Ins. No. D-544KS

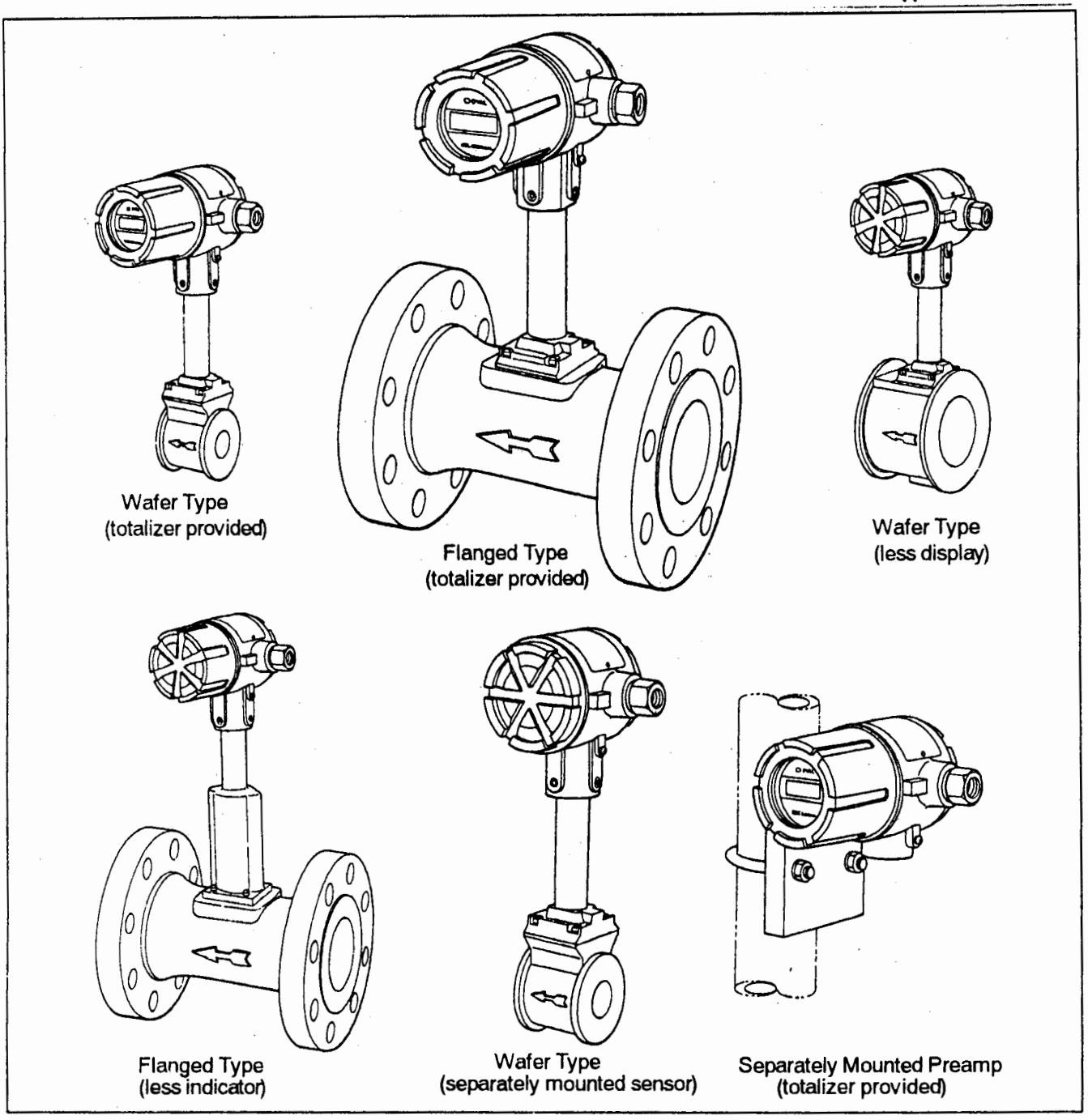
SPARLING / OVAL

FM APPROVED

HART COMMUNICATION FOUNDATION

Vortex Flowmeters
OPERATION MANUAL
Smart EX DELTA, Smart EX DELTA DIA

MODEL : VX·$\begin{matrix}W\\F\\R\end{matrix}$·$\begin{matrix}1\\2\end{matrix}$□□□−$\begin{matrix}N\\C\\Z\end{matrix}$□$\begin{matrix}1\\2\end{matrix}$·$\begin{matrix}G\\L\\S\\H\end{matrix}$−$\begin{matrix}1\\2\end{matrix}$·$\begin{matrix}0\\1\end{matrix}$·$\begin{matrix}0\\1\end{matrix}$·$\begin{matrix}4\\5\\6\end{matrix}$



Every OVAL Smart EX DELTA is fabricated and shipped from our factory under stringent quality control. In order to maintain its design performance throughout its life, this manual offers the operator the necessary installation, operation and maintenance information. Be well familiar with these instructions before you place the meter in service and keep this manual for ready reference.

CONTENTS

CONVENTIONS

Shown in this manual are the signal words NOTE, CAUTION and WARNING, as described in the examples below:

NOTE : Notes are separated from the general text to bring the user's attention to important information.

CAUTION : Caution statements signal the user about hazards or unsafe practices which could result in minor personal injury or product or property damage.

WARNING : Warning statements signal the user about hazards or unsafe practices which could result in severe personal injury or death.

1. BEFORE YOU BEGIN

1.1 Confirming the Specifications

(1) When received, the meter should be thoroughly inspected for indication of rough handling during transit.
(2) Product code number and ratings are stated on the meter nameplate. Make sure that the ratings shown conform to your particular specifications.

1.2 Transit Considerations

(1) It is desirable that the meter be transported to the installation site in the shipping container used for transit from the factory.
(2) During transportation, exercise care to avoid impact shock and rainwater.

1.3 Storage Considerations

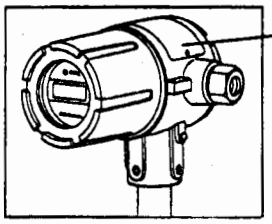
(1) The meter can best be stored in the shipping container used for transit from the factory.
(2) The place of storage should meet the following requirements:
- Free from rain and water
- Free from vibration and impact shocks
- with least temperature and humidity variation (around 25°C (77°F) and 65% R.H.)

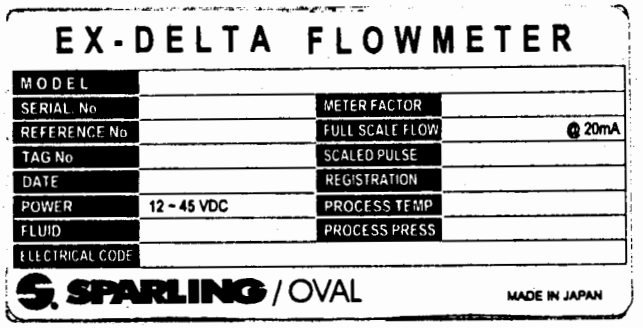
(3) A meter that has once been placed in service for any length of time should be washed clean to remove residue metered material completely from its inner walls before Storage. Waterproofing the wiring entrance should also be taken into consideration.

⚠ **CAUTION:** Unauthorized modification will invalidate the specifications.

2. OPERATING CONDITIONS

To maintain the stated high accuracy and long service life of the meter, make sure that the operating flowrate, pressure, temperature, etc., are held within the ratings specified. These ratings are stated on the meter preamplifier nameplate (tag). Read them carefully before you place the meter in service.





(Product Label)

No.	Item	Description
①	Model	———
②	Serial No.	———
③	Reference No.	———
④	Tag No.	Stated only where specified
⑤	DATE	———
⑥	Power	Power supply range
⑦	Fluid	———
⑧	Electrical code	Stated only where specified

No.	Item	Description
⑨	Meter factor	Unscaled pulse unit in pulse output
⑩	Full scale flow	Full scale frequency established Not stated for pulse output
⑪	Scaled pulse	Not stated for pulse output
⑫	Registration	———
⑬	Process temp.	———
⑭	Process press.	———

In addition to this product label, a warning label is applied on the preamplifier housing. Also follow the instruction on the warning label and Never attempt to remove these labels.

3. GENERAL

EX Delta is a vortex flowmeter, making use of a piezoelectric sensor. Behind the bluff body in a flowing fluid, von Karman vortices form and shed proportional to the rate of flow on alternating side of the bluff body placed perpendicular to the stream of flow. A piezoelectric sensor picks up the frequency of these vortices, which is used for flowrate measurement.

OVAL's many years of experience in the field shows up in the EX Delta Dia, another vortex meter, specifically designed for liquids with a high resistance to contamination. This meter is best suited for processes where ferrous meter components tend to become rusty, or where entrained foreign matter tends to build up. It significantly reduces trouble that is not uncommon to other meter type or ordinary vortex meters, and realizes consistent flow measurement over extended periods of time.

This meter is full of intelligent features to review, set up, change compensated calculations, ranges, parameters, with self diagnostics and loop test capabilities through communications with HART Communicator or OVAL Smart Communication Unit (Model EL2300) and general-purpose Windows PC.

EX Delta Features

(1) A broad flow range with high metering accuracy.
(2) The sensor isolated from the process fluid and simple meter design with no moving parts contributes to long life.
(3) No loss of accuracy with age.
(4) A wide temperature and pressure range. Accepts most fluids, including liquids, gases and steam.
(5) Small pressure loss across the meter to save energy.
(6) Cartridge type, replaceable sensor facilitates inspection and replacement without interrupting the process fluid flow for maximum ease of maintenance.

EX Delta Dia Features

(1) Proprietary diamond-section bluff body combined with a separate sensor prevents scale sedimentation or material buildup to maintain consistent performance in contaminated fluid measurement. The sensor element isolated from the process fluid and the absence of moving parts contributes to long life.
(2) Compatible with widely varying process temperature and pressure conditions.
(3) Withstands severe cleansing environments, including steam cleaning.

EX Delta Dia Construction

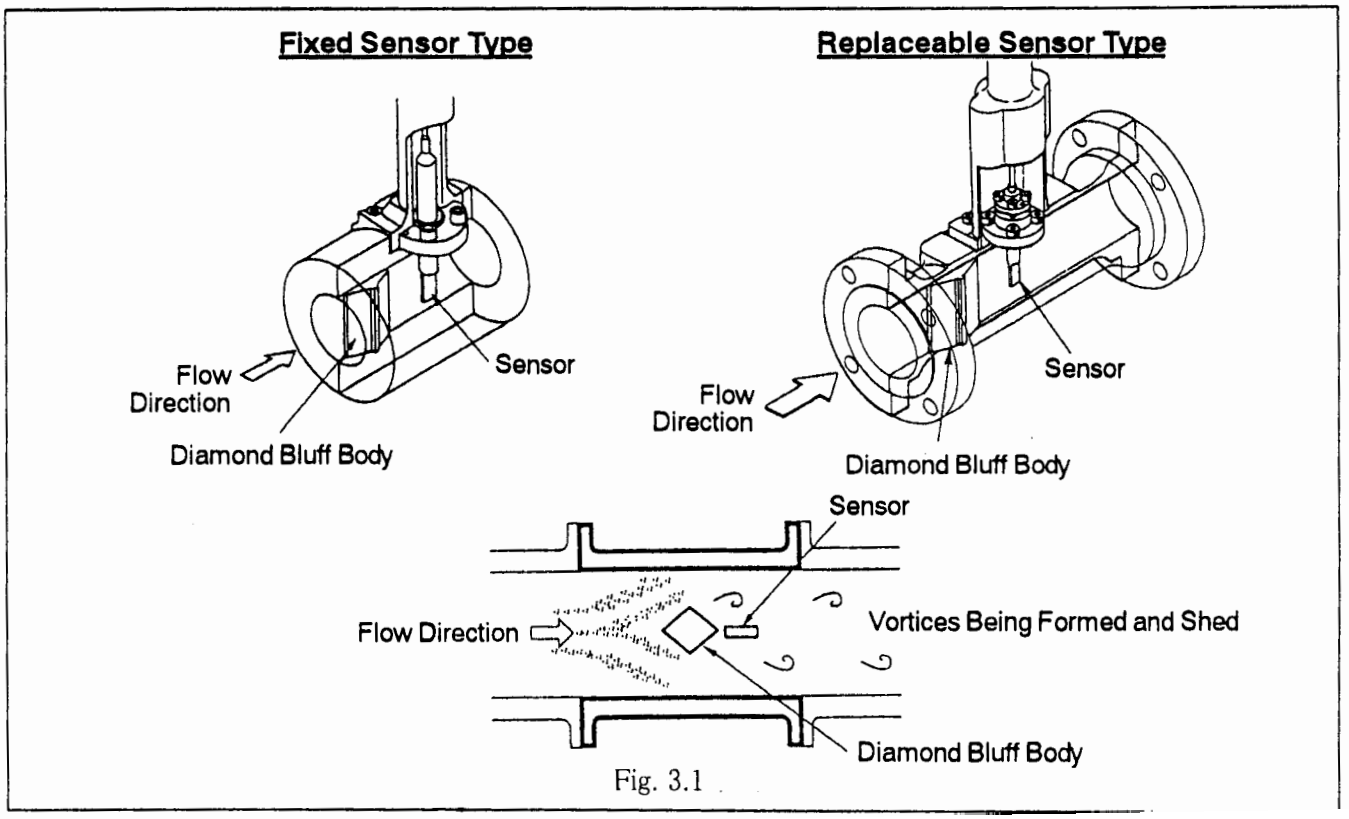


Fig. 3.1

4. COMPONENT NAMES AND FUNCTIONS

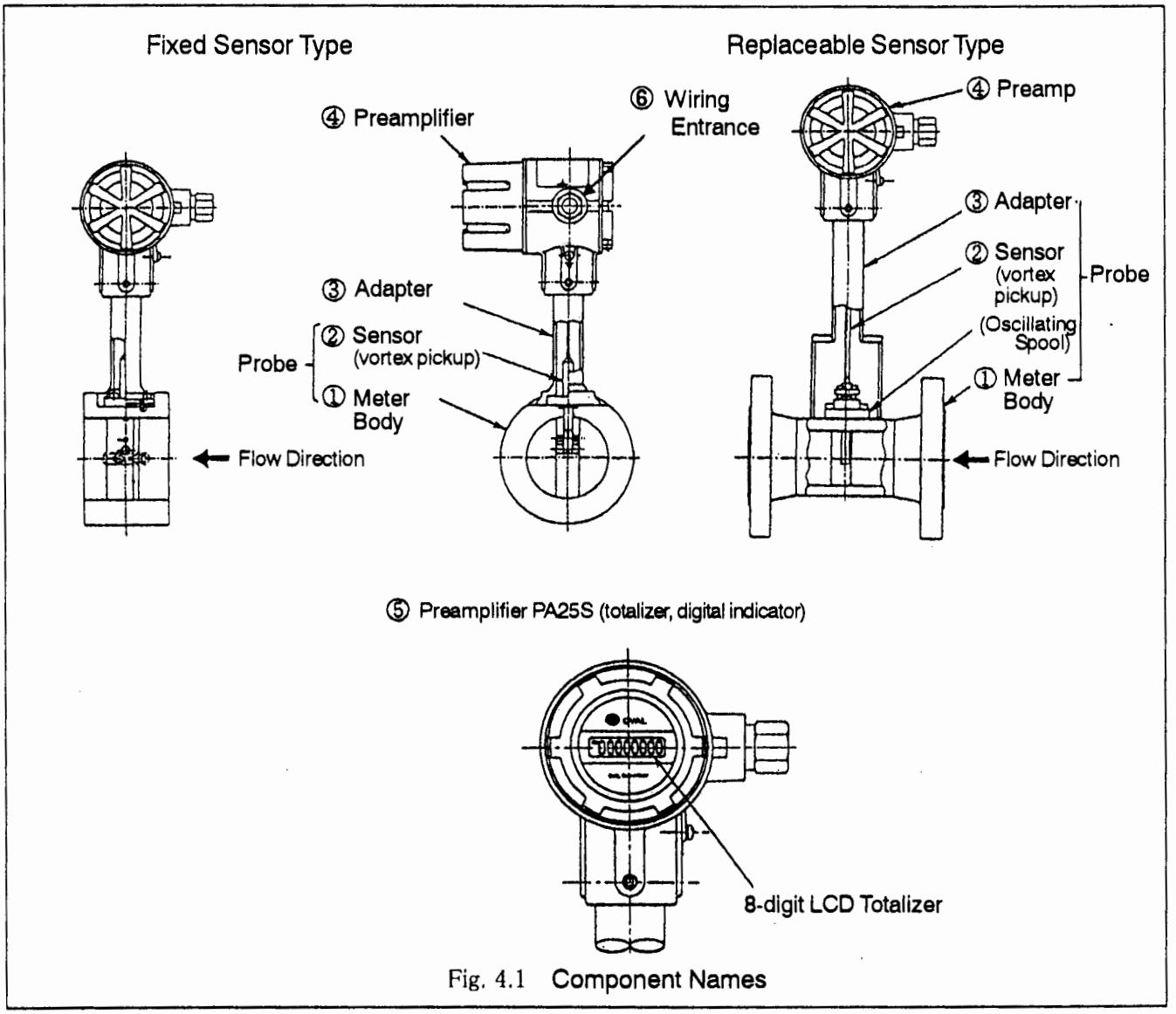


Fig. 4.1 Component Names

① Meter Body: Consists of a measuring pipe and a vortex shedding body (bluff body). As the metered material flows, von Karman vortices form and shed behind the bluff body.

② Sensor (vortex pickup) -
- Fixed sensor type: Has a built-in piezoelectric sensor. All weld parts are made of stainless steel for maximum life expectancy(common to all meters 40mm and larger in nominal diameter).
- Replaceable sensor type: Consists of an oscillating spool which transmits the alternating changes in pressure by Karman vortices to the sensor above as mechanical displacement. The sensor, which is isolated from the process fluid, is removable without the need of interrupting the process flow.

