> Inverse direction) <input type="checkbox"/> Status output (<input type="checkbox"/> NONE <input type="checkbox"/> Alarm <input type="checkbox"/> Zero point adjustment <input type="checkbox"/> Zero point adjustment) <input type="checkbox"/> Analog output, Full scale _____ to _____ _____ /h <input type="checkbox"/> Alarm output (<input type="checkbox"/> HIGH <input type="checkbox"/> LOW <input type="checkbox"/> HOLD <input type="checkbox"/> NONE)					
8. Explosionproof	<input type="checkbox"/> Non-explosionproof <input type="checkbox"/> TIIS explosionproof <input type="checkbox"/> ATEX explosionproof					
9. Power supply	Power supply _____V <input type="checkbox"/> AC <input type="checkbox"/> DC					
10. Application						
11. Remarks						

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