③ Adapter: Connects the meter body with the preamplifier. Also serves to protect the sensor and dissipate heat.

④ Preamplifier: Transforms changes in electric charges generated from the sensor into an output signal representing the flowrate. Consists of the interface board, amplifier board, isolation board, CPU board, and display. Output comes in three types – unscaled pulse output, scaled pulse output and analog output.

⑤ Preamplifier PA25S (totalizer and digital indicator)
Physical orientation of the preamplifier is adjustable in steps of 90 deg. around the adapter axis (see Sec. 6.3 on page 12). The display can also be oriented in steps of 90 deg. within the preamplifier housing.

⑥ Adapter (internal thread NPT1/2) at wiring entry is secured with thread sealant. Never attempt to remove it.

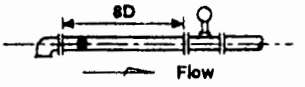
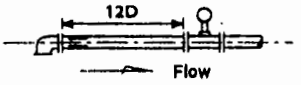
5. PIPING INSTRUCTIONS

For general considerations to be observed, refer to JIS Z 8766, "Flowrate Measurement Methods with Vortex Flowmeters."

5.1 Standard Piping Conditions

It is generally required that the flow pattern of a material moving into an inferential type meter be as uniform as possible for precise metering. Accordingly, proper flow straightening measures must be taken when the application engineer considers installation of a delta meter. In applications where OVAL straightening devices (flow straightener, honey vane, and downstream pipe) are used, a straight pipe section is not required unless otherwise specified. But if you plan to solve the flow pattern problem with a straight pipe section alone, secure the length of a straight pipe conforming to the ISO standards given in Table 5.1 below, using a Sch. 40 pipe:

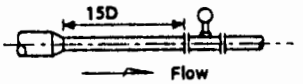
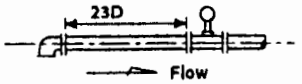
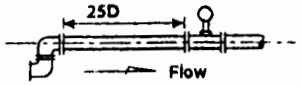
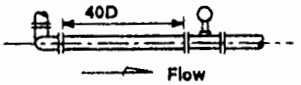
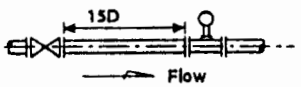
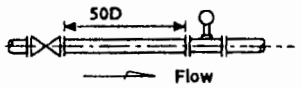
(1) OVAL flow straightener combined with downstream pipe (25mm and up in nom. dia.)

No.	Arrangement		Remarks
1	Honey vane L		⇨ See Fig. 5.1 on page 9.
2	Flow straightener		⇨ See page 56 for face-to-face dimensions.

(2) Straight pipe alone without flow straightener

To match the meter diameter, use a Sch. 40 pipe for the straight pipe.

Table 5.1 Straight Pipe Lengths Recommended by ISO-5167 D =Nom. dia.

No.	Arrangement		Remarks
1	Reducer		A concentric reducer is upstream of meter.
2	Elbow		An elbow is upstream of meter.
			Two elbows are horizontally upstream of meter.
			Two elbows are vertically upstream of meter.
3	Gate valve fully open		A full-open gage valve is upstream of meter.
4	Gate valve partially open		A partially open gage valve, a narrow orifice, or something that considerably disturbs the flow pattern is upstream of meter.

(3) Space Saving Arrangement

If required straight pipe space is not obtainable upstream of the vortex flowmeter due to existing restrictions on installation location, the OVAL Honey Vane S combined with a short pipe may be used to get around the Space problem. EX Delta SS with a built-in Honey Vane S requiring no upstream Straight pipe is accurate to ±2% RD in liquid applications. Accuracy varies with the length of short pipe,. consult factory for application assistance.

• Honey Vane Outline Dimensions

Dimensions in millimeters

Nom. Dia. (mm)	ϕ D*	Honey Vane S	Honey Vane L
		t	L
25	74	3.5	200
40	89	5.4	320
50	104	6.9	400
80	134	10.2	640
100	159	13.3	800
150	220	19.6	1200
200	270	26	1600
250	333	32.3	2000
300	378	38.7	2400

*: Dimensions at JIS 10K

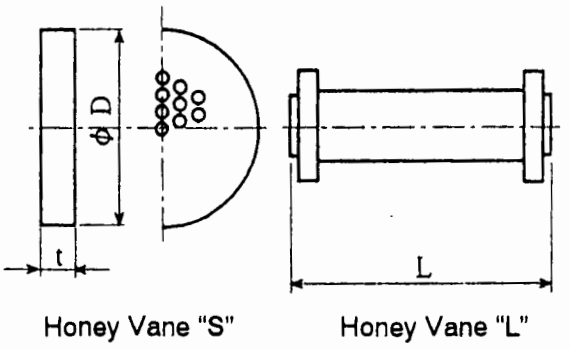


Fig. 5.1

➡ **NOTE:** The dimensions of honey vane built-in EX Delta (EX Delta SS) remain the same as those of standard EX Delta, flanged type (see page 51).

5.2 Pipes to be Used

Nominal thickness Sch. 40 pipes should be used for upstream and downstream pipes of this meter.

5.3 Location of Pressure Gage and Thermometer Taps

Taps for the pressure gage and/or thermometer, if desired, should be located as illustrated in the figure at right.

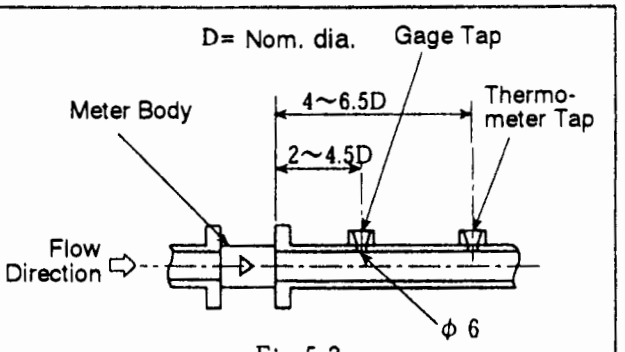


Fig.5.2

5.4 Ripples

Compressors, Roots blowers and other ripple pressure generating sources could adversely affect meter performance. Minimize pulsating pressures by referring to the following formula:

$$N < 2.25\rho V^2 \ (mmH_20)$$

where N: Ripple pressure (mmH_20)
ρ: Density (kg/m^3)
V: Minimum velocity (m/s)

If ripple pressure is excessive, the following measures should be taken into consideration:

① Locate the source of ripples downstream of the meter or locate it as far from the meter as possible.
② provide a ripple attenuator, such as a chamber or pulsation snapper.
③ Shut off valves upstream and downstream of the meter when fluid flow is interrupted (as a precaution against erratic signal generation at zero flow).

5.5 Prevention of Cavitation (liquid service)

To prevent cavitation, line pressure should be maintained above the level calculated by the following formula

$$P \geqq 2.60\Delta P + 1.25P_0 \ (MPa \ abs)$$

where ΔP: Pressure loss (MPa) $= 2.4 \cdot \gamma / 2g \cdot V^2 \times 10^{-4}$
P_0: Steam pressure of liquid (MPa abs)
γ: specific weight (kg/m^3)
V: Flowrate (m/s)
g: Acceleration of gravity ($9.8/s^2$)

5.6 Prevention of Excessive Flowrate

To ensure long meter life, transient flowrate should be held below 1.6 times the meter's maximum rating. Shown below are typical examples in steam measurement where excessive flow is often encountered:

Examples where meter's maximum rating is exceeded on a monetarily basis

In steam measurement

When $P_1 \gg P_2$, quickly opening the valve will result in a fluid flow at a rate dependent on the line resistance (mainly valve port position in "A" or meter resistance in "B"). The resultant rate of incoming flow is the sum of the downstream pipeline volume and consumption, but if pressure differential across the valve is great, the fluid velocity will easily reach the sonic speed, momentarily well in excess of meter's maximum rating. (Such phenomenon is often experienced at system startup or in batch operation.)

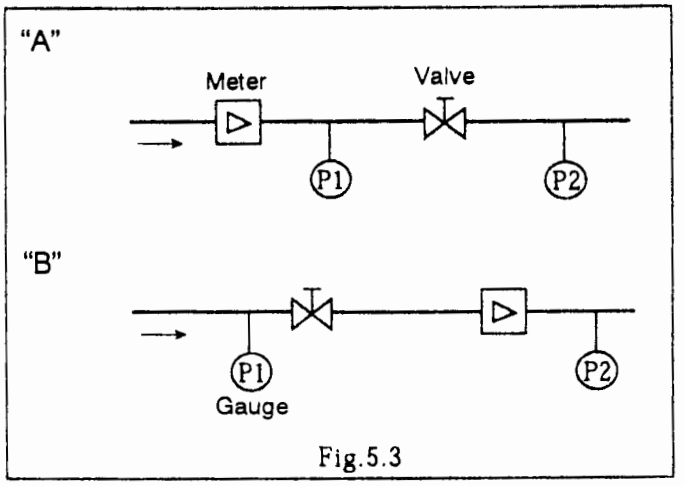


Fig.5.3

6.3 How to Change Preamplifier Orientation

The preamplifier can be oriented to the desired direction in 90. steps as shown in Fig. 6.3.

➡ CAUTION: To change the orientation, hex key (JIS B 4648), nominal size 4 is required. The preamplifier can be rotated by loosening its four hex socket head screws, but be sure to disconnect sensor leads before attempting to rotate it.

⚠ **CAUTION: Turning the preamplifier with sensor leads in place may damage the sensor.**

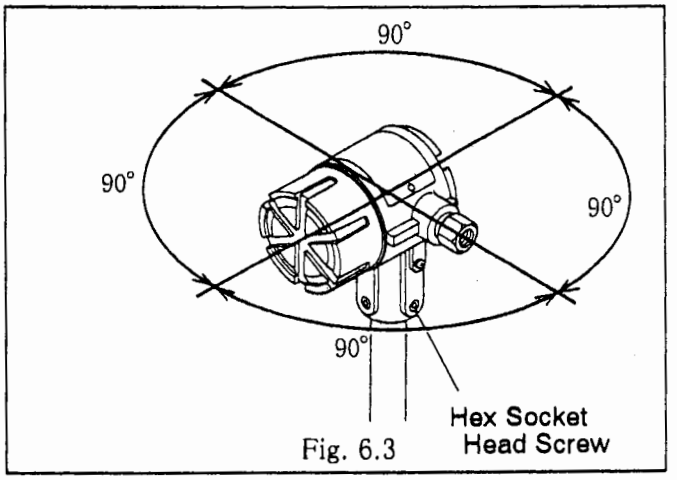


Fig. 6.3

Procedure

Refer to Section 15, "ASSEMBLY DRAWINGS AND PARTS LIST" on pages 37 through 40.

① Turn off power.

② Remove the terminal box cover (Fig. 6.4).

③ Separate the shield strip (Fig. 6.5).

④ Disconnect sensor leads from the terminal block.

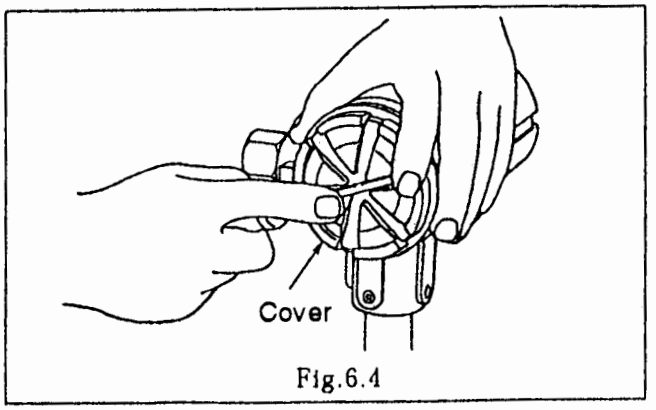


Fig.6.4

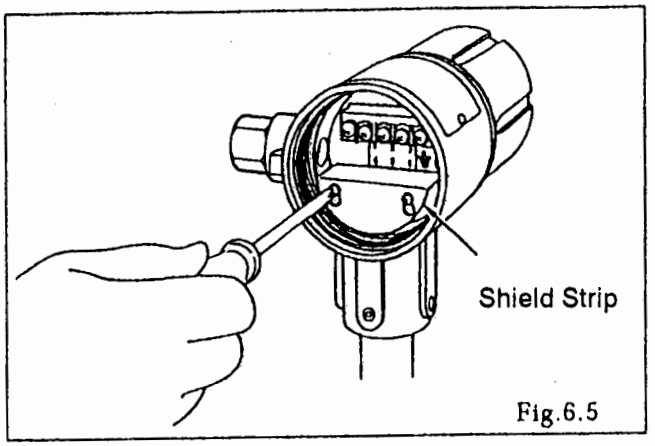


Fig.6.5

⑤ Loosen a total of four hex socket head screws securing the preamplifier's neck (Fig. 6.6).

⑥ Turn the preamplifier to the desired direction, exercising care not to force the sensor leads.

⑦ when the preamplifier orientation has been set, assemble in the reverse order of removal.

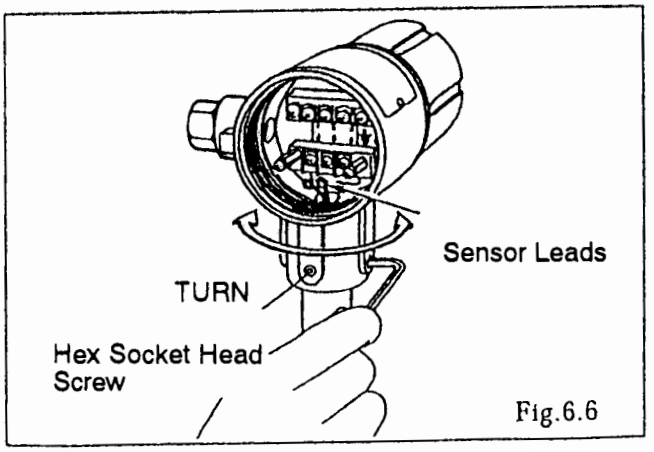


Fig.6.6

6.4 Separately-Mounted Type Preamplifier Installation

① The maximum transmission length from the sensor is 200 meters,. install the preamplifier within this length.
② The preamplifier requires installation on a horizontal or vertical steel pipe 2 inches in diameter with furnished U-bolt.
③ select an installation location easy for maintenance and in a desirable environment.

⚠ **CAUTION**

Use watertight type conduit (NPT1/2) from the separately-mounted type preamplifier to the sensor and ensure good electrical contact of leads at terminals. Seal the clearance between conduit end and wiring entry with RTV, or suitable sealant, for waterproofing.

⚠ **IMPORTANT**

Locations that comes under any of the following conditions should be avoided:

① Difficult for inspection and maintenance.
② Temperature change and/or vibration is excessive.
③ Possible immersion in water.

Installation on a Horizontal Pipe

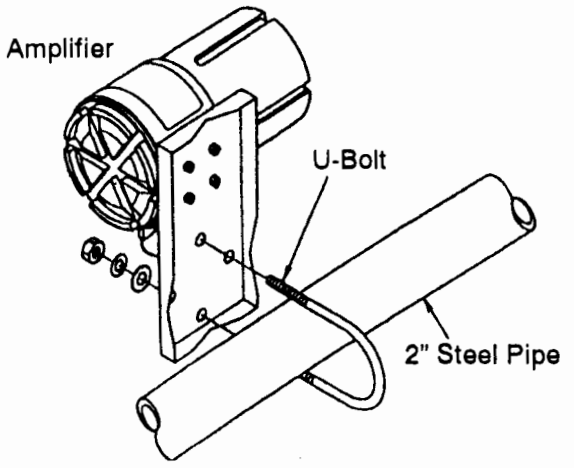


Fig.6.7

Installation on a Vertical Pipe

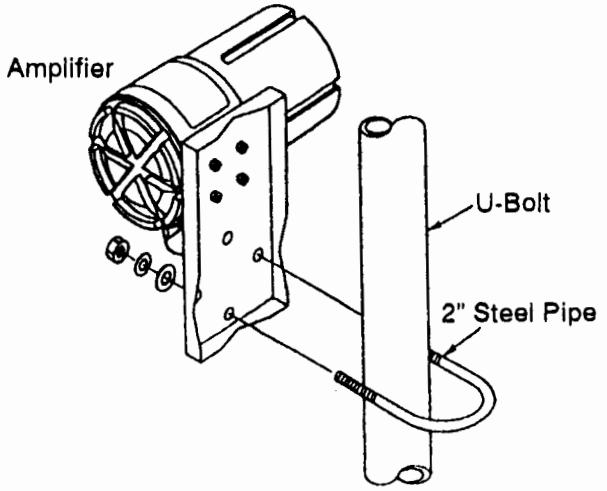


Fig.6.8

6.5 How to Change Indicator and Totalizer Orientation

If the preamplifier is equipped with local display (indicator and totalizer), the display assembly can be rotated to the desired direction in 90° steps through 360° . By changing the angle of display assembly (internal assembly), the indicator or totalizer appears for maximum readability on a vertical run or a horizontal run.

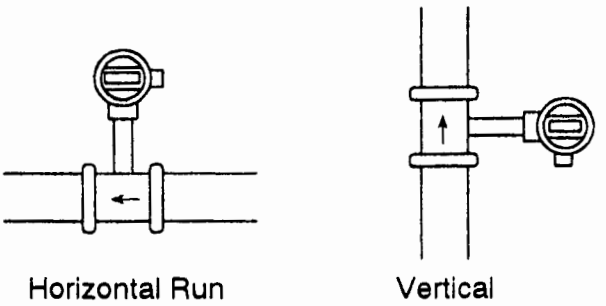


Fig.6.9

How to Change Display Angle

Refer to See. 14.3 "Display Installation (option)" on page 36 and See. "Section 15 ASSEMBLY DRAWINGS AND PARTS LIST" on pages 37 through 40.

⚠ **WARNING:**
In the case of externally powered model, be sure to remove power before your work.

① Remove the window cover (Fig. 6.10).

② Loosen four screws holding the display assembly and remove the display assembly from its connector (Fig. 6.11).

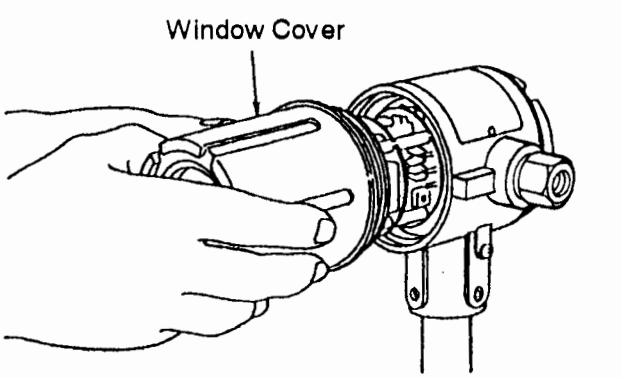


Fig.6.10

➡ **NOTE:** The procedure above applies to the separately-mounted type preamplifier.

③ Orient the display assembly to the desired angle, install it as far into the connector as it will go and secure it with four screws (adjustable in 90° steps).

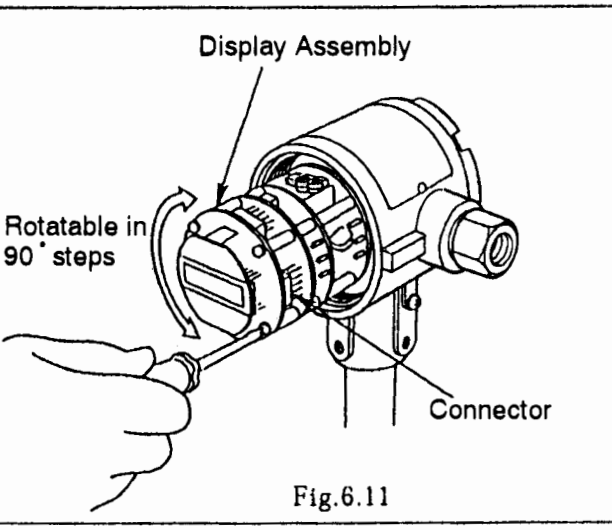


Fig.6.11

➡ **IMPORTANT:** Make sure it is pushed in as far as it will go.

④ Install the window cover in place.

⚠ **WARNING: The cover must be screwed in as far as it will go.**

6.6 Installation procedure

Install the meter body in the following manner:

6.6.1 Wafer Type

① Install adjust rings on the meter periphery at both ends. ANSI 150 and JPI 150 of 25 millimeters in nominal diameter do not require adjust rings.

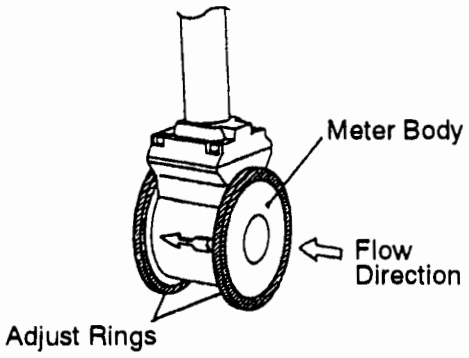


Fig.6.12

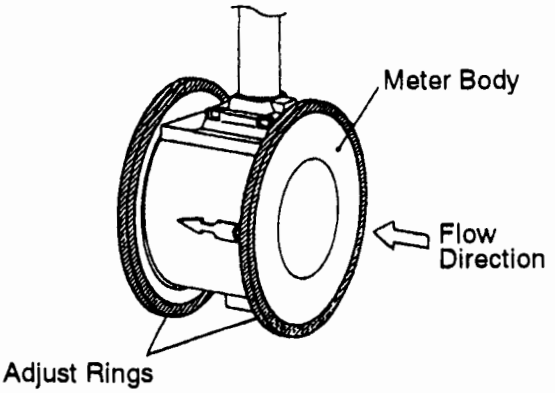


Fig.6.13

② Fitting flange gaskets at both Sides, sandwich the meter body between flanges.

⚠ **CAUTION: Exercise care not to allow flange gaskets to extrude into the interior of the meter (pipe), or meter accuracy will suffer.**

Nominal dia. 15mm – 25mm

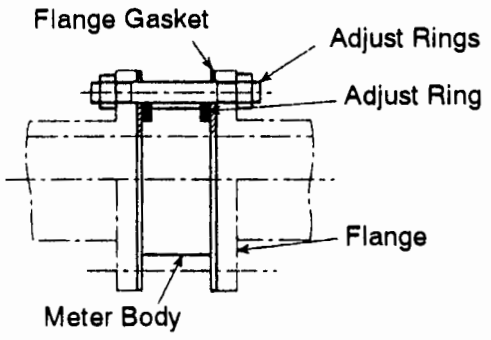


Fig.6.14

Nominal dia. 40mm – 150mm

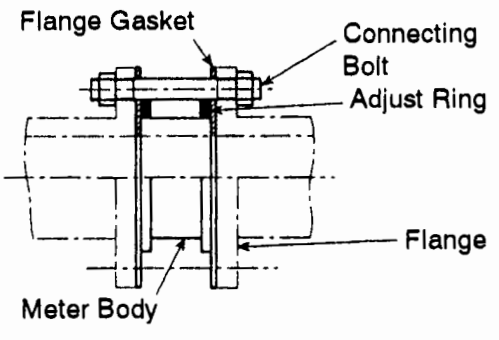


Fig.6.15

③ Pass the connecting bolts through their openings and tighten up the bolts. Individual bolts are now in contact with the adjust rings and the inner wall of flange boltholes, forcing the meter body to be concentric to the pipeline.

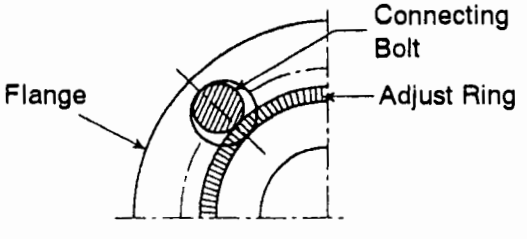


Fig.6.16

⚠ **IMPORTANT**

Unless adjust rings are installed in place, flowmeter-to-pipe misalignment will result in loss of meter accuracy. Be sure, for this reason, to fit the adjust rings in place before bolting the flanges.

6.6.2 Flanged Type

① Align the meter flange periphery with the pipeline flange periphery and bolt them together with hex bolts.

② It is preferable to use the flange gaskets furnished with the meter.

⚠ **CAUTION**

Do not use flange gaskets the I.D. of which is smaller than the meter I.D. Do not allow flange gaskets to protrude into the meter body (pipe), or meter accuracy will suffer.

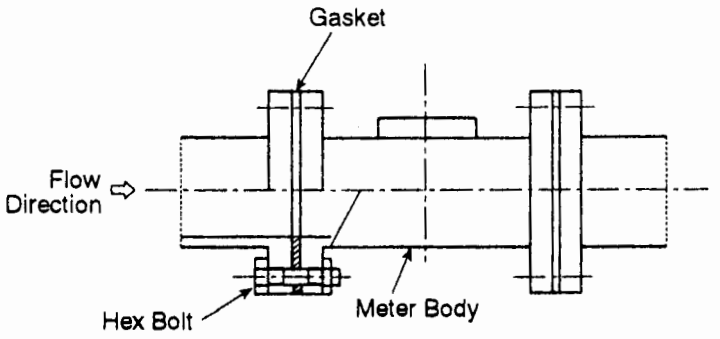


Fig.6.17

6.7 Lagging Work

In steam service, the meter must be insulated thermally. To facilitate maintenance and servicing, simple lagging (without mortar finish) is suggested for the area where the meter is installed.

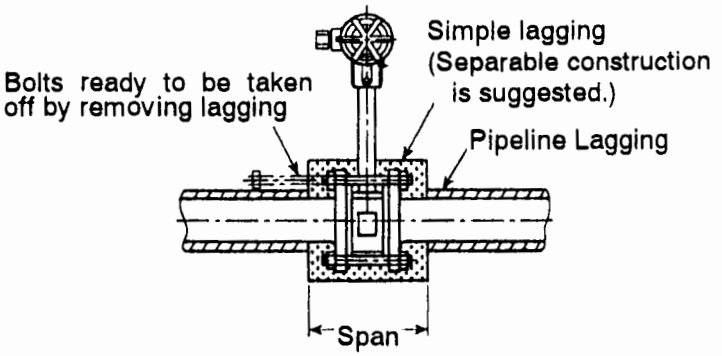


Fig.6.18

6.8 Ambient Temperature

Given in Fig. 6.19 is the allowable process fluid temperature relative to the ambient temperature.

Ensure that the ambient temperature is held within the rating.

If there is a possibility that the ambient temperature exceeds the allowable limit, the following measures
should be taken into consideration.

- Avoid exposure to the direct rays of the sun.
- Separate from the piping and equipment of elevated temperatures or provide a heat shield.
- Thermally insulate the preamplifier (in a low temperature environment).

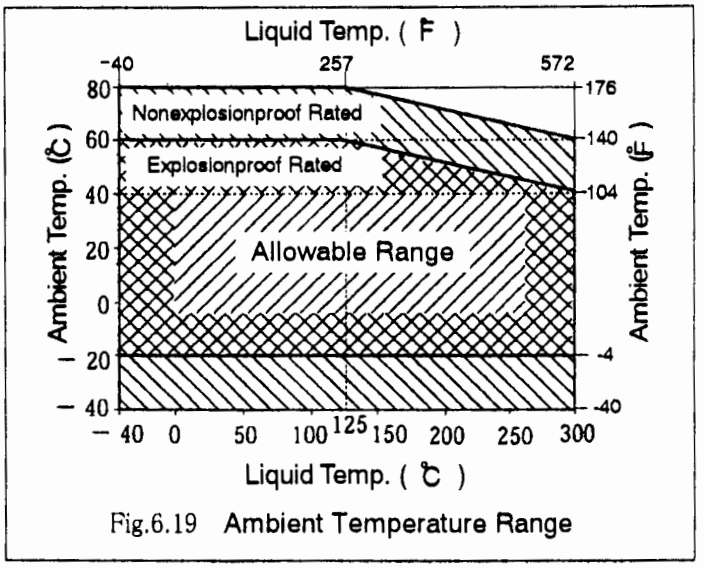


Fig.6.19 Ambient Temperature Range

7. WIRING CONNECTIONS

7.1 Wiring Specifications

Wiring Entry	Watertight conduit (internal threads NPT1/2) and seals are required to maintain the moisture-free integrity of all enclosures.
Transmission Length	Preamplifier to receiving instrument: 1 kilometer max. Probe to preamplifier: 200 meters max. (separately-mounted model)
Cables Used	Probe to preamplifier: 3-conductor shielded cable 1.25mm^2 min. Preamplifier to receiving instrument: 2-conductor shielded cable 1.25mm^2 min. Finished outside diameter: Max. ϕ 13.5mm with cable heat resistant to 70 ˚C (158 ˚F) or higher.
Terminal Block	Cross recess pan head screws, M3.5
Explosionproof Work	References: NEC Art. 500NFPA70 for U.S. and CEC Part 1, CSA Standard C22.1 for Canada Follow the instructions on the warning labels with this instruction manual. Ensure to earth ground the preamplifier. Do not attempt to remove the adapter attached to the preamplifier.

Table7.1

7.2 Terminal Connections

Output Specification	Terminal No.
Both analog type and pulse output type	① + ② -

Table 7.2 Terminal Identification

⚠ **NOTE: Cable shield must be grounded to the earth ground terminal in the terminal box.**

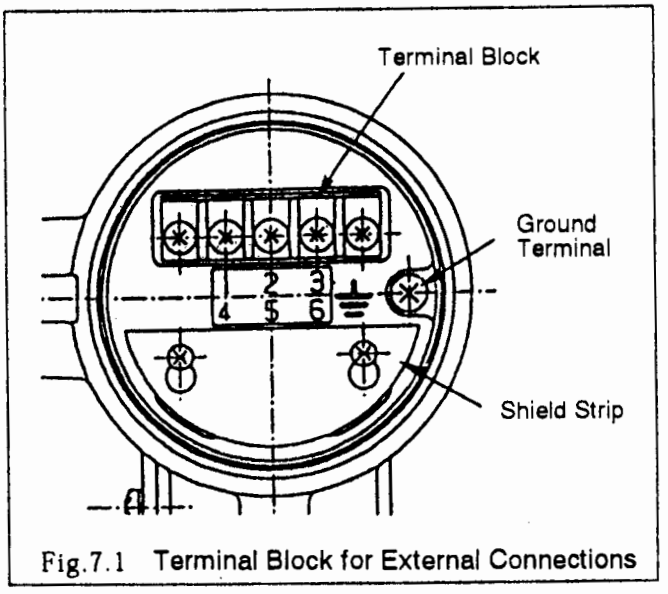


Fig.7.1 Terminal Block for External Connections

7.3 Separately-mounted Type Preamp to Sensor Terminal Box Wiring Connections

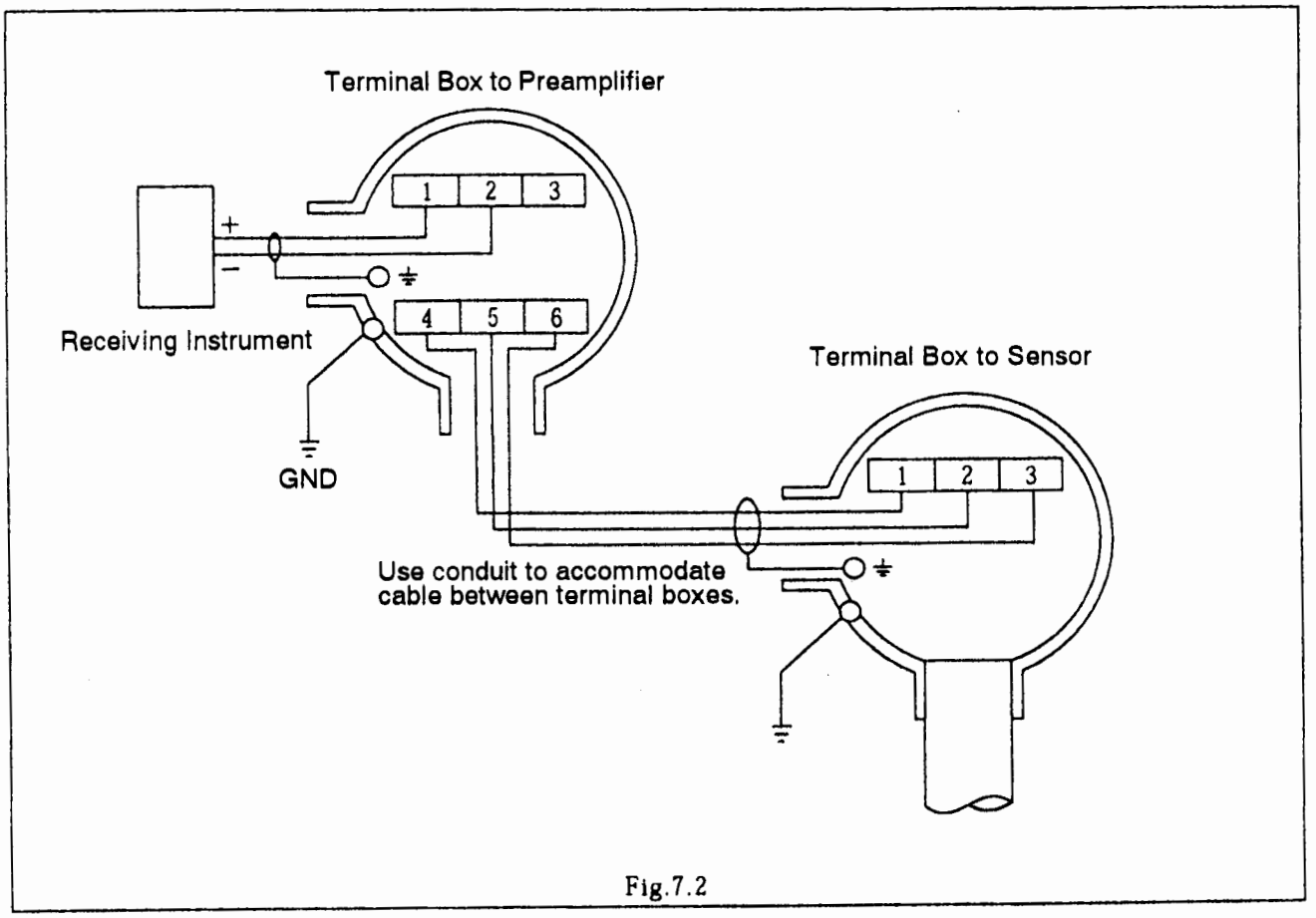


Fig.7.2

7.4 Terminal Box Cover Removal

Apply the key to the terminal box cover and turn it as shown until the cover comes off. The terminal block is now accessible.

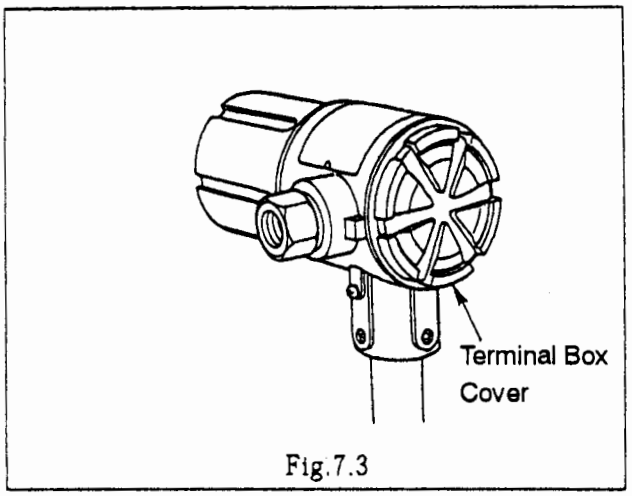


Fig.7.3

① The illustration above shows the terminal box cover to be removed.

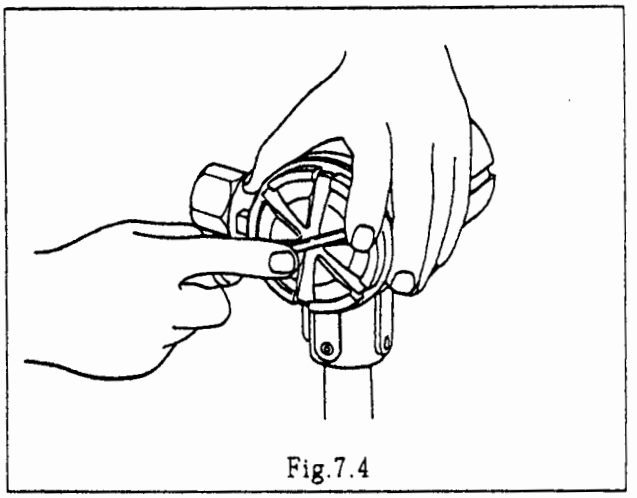


Fig.7.4

② Apply the key to the terminal box cover and turn it as shown until it comes off. The terminal block is now accessible.

7.5 Considerations on wiring Connections

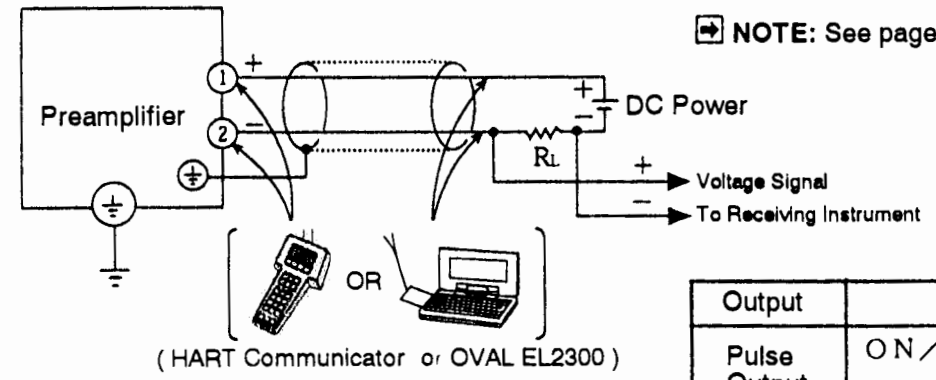
① Use watertight type conduit at wiring entry and ensure to seal the connecting point.
② Cable ends are terminated with M3.5. Use applicable crimp-style terminals.
③ The ground terminal of the preamplifier must be earth grounded.
④ Pitch down the cable at the cable entry to prevent rainwater and moisture from getting into the equipment.
⑤ To eliminate the possibility of stray current pickup, route field wiring. Sufficiently away from high tension lines, power lines and power equipment.
⑥ In a district where lightening is expected, a lightening arrestor should be provided.

7.6 Hookup With Receiving Instruments

The 2-wire signal transmission system used in this flowmeter furnishes DC power to the meter. It serves as the power line and signal line as well with pulse or analog current output.

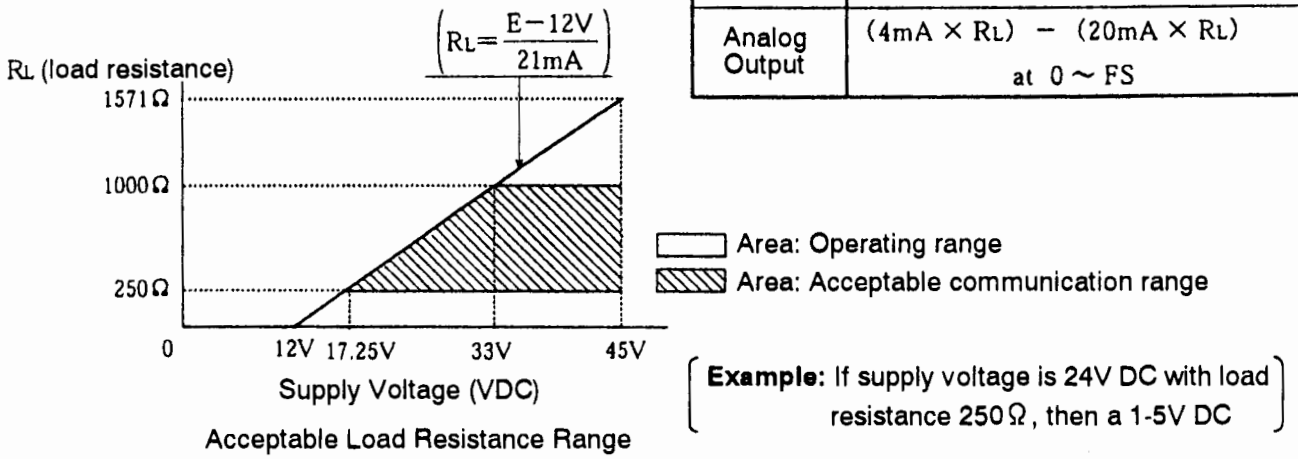
An OVAL receiving instrument can be coupled directly, but instruments in general which are designed to accept a voltage signal input require a load resistor connected in series for voltage conversion. Since the voltage signal level varies with the load resistance value, determine the load resistance value by referring to the receiving instrument specifications and the acceptable load resistance range shown below.
Communications with a suitable communication unit (e.g. HART Communicator or OVAL Smart Communication Unit EL2300) requires a 250~1000Ω load.

● **In case a voltage input is fed to the receiving instrument**



NOTE: See page 16 for terminal identification.

Output	Voltage Signal (V)
Pulse Output	ON／OFF＝ (20mA × RL) ／ (4mA × RL)
Analog Output	(4mA × RL) − (20mA × RL) at 0 ~ FS



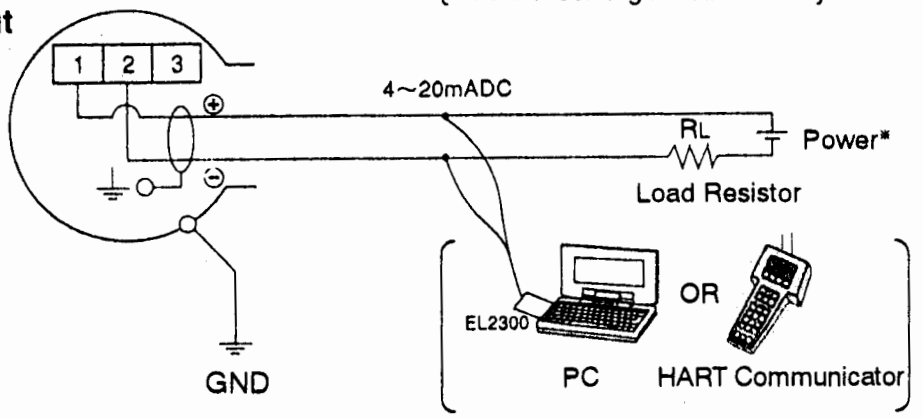
Example: If supply voltage is 24V DC with load resistance 250Ω, then a 1-5V DC

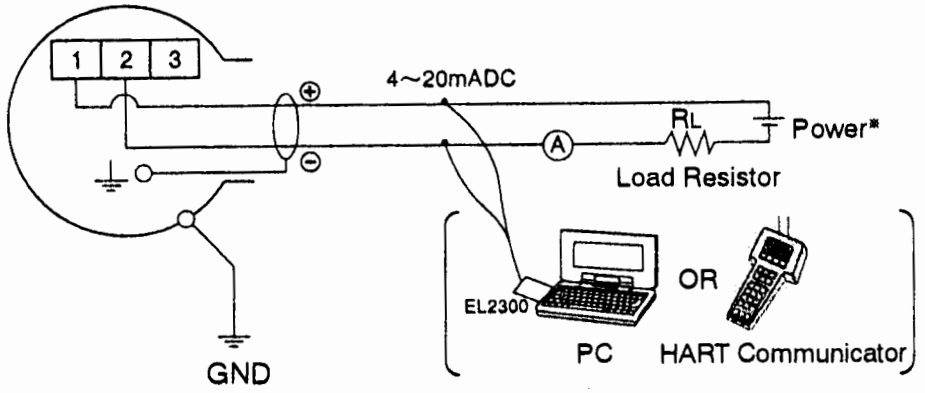
Fig. 7.5

7.7 Diagrams Showing Wiring Connections

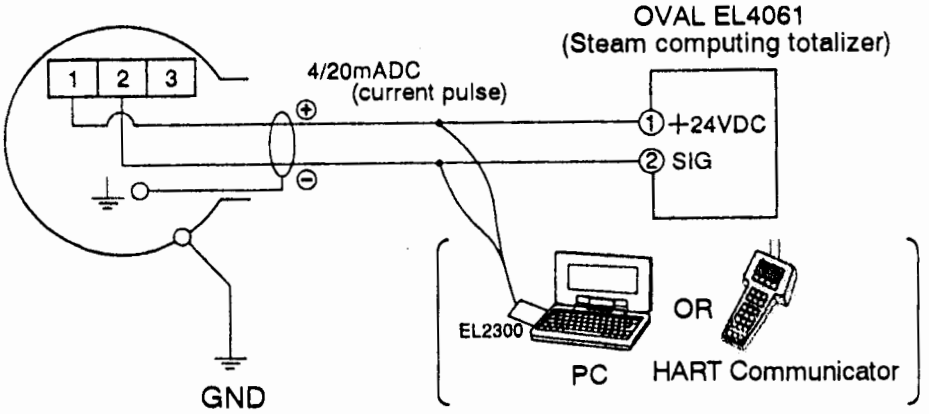
Only examples are shown. Follow the instructions of the receiving instrument of your choice.

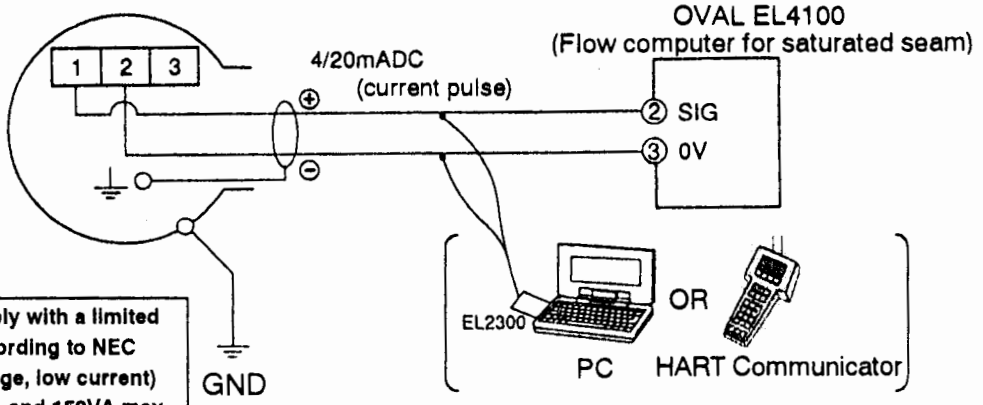
Analog Output





Pulse Output





※ Use a SELV supply with a limited power circuit according to NEC Class 2 (low voltage, low current) limited to 8A max. and 150VA max.

8. OPERATION

8.1 Flushing the Piping Assembly

On a newly installed piping assembly where scale, Sludge and other foreign matter are expected, flushing the piping assembly is necessary before commencing meter operation.

In order to Safeguard the meter, use a bypass line for flushing. If there is no bypass line, install a short pipe section in place of the meter as shown in the sketch at right.

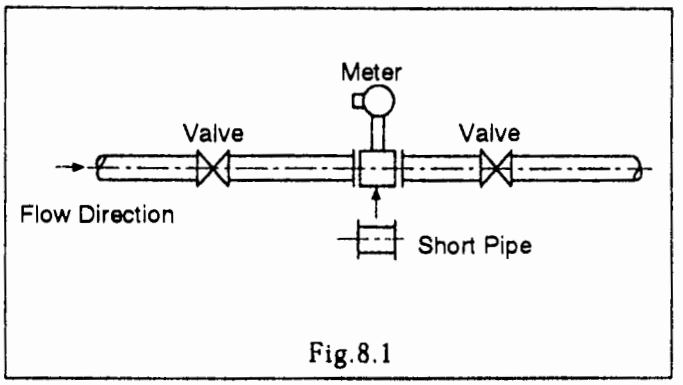


Fig.8.1

8.2 Operation Procedure

① Drainage (in steam service)
To prevent steam hammer, drain the piping assembly completely.

② Checking the meter for proper installation
To ensure Safety, inspect connecting bolts, gaskets, etc. for tightness and other condition.
Make sure of the flow direction also.

③ Leak check
Fill the meter with fluid and check for any leak.

④ Upon completion of wiring connections, turn on power.
Verify that the receiving instrument will not register erratic counts with no flow.

⑤ Starting up the measurement line
By starting up the pump or opening up the valve, carefully allow the fluid to flow.

⚠ **CAUTION: To safeguard the equipment connected against damage, avoid sharp increase in flowrate.**

⑥ Checking the operation
Verify that the receiving instrument registers properly.
Make sure that the fluid conditions (pressure, temperature, etc.) and flowrate conform to the meter specifications.

9. FLOW SENSITIVITY ADJUSTMENT PROCEDURE

Flow sensitivity is accurately adjusted over the specified flow range before leaving the factory. However, in cases where the sensor has been replaced or if the receiving instrument registers erratic counts at meter shutoff due to noises caused by pipeline oscillation, for example, sensitivity readjustment will be required.

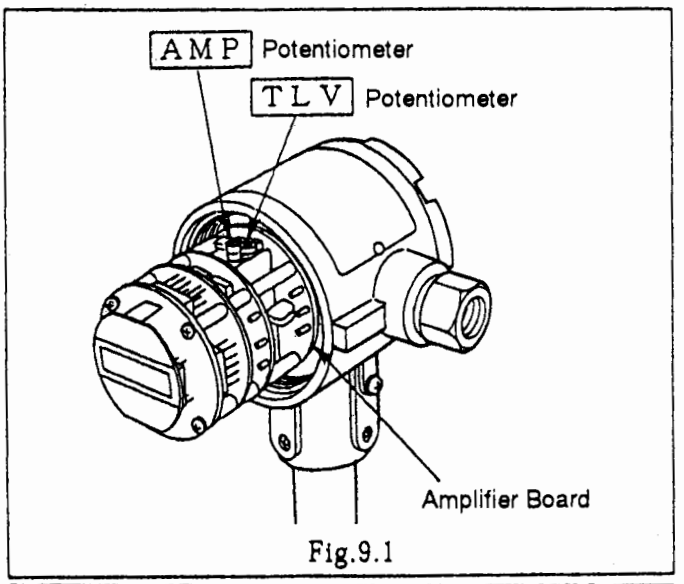


Fig.9.1

9.1 Amplifier Gain

Amplifier gain (amplification) is adjusted to the sensor used. Do not attempt to readjust it except when the sensor has been replaced. Amplifier gain is adjustable with AMP potentiometer on the amplifier board. Monitor the vortex wave form following amplification on the oscilloscope and adjust such that the peak value of vortex wave form is $100mV_{p\text{-}p}$ approx. at the minimum flowrate.

Sensitivity Potentiometer	Vortex Waveform After Amplification
Amplifier Board AMP	Amplifier Board VTX (+) — 0V (-)

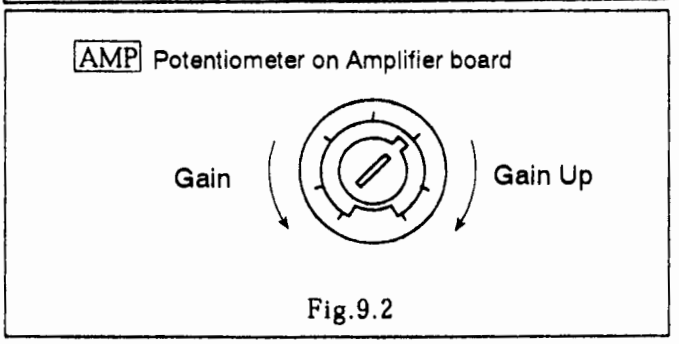


Fig.9.2

9.2 Trigger Level

With increasing trigger level (sensitivity to pulse generation), flowrate sensitivity decreases. Erratic pulse generation attributable to noises caused by pipeline oscillation, pulsating flows, etc. at meter shutoff can be treated effectively by increasing the trigger level.

Trigger level is adjustable with TLV potentiometer on the amplifier board.

Whenever the peak value of amplified vortex wave form exceeds a predetermined trigger level, it is converted to a pulse.

Hence, flow sensitivity decreases with increased trigger level; the influence of noises produced at meter shutoff, etc. can be suppressed by adjusting the trigger level.

The trigger level is factory adjusted to $80mV_{p\text{-}p}$ before shipment.

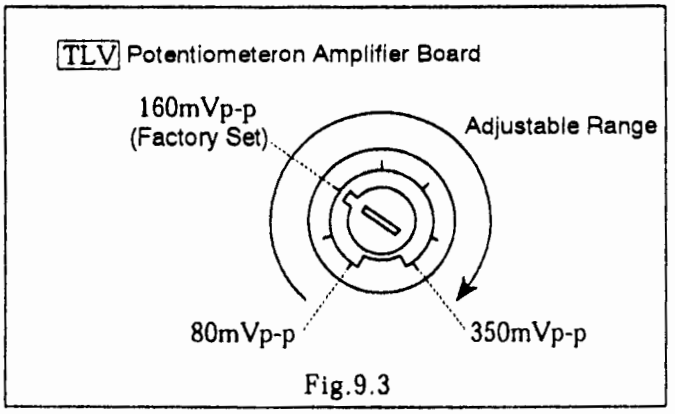


Fig.9.3

Trigger Level Potentiometer
Amplifier Board TLV

① By increasing the trigger level, the flowrate sensitivity decreases with the ratio of trigger level (sensitivity ratio).

Example: When a trigger level 80mV$_{p-p}$ is changed to 350mV$_{p-p}$, the resultant sensitivity will be 80/350% ≒ 1/4.4 (sensitivity ratio) times.

② When sensitivity is changed, the resultant minimum flowrate (measurable lower bound flowrate) is approximately the standard minimum flowrate multiplied by $\sqrt{1/(\text{Sensitivity ratio})}$.

Example: When a trigger level 80mV$_{p-p}$ is changed to 350mV$_{p-p}$, the resultant minimum flowrate will be approximately $\sqrt{350/80}$ = 2 times the minimum flowrate.

10. PARAMETER SETUP

Establishing the following parameters configures specifications of individual flowmeters.

Parameters are set through communications using a PC and HART Communicator or OVAL Smart Communication Unit (Model EL2300). (See the section under the topic "Wiring Connection."

Since parameters are correctly established before the meter is delivered to the customer, no further configuration is normally required.

For procedures to review and set up parameters see the instruction manual for HART Communicator or OVAL EL2300.

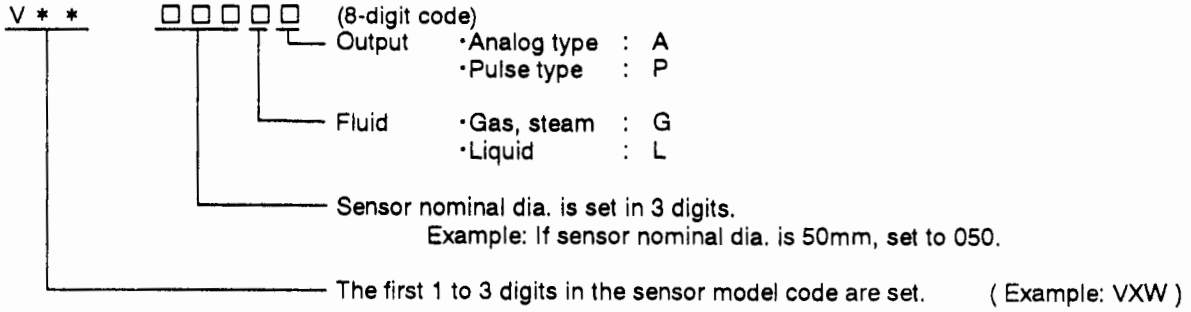
● **Description of Parameters**

Parameter	Setup Range or Item to be Selected	Units of Measurement
Tag No.	Enter alphanumeric up to 8 characters.	
Sensor serial No.	Enter numerals up to 7 characters.	
Sensor type	Set the flowmeter type conforming to the flowmeter model code. Enter alphanumeric up to 8 characters. *	
Date of manufacture	Numerals (the year represented by 2-digits)	
Sensor material	Select one from SUS316, Hastelloy C, Monel, tantalum, special, or unknown.	
Flange ratings	Select one from JIS 10K, JIS 20K, JIS 30K, ANSI 150, ANSI 300, ANSI 600, special, or unknown.	
Description	Alphanumeric: accepts 16 characters max. Generally used for entering brief comments.	
Message	Alphanumeric; accepts 16 characters max.	
Preamplifier display	Setup of the type of totalizer display in the flowmeter preamplifier. Select one from ·Total flow ·Actual instantaneous flowrate ·% instantaneous flowrate	
Instantaneous flowrate units	① L/min, L/h, m^3/min, m^3/h, kL/min, kL/h ② L/min [normal], L/h [normal], m^3/min [normal], m^3/h [normal] ③ g/min, g/h, kg/min, kg/h, t/min, t/h ④ ton (U.S.)/min, ton (U.S.)/h ⑤ gal/(U.S.)/min, gal (U.S.)/h ⑥ Ft^3/sec, Ft^3/min, Ft^3/h ⑦ SCFS, SCFM, SCFH ⑧ lb/min, lb/h Select one from the available units having the same unit as the attribute number at "Totalized flow and scaled pulse units" setup menu.	
Measurement units of total flow and scaled pulse output	① L, m^3, kL ② L [normal], m^3 [normal] ③ g, kg, t ④ ton (U.S.) ⑤ gal (U.S.) ⑥ SFt^3 ⑦ NFt^3 Select one from the available units having the same unit as the attribute number at "Totalized flow and scaled pulse units" setup menu.	
Temperature units	One selected from °C, °F, or K	
Pressure units	Select one from Pa, kPa, MPa, mmHg, psi, bar, atm, or torr. (Each unit shows gage pressure except for mmHg, atm, and torr.)	
Meter factor (value at 20 °C [68 °F]	Within ±50% of nominal meter factor	L/P
Linear expansion coeff. (α)	0 ≦ "Linear expansion coeff. (α)" ≦ 0.00003 Default setting: 0.000016	
Linear expansion coeff. (β)	0 ≦ "Linear expansion coeff. (β)" ≦ 0.00003 Default setting: 0.000016	

Cont'd

Parameter	Setup Range or Item to be Selected	Units of Measurement
Metered fluids	Select one from ·Gas and steam ·Liquid	
Calculation	Select one from ·Calculation on actual flow ·Calculation corrected for temperature and pressure ·Saturated steam calculation ·Superheated steam calculation	
Reference temperature for correction	·With "Calculation on actual flow" or "Calculation corrected for temperature and pressure at "Calculation," −250 ≦Reference temperature for correction" ≦450[˚C] ·With "Saturated steam calculation" or "Superheated team calculation at "Calculation," −100 ≦Reference temperature for correction" ≦450[˚C] NOTE: By the "Temperature units" setup, convert the temperature range above.	By "Temperature units"
Reference temp. for measurement (process temp.)	Same as "Reference temperature for correction."	By "Temperature units"
Reference pressure for correction	−0.098 ≦"Reference pressure for correction" ≦10.8MPa NOTE: Relative to the pressure unit setup, convert the pressure range above.	By "Pressure units"
Reference pressure for measurement (process pressure)	Same as "Reference temperature for correction."	By "Pressure units"
Fixed conversion value	0.0001 ≦ Fixed conversion value ≦"99999999." When the mass flowrate units are selected with "Calculation on actual flow" or "Calculation corrected for temperature and pressure" at "Calculation," set the density (fixed value). Deviation factor is set up, in practice, by setting [1/deviation factor].	Calculation on actual flow in kg/m^3 [normal]; "Calculation corrected for temperature and pressure" in kg/m^3 [normal]
Zero flowrate	Always set to 0.	By "Instantaneous flowrate units"
Span flowrate (full scale flowrate)	Min. flowrate × 3 ≦"Span flowrate ≦"Max. flowrate × 1.5 (See "General Specifications" for the max. and min. flowrates.)	By "Instantaneous flowrate units"
Low cutoff flowrate	Set up such that 0 ≦"Low cutoff flowrate<"Span flowrate" or "High alarm flowrate"	By "Instantaneous flowrate units"
High alarm flowrate	"High alarm flowrate">0 where "High alarm flowrate">"Low cutoff flowrate"	By "Instantaneous flowrate units"
Weight of totalized flow and scaled pulse output	0.01≦"Pulse width"≦10000 (See "General Specifications.")	By "Totalized flow and scaled pulse units"
Pulse width (scaled pulse)	10 ≦"Pulse width" ≦1000 where pulse width duty at full scale must be below 50%. Default setting: 50	ms
Pulse output type	Select one from ·Scaled ·Unscaled	
Damping (analog, Instantaneous flowrate)	0≦"Damping" ≦100 Default setting: 50	s

※ "Sensor type" (flowmeter type) is represented by the following:



11. BUILT-IN DISPLAY FUNCTIONS AND OPERATION (For Totalizer or indicator equipped model)

Description of Display Functions

This totalizer can display a total of four different readings: total flow, actual instantaneous flowrate, percent instantaneous flowrate, and 8-division % bar graph. It also shows the following error messages:

Full scale is exceeded : Error FS
Upper-end flowrate is exceeded : Error OF

➡ **NOTE:** When both errors above have occurred, message "ErrorOF" has priority over the other.

11.1 Display Selection (totalizer equipped model)

Display is selectable either with the display select switch located inside the preamplifier or through communications using the Smart Communication unit.

If communications is your choice, follow the instructions outlined in the instruction manual for the HART Communicator or OVAL EL2300.

➡ **NOTE:** If you select "OVAL EL2300," select your option at "preamplifier Information" menu at "Setup" on the PC screen.

With display select switch, opening up the cover facing the internal assembly of the preamplifier, press the display select Switch SW1 located on the isolation board. The display will then scroll forward each time this switch is pressed as shown in Fig. 11.2.

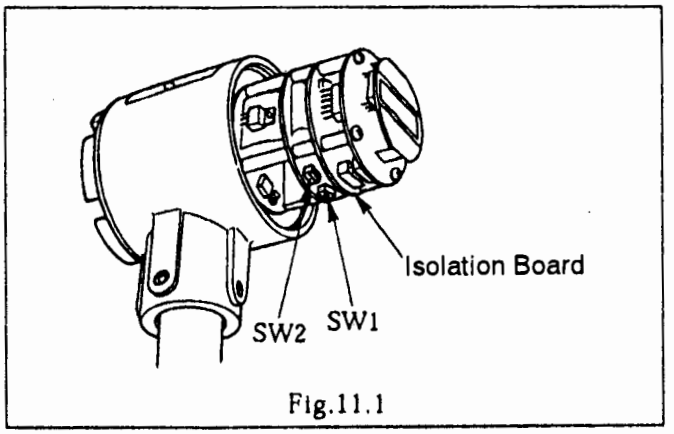


Fig.11.1

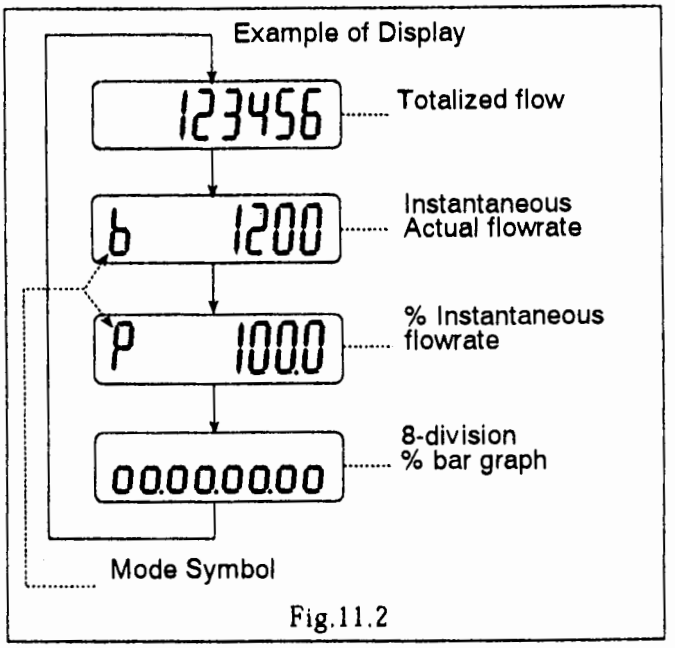


Fig.11.2

11.2 Total Flow Reset

Display total flow can be reset by the display select switch SW1 or through communications with the HART Communicator or OVAL EL2300. If communication is your option, see the instruction manual for the HART Communicator or OVAL EL2300.

➡ **NOTE:** If you select "OVAL EL2300," select your option at "Measurement" at "Display" menu on the PC screen. ith Display Select Switch (totalizer equipped model), while the totalizer is in the total flow display mode, holding the display select switch SW1 depressed for more than 3 seconds resets the total flow.

12. PRECAUTIONS ON PULSE OUTPUT TYPE

(1) If your model is of pulse output type, the pulse output and total counter remain inoperative for 15 seconds approx. after power on and while communications with HART Communication unit continue. For 15 seconds approx. after termination of communications, the pulse output and total counter also remain inoperative.

(2) Requirements for validating communications

Communication is valid only when the following requirements are met:

Flowrate at zero (There is no pulse output.) within 15 seconds after power turn-on

NOTE: The period of 15 seconds immediately after power on is called "Communication standby mode." (The built-in indicator, if so equipped, will display as shown in ① in the figure below.) If communications are started during this time period, a Switchover to "Communication mode" takes place, permitting you to communicate until power is turned off the next time. (The built-in indicator will display as shown in ② in the figure below.) To start flow measurement routine, turn power off and on again. (After power cycling, the pulse output and total counter will also remain inoperative for 15 seconds.)

Starting communications within this time period permits uninterrupted communications until power is turned off the next time, in the meantime, the pulse output and total flow remain inoperative.

To start the ordinary flowmeter measurement, turn power back on.

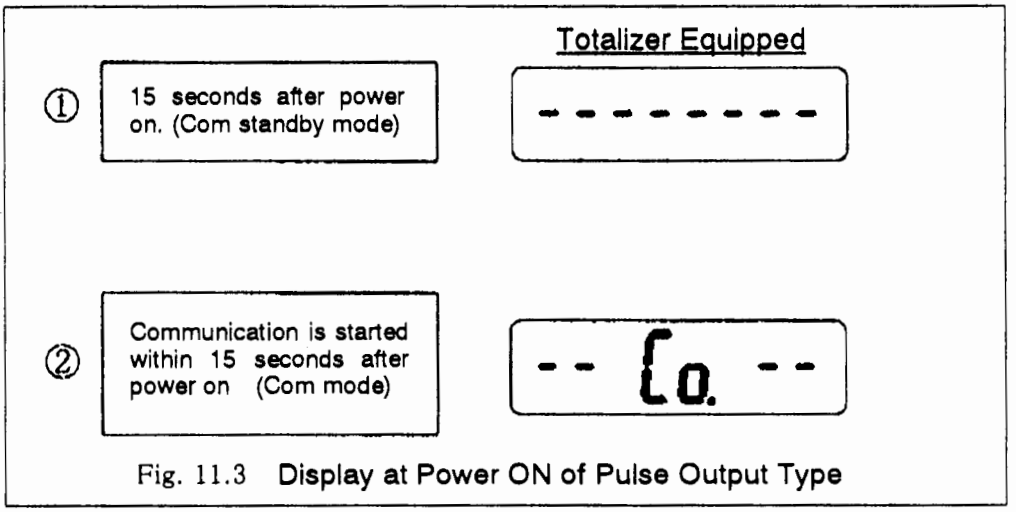


Fig. 11.3 Display at Power ON of Pulse Output Type

(3) While communications continue, the receiving instrument (total counter, etc.) may overcount under certain circumstances. To eliminate the possibility of such erratic extra counting, precautions should be taken by either disconnecting the receiving instrument before starting communications, or putting on paper the current total reading and other important data.

(4) Except for the purpose of communications, do not attempt to connect the probe of HART Communicator or OVAL EL2300 with the signal lines. If its probe is left connected, the influence of capacitive impedance the interface has could go to the point of producing distorted signal wave forms and, as a result, the receiving instrument would fail to receive pulse signals accurately.

⚠ CAUTION ON ANALOG OUTPUT TYPE

The analog type generally permits communications with HART Communication equipment. However, if, in an attempt to alter current parameters, the meter is configured by mistake Such that the new parameters are incompatible with the specification, resultant sharp changes in output may disturb the behavior of the receiving instrument. It is good practice, therefore, to make parameter changes while the fluid flow is at zero.

13. PREAMPLIFIER OPERATION CHECK WITH SIMULATED PULSE INPUT (Output and Display)

At zero flow, you can check the preamplifier operation for its output and display according to the procedures as set forth below.

⚠ **CAUTION:** Operation check should be conducted with zero flow.

13.1 Test Setup

Couple the pulse generator (open collector output) across test pins TP + and TP - on the isolation board. Feeding a full-scale frequency pulse train from the pulse generator causes the preamplifier to produce a 100% output.

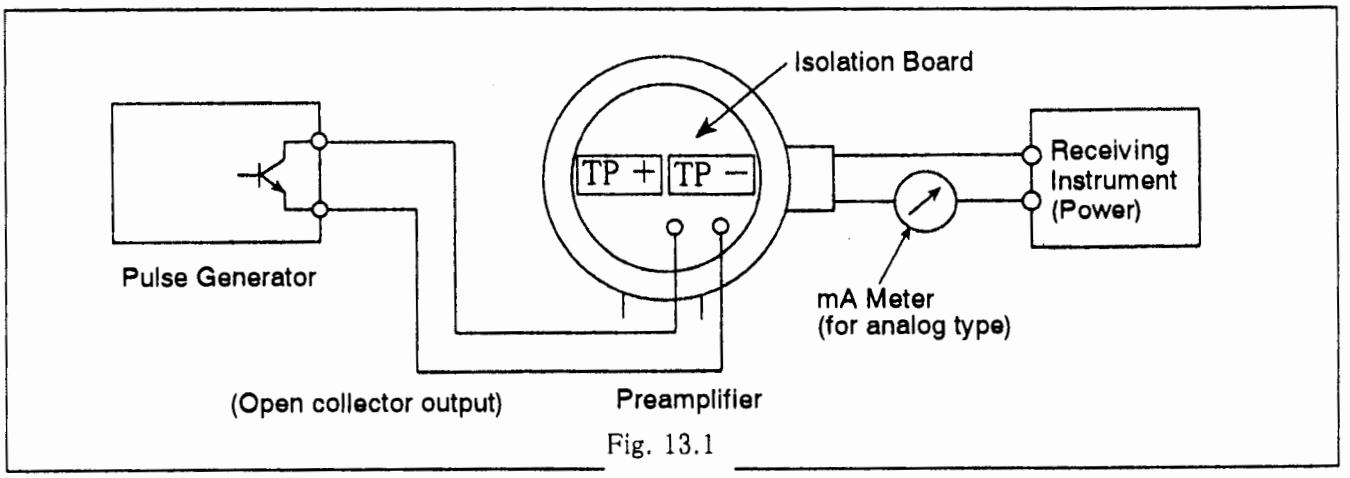


Fig. 13.1

■ **About Pulse Generator**

Illustrated diagrammatically is the test setup if OVAL pulse checker (Model PC2201 is available as a pulse generating source). Also refer to the pulse generator instruction manual.

Pulse Checker Switch Settings

- OUTPUT → O. C
- WIDTH → 0.25
- SETTER → 100%
- TUNING → 1 - 10K (chosen according to the frequency established)
- FREQUENCY → Frequency established

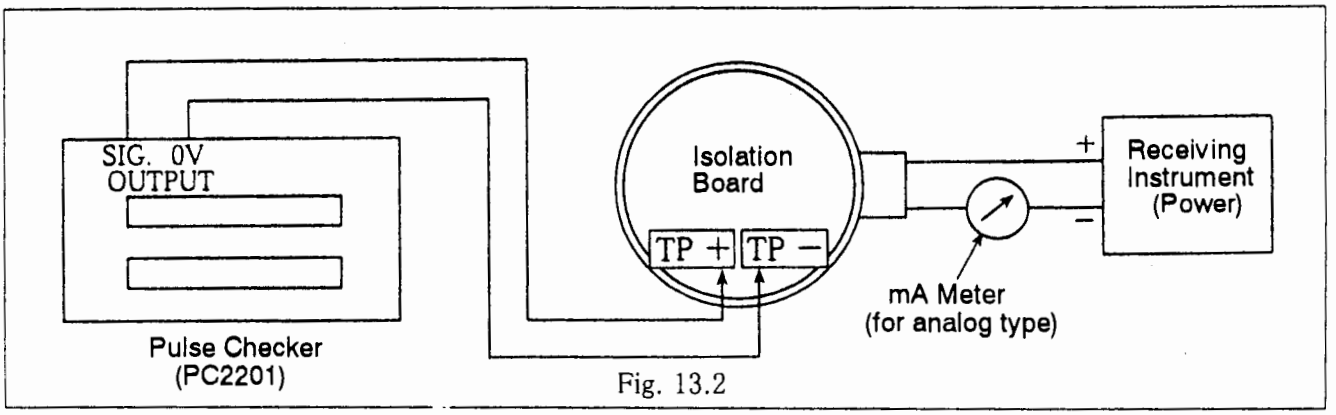


Fig. 13.2

13.2 Full Scale Frequency Calculation

The full scale frequency of unscaled pulses equivalent to the full scale flowrate is calculated by the following formula:

$$\text{Full Scale frequency (Hz)} = \frac{\text{Full Scale Flowrate (volume unit/hour)}}{\text{Meter Factor (volume unit/P)}} \times \frac{1}{3600}$$

NOTE: Full-scale flowrate must have the same unit of measure as meter factor.
The full-scale frequency established before shipment from the factory is stated in the ANALOG F.S. on the nameplate.

If the fluid temperature ("Reference temperature for measurement" setting) is below 10 °C (50°F) or above +60 °C (122°F), multiply the meter factor with a temperature correction factor determined by the following equation:

$$\text{Temperature correction factor} = (2\alpha + \beta) \times (\text{Fluid temperature [°C]} - 20) + 1$$

Where

α: Expansion coefficient of the meter material (Standard: 0.000016)
β: Expansion coefficient of the meter bluff body material (Standard: 0.000016)
Process temperature: Setpoint in the "Reference temperature for measurement" (units in terms of °C)

Example: Given the meter factor Mf = 0.06021 L/P and 200 m^3/h, find the full-scale frequency.

$$\text{Full Scale frequency} = \frac{200000\ (L/h)}{0.06021\ (L/P)} \times \frac{1}{3600}$$
$$= 922.7\ \text{Hz}$$

If the flowmeter produces an output representing the normal fixed conversion of gases or the mass fixed conversion of steam, perform conversion into a reduced meter factor by multiplying the meter factor in volumetric term (L/P) with normal conversion factor or density and, from the meter factor thus obtained, calculate the full scale frequency.

Example: Given Meter factor Mf = 0.06021 L/P
Fluid density p = 1.638 kg/m3 (g/L)
If the full scale is 400 kg/h, we obtain the reduced meter factor Mf,

$$Mf' = 0.06021\ (L/P) \times 1.638\ (g/L)$$
$$= 0.09862\ (g/P)$$

It follows that

$$\text{Full Scale frequency} = \frac{200000\ (L/h)}{0.09862\ (g/h)} \times \frac{1}{3600}$$
$$= 1126.7\ \text{H2}$$

14. MAINTENANCE

⚠ **CAUTION:** The fixed sensor is a Pressuretight member. Be sure therefore to stop the flow and reduce the line pressure to zero when you remove it. A leak check is suggested after sensor replacement for added safety.

14.1 Sensor Replacement

14.1.1 Fixed Sensor Removal

PROCEDURE See. "15. Assembly Drawing and Parts List" on pages 37 and 38.

① Turn off power.
② Remove cover (310) on the terminal box (⇒See Page 12).
③ Disconnect the cable for external wiring connections (⇒See Page 12).
④ Remove shield strip (307) (⇒ See page 12).
⑤ Disconnect sensor leads (⇒ See page 12).
⑥ Loosen hex socket head setscrews (301) and extract the preamplifier upward.
⑦ Remove C-shaped stop ring (209) for Shaft (Fig. 14.2).
⑧ Remove O-ring retainer (208) and 0-ring (207).
⑨ Take off hex socket head bolts (206) and Remove adapter (204) (Fig. 14.3).
⑩ Take off hex socket head bolts; (203).

➡ **NOTE:** Loosen bolts in an alternating order to ensure even loosening. Ensure also that no internal pressure exists.

⑪ Remove the sensor (202) from the meter body (101) (Fig. 14.4).

14.1.2 Fixed Sensor Installation

PROCEDURE See. 15. ASSEMBLY DRAWING and PARTS LIST on pages 37 and 38.

Reverse the order of disassembly for assembly, observing the following instructions:

① Do not drop or force the sensor, or it may be damaged.
② When you install the sensor, make sure that gasket (201) is in place (See Fig.14.4).
③ With sensor's locating pin in alignment with meter body's pin slot, carefully install the sensor into position.
④ While installing the sensor with hex socket head bolts (203), ensure even bolt tightening.

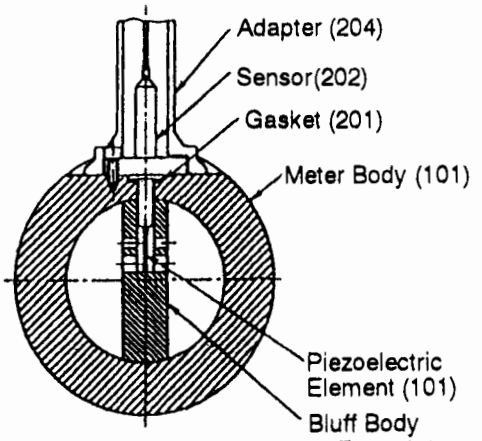


Fig.14.1

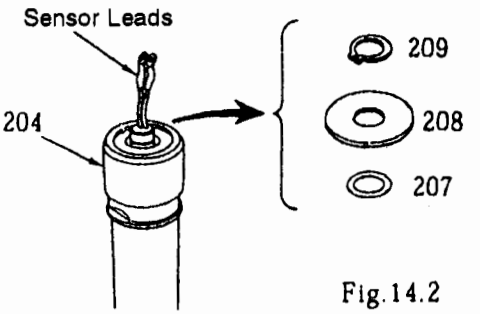


Fig.14.2

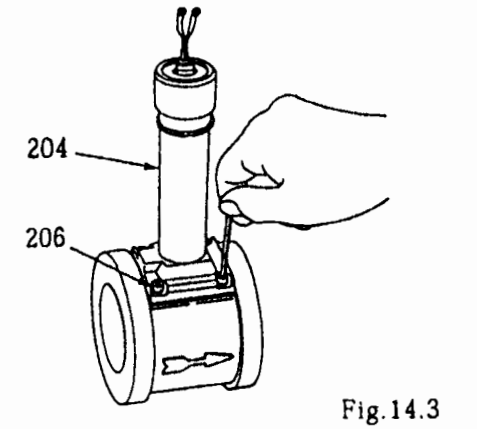


Fig.14.3

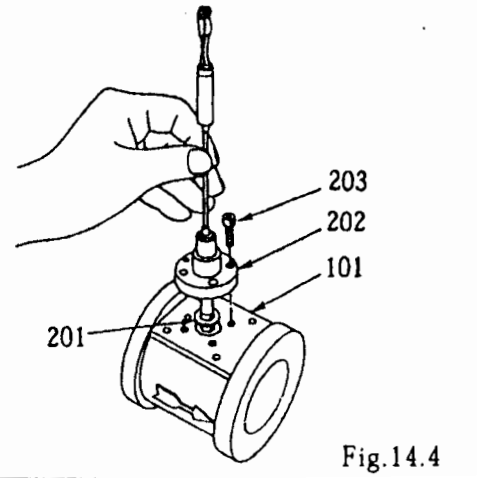


Fig.14.4

14.1.3 Replaceable Sensor Removal

⚠ **CAUTION:** Since the sensor does not come in contact with the fluid (located external to the housing), it can be replaced without need of interrupting the fluid flow. But for safety's sake, replace the sensor at temperatures below 220 ° C.

PROCEDURE See. 15. Assembly Drawing and Parts List on pages 39 and 40.

① Turn off power.
② Remove cover (310) on the terminal box (⇒See Page 12).
③ Disconnect the cable for external wiring connections (⇒See Page 12).
④ Remove shield strip (307) (⇒ See page 12).
⑤ Disconnect sensor leads (⇒ See Page 12).
⑥ Loosen hex socket head Setscrews (301) and extract the preamplifier upward.
⑦ Remove C-shaped Stop ring (209) for shaft (Fig. 14.6).
⑧ Remove O-ring retainer (208) and 0-ring (207) (Fig. 14.6).

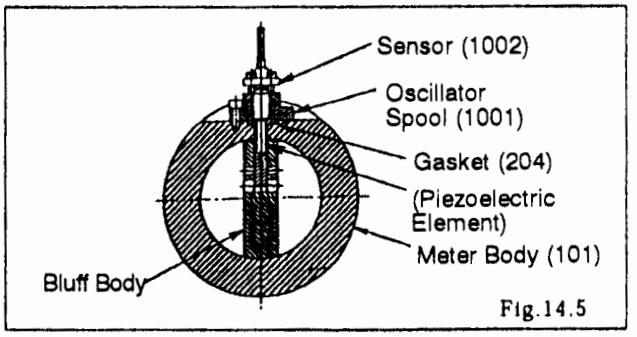


Fig.14.5

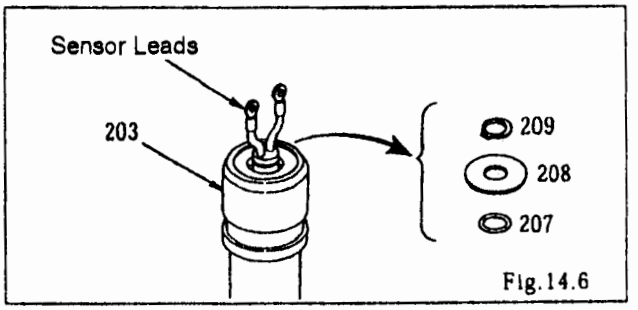


Fig.14.6

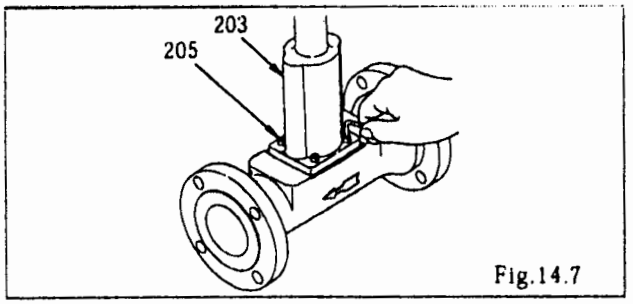


Fig.14.7

⑨ Taking off bolts (205), adaptor (203) (Fig. 14.7).

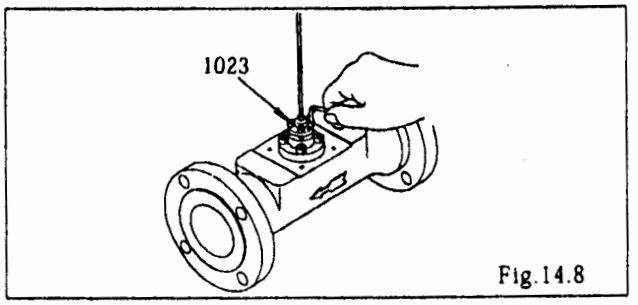


Fig.14.8

⑩ Take off sensor fitting screws (hex socket head screws) (1023) (Fig. 14.8).

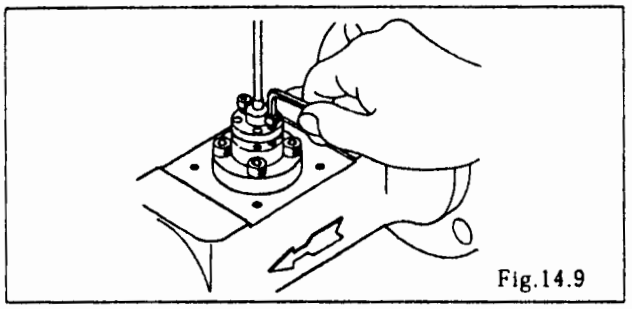


Fig.14.9

⑪ Screwing bolts (M3.5) into tapped holes provided for sensor removal (two places), force the sensor to unseat (Fig. 14.9).

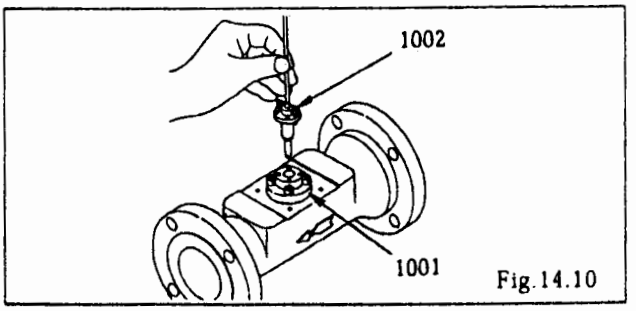


Fig.14.10

⑫ Carefully extract the sensor (1002) from the oscillating spool (1001) (Fig. 14.10).

14.1.4 Replaceable Sensor Installation

PROCEDURE

The assembly is reverse of the removal procedure, observing the following

① Exercise care not to drop or force the sensor, or it may be damaged.
② When you install the sensor, make sure that sensor's locating pin fits in the mating pin slot in the oscillating spool, and carefully insert the Sensor into place.
③ While securing the sensor with its fitting screws (1023), ensure even tightening of the screws.

NOTE: Good practice is to tighten bolts in increments of 30 degrees one at a time.

14.2 Preamplifier Inspection

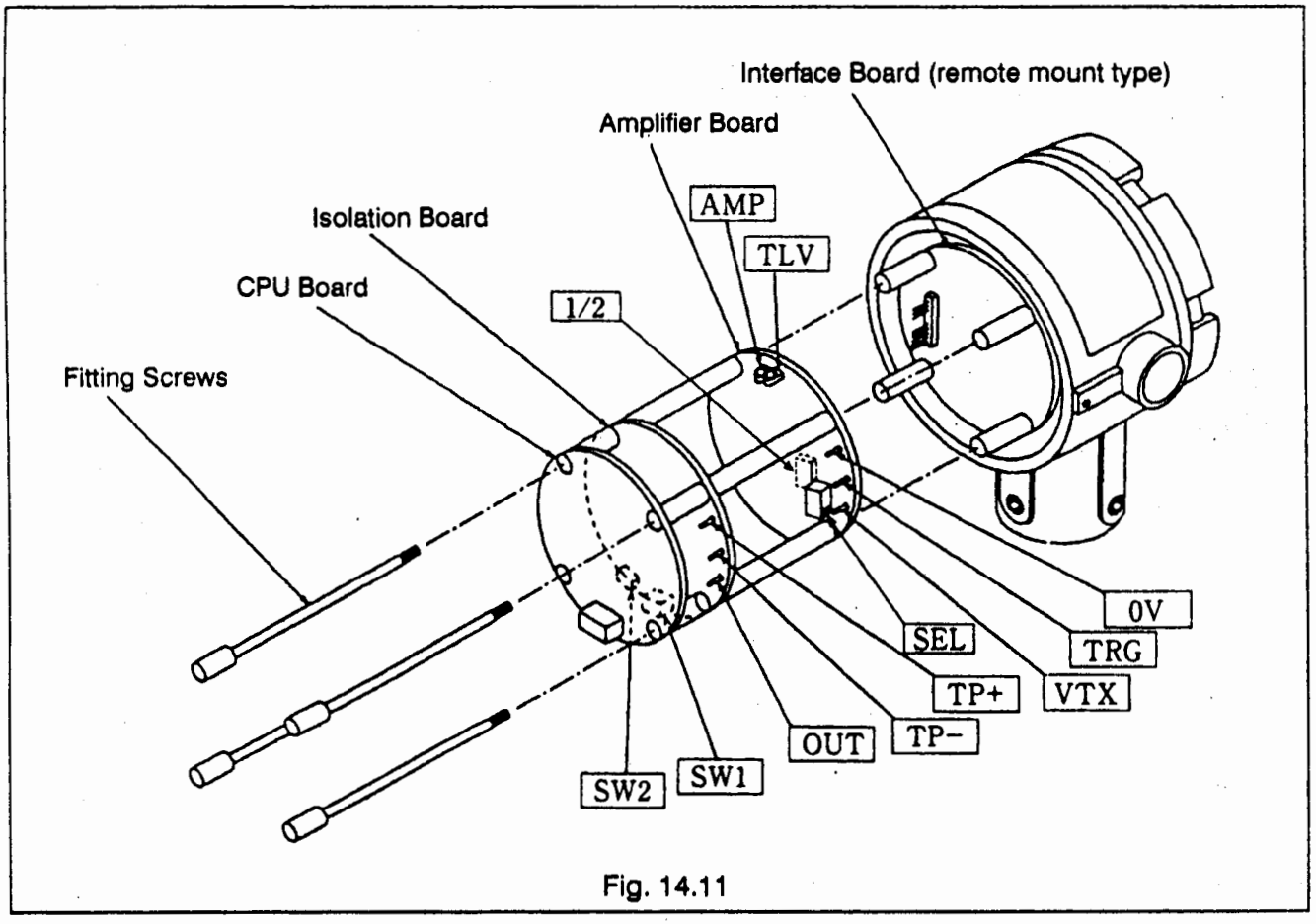


Fig. 14.11

14.2.1 Description of Test Pins

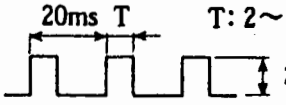
(1) Amplifier Board

Name	Test Pins	Description
Amplified vortex waveform	+ · · · VTX − · · · 0V	At measurement  0.1Vp-p App.
Pulse sync with vortex	+ · · · TRG − · · · 0V	 3Vp-p App.

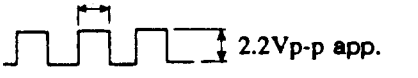
(2) Isolation Board

Pulse generator connection	+ · · · TP+ − · · · TP−	Input is fed from pulse generator (open collector pulse output)

(3) Isolation Board (analog output type)

Test terminals for pulse signal before analog conversion	+ · · · OUT − · · · TP−	 20ms T T: 2~10ms App. at 0~FS 2.2Vp-p App.

(1) Isolation (Pulse output type)

Name	Symbol	Description
Unscaled pulse output	+ · · · OUT − · · · TP−	
Scaled pulse output	+ · · · OUT − · · · TP−	Depends on "Pulse width" setup. 

14.2.2 Description of Switches and Potentiometers

(1) Amplifier Board

Name	Symbol	Description
Amplification adjust potentiometer	AMP	Amplification factor of the amplifier is factory adjusted relative to the sensor used. Readjustment is basically not required except when the sensor is replaced with a new one. ⇒ See "Flowrate Sensitivity Adjustment Procedure."
Trigger level setting switch	TLV	Sets the trigger level (pulse generation threshold sensitivity) to somewhere between 80mV and 350mA p-p. ⇒ See "Flowrate Sensitivity Adjustment Procedure."
Process fluid and nominal dia. select switch	SEL	Selects amplifier characteristics relative to the process fluid to be metered and meter nominal diameter. Settings may vary with flowmeter specifications.
1/2 frequency reduction switch	1/2	Amplification factor of the amplifier is factory adjusted relative to the sensor used. Readjustment is basically not required except when the sensor is replaced with a new one. → 1/2: Set to ON; 1/1: Set to OFF

(2) Isolation Board

Name	Symbol	Description
Display select switch (Also serves as total flow reset switch.)	SW1	In case of the totalizer equipped model, selects the totalizer display menu and resets the total flow. ⇒ See "Built-in Indicator Functions and Operation."
Parameter overwrite protect switch	SW2	Placing the switch in the ON position inhibits overwriting parameter settings through communication. Reviewing the parameters that have already been established, reviewing variables of flow measurement, and resetting the totalized flow are acceptable, however.

14.2.3 Preamplifier Block Diagrams

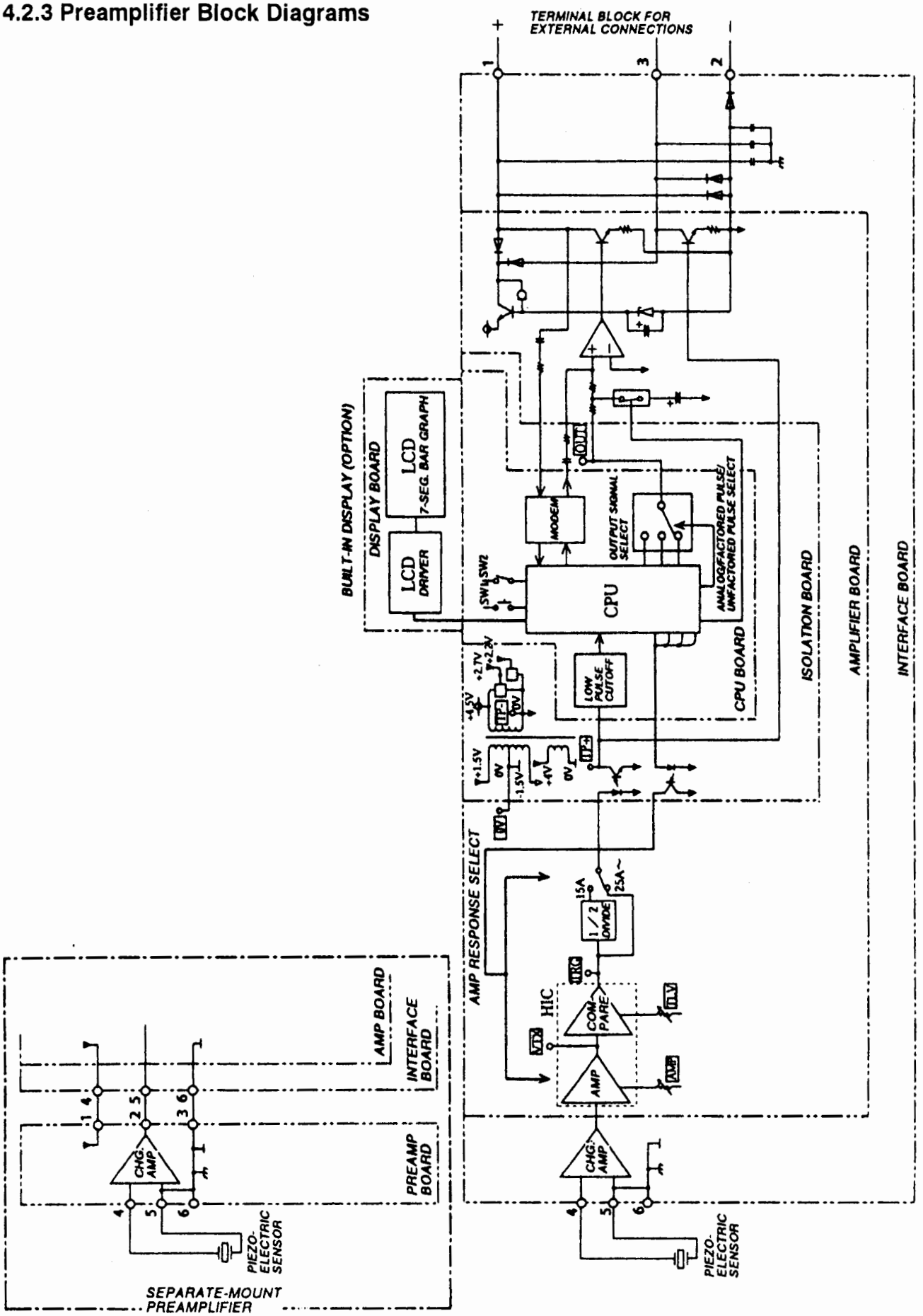


Fig. 14.12 Preamplifier Block Diagram

14.3 Display Installation (option)

An optional built-in display (local indicator or totalizer) may be added.
Installation is simple by coupling the indicator unit or totalizer unit to the existing internal assembly.

⚠ **NOTE:** When the display is added, replace the existing cover over the internal assembly with a screw cover having a glass in the window.

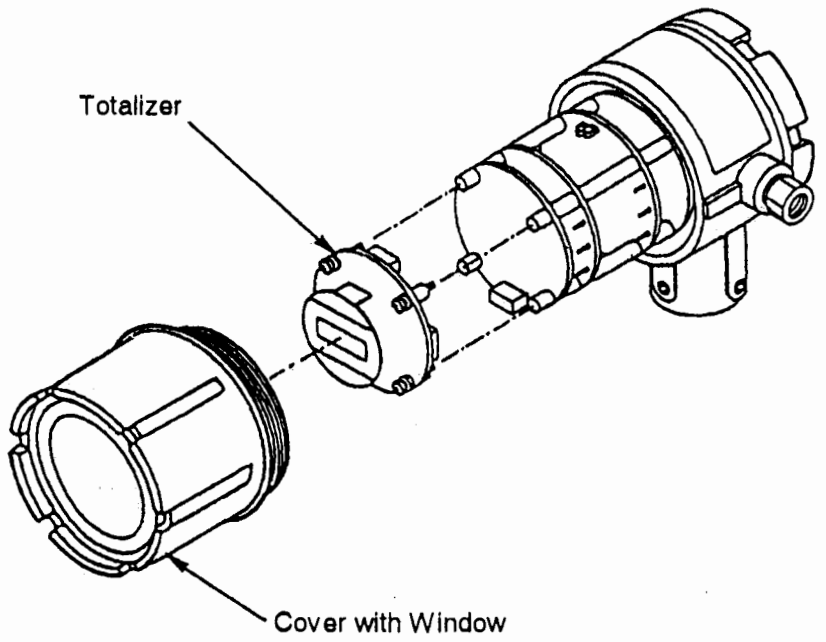


Fig. 14.13

15. ASSEMBLY DRAWINGS AND PARTS LIST

15.1 Fixed Sensor Type

NOTE: Parts list is shown on the next page.

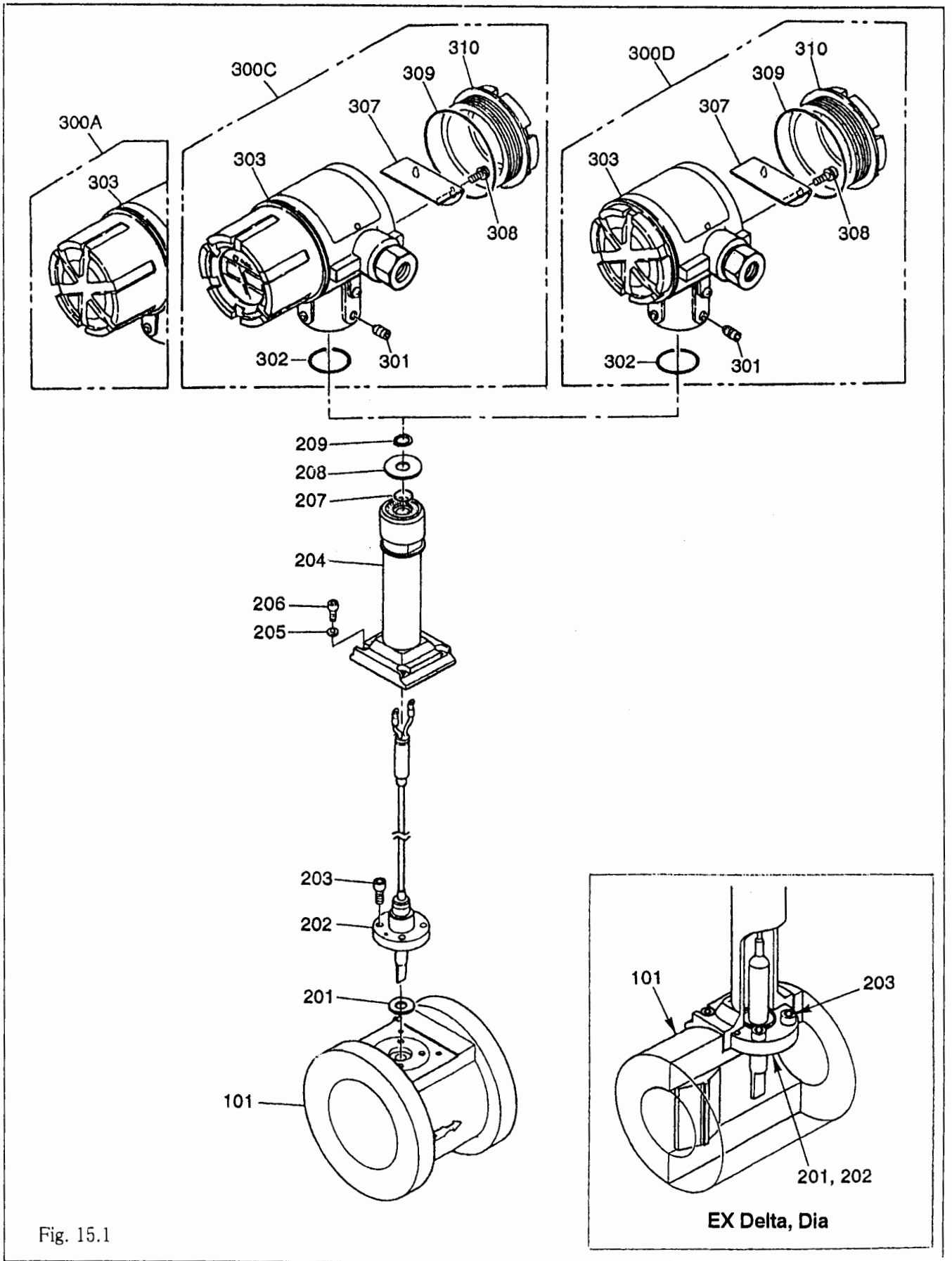


Fig. 15.1

Parts List

Sym. No.	Part Name	Q'ty	Remarks
101	Meter Body	1	
201	Gasket A	1	ϕ 17.5 × 12
202	Sensor	1	
203	Hex Socket Head Bolt A	4	M5 × 13
204	Adapter	1	
205	Spring Washer A	4	Nom. 4 (Fits M4)
206	Hex Socket Head Bolt B	1	M4 × 12
207	O-Ring A	1	P10A
208	O-Ring Retainer	1	
209	"C" Stop Ring for Shaft	1	Nom. 10 (JIS B 2804)

Sym. No.	Part Name	Q'ty	Remarks
300A	Preamplifier	1 set	PA25
300C	Preamplifier with Totalizer	1 set	PA25S
300D	Terminal Box	1 set	
311	Preamplifier Assembly	1 set	See page 33.
312	Totalizer Assembly	1 set	See page 36.
301	Hex Socket Head Screw B	4	M8 × 10 (nom. 4)
302	O-Ring B	1	JASO 2033
303	Preamplifier Housing	1	
307	Shield Strip	1	
308	Cross Recess Pan Hd. Scr.	2	M3 × 6
309	O-Ring C	2	AS568-233
310	Terminal Box Cover	1	
314	Bracket	1	
315	U-Bolt	1	With Nut

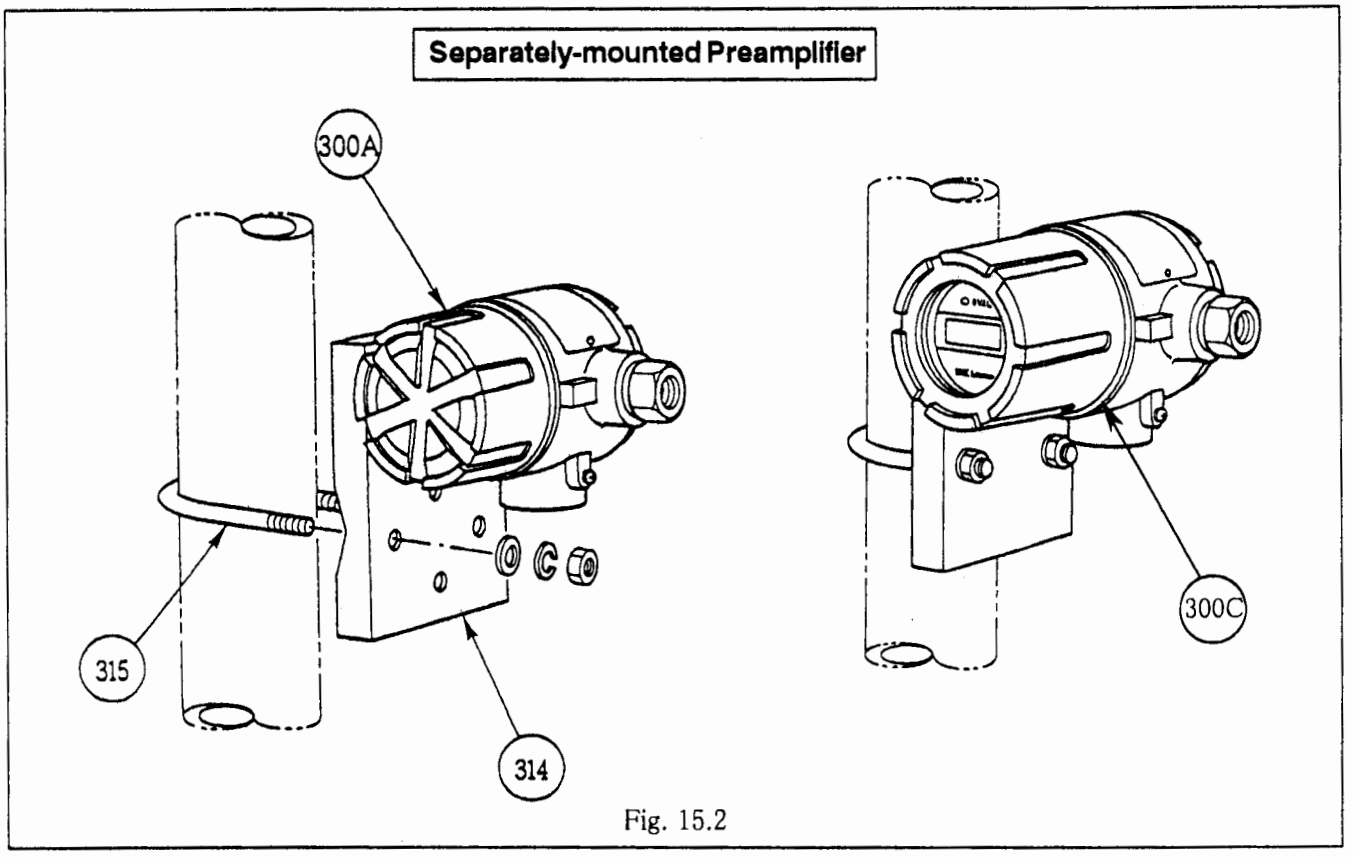


Fig. 15.2

15.2 Replaceable Sensor Type

NOTE: Parts list is shown on the next page.

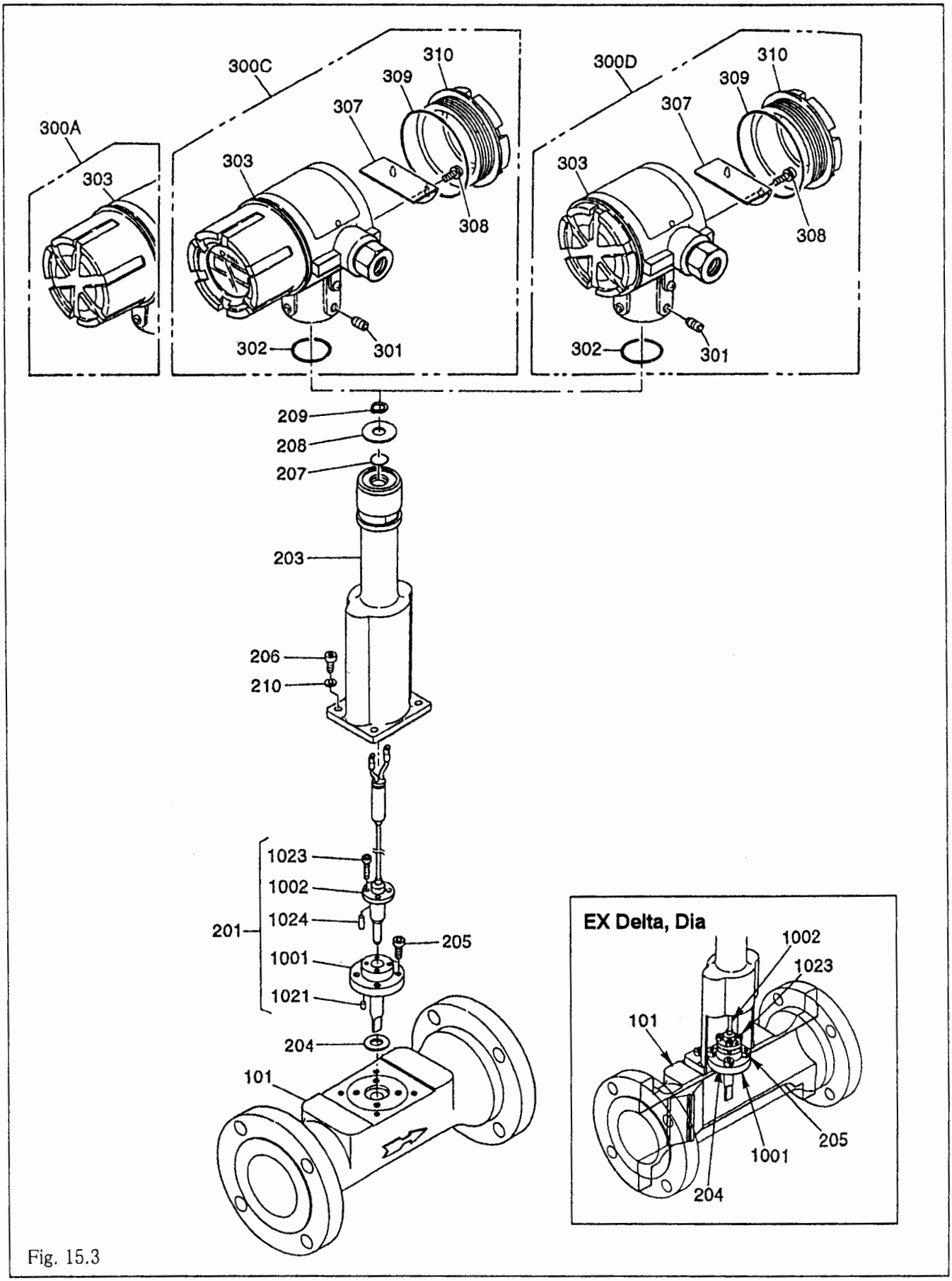


Fig. 15.3

Parts List

Sym. No.	Part Name	Q'ty	Remarks
101	Meter Body	1	
201	Sensor Assembly	1	ϕ17.5 × 12
202	Oscillating Spool	1	
1001	Sensor	4	M5 × 13
1002	Locating Pin	1	
1021	Sensor Fitting Screw	4	Nom. 4 (Fits M4)
1023	(Hex Socket Head Screw)	1	M4 × 12
1024	Sensor Locating Pin	1	P10A
203	Adapter	1	
204	Gasket A	1	Nom. 10 (JIS B 2804)
205	Bolt A		
206	Bolt B		
207	O-Ring A		
208	O-Ring Retainer		
209	"C" Stop Ring for Shaft		
210	Spring Washer		

Sym. No.	Part Name	Q'ty	Remarks
300A	Preamplifier	1 set	PA25
300C	Preamplifier with Totalizer	1 set	PA25S
300D	Terminal Box	1 set	
311	Preamplifier Assembly	1 set	See page 33.
312	Totalizer Assembly	1 set	See page 36.
301	Hex Socket Head Screw B	4	M8 × 10 (nom. 4)
302	O-Ring B	1	JASO 2033
303	Preamplifier Housing	1	
307	Shield Strip	1	
308	Pan Head Screw	2	M3 × 6
309	O-Ring C	2	AS568-233
310	Terminal Box Cover	1	
314	Bracket	1	
315	U-Bolt	1	With Nut

Separately-mounted Preamplifier

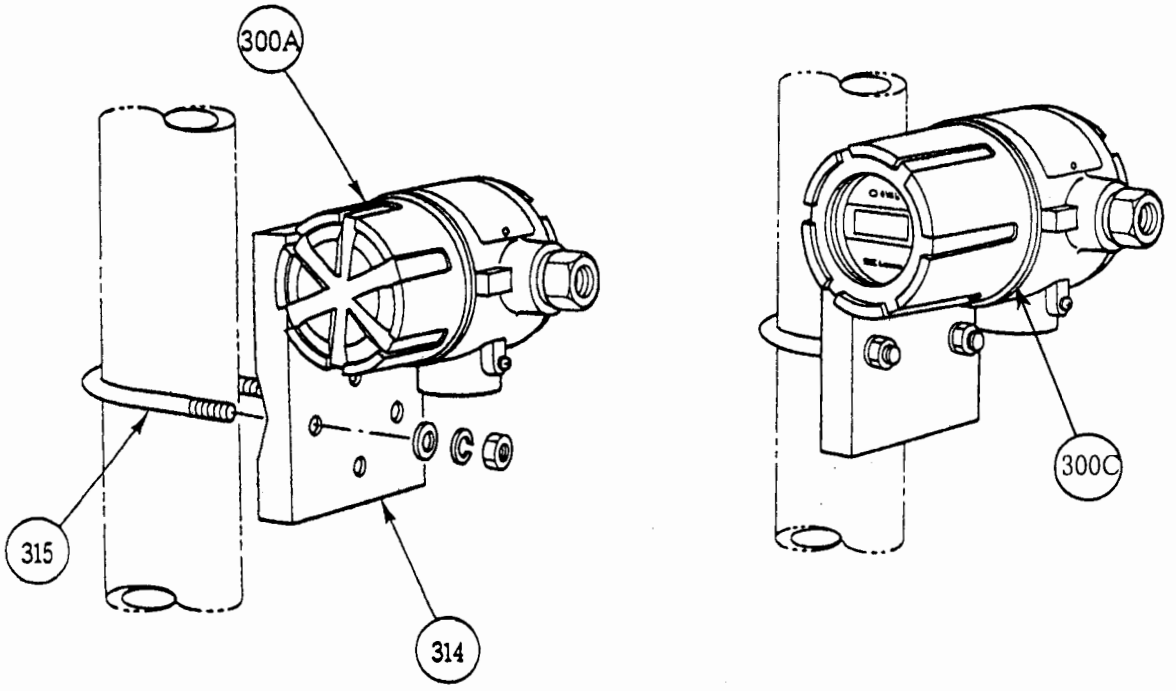


Fig. 15.4

16. GENERAL SPECIFICATIONS

16.1 Sensor Specifications

16.1.1 EX Delta Sensor Specifications

Item		Description		
Sensor Construction		Fixed sensor	Fixed sensor	Replaceable sensor
Nominal Dia., mm		15, 25, 40, 50, 80	50, 80	50, 80
Process Connection		Wafer type	Flanged (RF standard)	Flanged (standard)
Pressure Rating		JIS 10, 16, 20, 30K ANSI/JPI Class 150, 300		
Std. Connecting Pipe		Nominal wall thickness Sch. 40		
Acceptable Fluid		Liquid, gas, and steam		
Operating Temp. Range		-40 to +300°C (-40 to +572°F) Nominal diameters 200-300mm, 0 to +300°C (Temperature limitation depends on flange material.)		Standard type: -40 to +420°C (-40 to +788°F) High temp. type: -40 to +420°C (-40 to +788°F) 300mm in nominal dia. (Temperature limitation depends on flange material.)
Max. Operating Press.		Depends on flange rating. [Design pressure: 5.00MPa] See table below.		
Accuracy		Select one from the following options according to the given operating conditions. ① ±1% of indicted reading or better * ② ±1% of full scale or better (*: In analog output, ±0.1% of full scale is added.)		
Repeatability		±0.2% or better		
Material	Measuring Pipe	SUS316 or SCS14A	SUS316 or SCS14A (Nom. dia. 200-300mm flange material is SFVC2A.)	
	Bluff Body	SUS316 or SCS14A		
	Adapter	SUS304 or SCS13A		
Installation		No restrictions on physical orientation to cause loss of accuracy (Maintainability and waterproof work for wiring entry should be taken into consideration.)		
Finish (Measuring Pipe)		Nominal dia. 50 – 150mm: Not coated (because of stainless steel material) Nominal dia. 200 – 300mm: Diallyl phthalate resin finished Munsell 7.5G7/2.5		

Table 16.1

● **Flange Ratings and Max. Operating Pressure**

Nominal Dia. 10 - 300mm (Material: SUS376 or SCS14A) Unit: MPa

Flange Rating / Operating Temp.	JIS 10K	JIS 16K	JIS 20K	JIS 30K	ANSI/JPI 150	ANSI/JPI 300
Below 300°C (572°F)	1.18	1.96	2.45	4.51	1.21	2.20
Above 220 to 300°C (428 to 572°F)	0.98	1.77	2.26	4.22	1.02	2.91
Above 300 to 350°C (572 to 662°F)	—	1.57	1.96	3.82	0.84	2.80
Above 350 to 420°C (350 to 788°F)	—	—	—	2.94	0.56	2.72

Nominal Dia. 200 - 300mm (Material: SFVC2A) Unit: MPa

Flange Rating / Operating Temp.	JIS 10K	JIS 16K	JIS 20K	JIS 30K	ANSI/JPI 150	ANSI/JPI 300
Below 300°C (572°F)	1.18	2.45	3.04	4.51	1.32	4.31
Above 220 to 300°C (428 to 572°F)	0.98	2.26	2.84	4.22	1.02	3.87
Above 300 to 350°C (572 to 662°F)	—	2.06	2.55	3.82	0.84	3.70
Above 350 to 420°C (350 to 788°F)	—	1.57	1.96	2.94	0.51	2.88

NOTE: See meter tag or approval drawing for the operating flow ranges and preamplifier output specifications.

16.1.2 EX Delta Dia Sensor Specifications

Item		Description		
Nominal Dia.		15, 25, 40, 50, 80 mm	50, 80 mm	50, 80 mm
Process Connection		Wafer type	Flanged (RF standard)	Flanged (standard)
Sensor Construction		Fixed sensor	Fixed sensor	Replaceable sensor
Material	Measuring Pipe	SUS316 or SCS14A		
	Bluff Body	SUS316 or SCS14A		
	Adapter	SUS304 or SCS13A		
Max. Operating Press.		Depends on flange rating. [Design pressure: 5.00MPa] See table below.		
Accuracy		Select one from the following options according to the given operating conditions. ① ±1% of indicted reading or better * ② ±1% of full scale or better (*: In analog output, ±0.1% of full scale is added.)		
Repeatability		±0.2% or better		
Installation		No restrictions on physical orientation to cause loss of accuracy (Maintainability and water-proof work for wiring entry should be taken into consideration.)		
Pressure Rating		JIS 10, 16, 20, 30K ANSI/JPI Class 150, 300		
Std. Connecting Pipe		Nominal wall thickness Sch. 40		
Operating Temp.		-40 to +300°C (-40 to +572°F)		-40 to +420°C (-40 to +788°F)
Acceptable Fluid		Liquid		
Finish (Measuring Pipe)		Nominal dia. 50 – 80mm: Not coated (because of stainless steel material)		

Table 16.2

● **Flange Ratings and Max. Operating pressure**

Nominal Dia. 50 - 80mm (Material: SUS316 or SCS14A) Unit: MPa

Flange Rating / Operating Temp.	JIS 10K	JIS 16K	JIS 20K	JIS 30K	ANSI/JPI 150	ANSI/JPI 300
Below 300°C (572 °F)	1.18	1.96	2.45	4.51	1.21	2.20
Above 220 to 300°C (428 to 572 °F)	0.98	1.77	2.26	4.22	1.02	2.91
Above 300 to 350°C (572 to 662 °F)	—	1.57	1.96	3.82	0.84	2.80
Above 350 to 420°C (350 to 788 °F)	—	—	—	2.94	0.56	2.72

NOTE: See meter tag or approval drawing for the operating flow ranges and preamplifier output specifications.

16.2 Preamplifier Specifications

Item	Description	
Model	PA25 (preamplifier)	PA25S (totalizer, digital indicator)
Mounting Construction	Select one of the following: ① Integral mount flowmeter ② Separately-mounted type (totalizer on 2" pipe)	
Degree of Protection for Enclosure	IP66 (dusttight/watertight type)-IEC60529, EN60529, JIS C 0920	
Explosionproof Construction	Select one of the following: ① Non-explosionproof ② FM/CSA (North America) "Explosionproof" Class I, Div.1 Groups B,C and D	
Ambient Temperature	Non-ex.: -40 to +80°C (-40 to 176 °F) Ex.: -20 to +60C (-4 to 140 °F)	Non-explosionproof: -20 to +80 °C (-4 to 176 °F) Explosionproof: -20 to +60 °C (-4 to 140 °F)
Ambient Humidity	5 – 100% R.H. free from dew condensation	
Housing Material	Aluminum alloy	
Housing Finish	Finished in baked melamine Finish: Munsell 7.5G7/2.5 (Cover: Munsell 10G5/5.5)	
Output	Current signal: 2-wire system (serves also as power lines.) Select one of the following: ① Analog 4-20mA DC at 0 – FS Time constant: 0 – 100s (Standard: 2.5s) ② Unscaled pulse (vortex synchronized pulse) Pulse levels – "0": 4mA "1": 20mA Pulse width: 200 μA ③ Scaled pulse Pulse levels – "0": 4mA "1": 20mA Pulse width: 10 – 100ms (Standard: 50ms)	
Built-in Display (option)	———	Display: 7-segment LCD Scrolls through available variables ①Total flow 8-digit LCD counter shows total flow. Reads in the same units as that of scaled pulse output. (NOTE *1) At power failure, the total reading is retained in nonvolatile memory; resettable by an internal switch or by communication. ②Instantaneous actual flowrate – 7-digit (3 1/2-digit effective numerical area) Reads in any of the units given in NOTE *1. ③% instantaneous flowrate Reads in % of full scale. Full scale remains the same as that of analog output ④8-section bar graph – Reads in % of full scale. Full scale remains the same as that of analog output.
Power Supply	12 – 45V DC (See the acceptable load resistance range on the next page.) Use a SELV power supply with a limited power circuit according to NEC Class 2 (low voltage, low current); limited to 8A and 150VA in case of short-circuit.	
Installation Category	Category " "	
Pollution Degree	Pollution degree " "	
Wiring Entry	NPT 1/2 – watertight conduit with sealing work required	
Cables	Preamp to receiving instrument: 1.25mm^2 min., 2-conductor shielded cable Sensor to preamp: 1.25mm^2 min., 3-conductor shielded cable (separately-mounted type) Finished cable outside diameter: ϕ 13.5mm min. with cable heat resistant to 70 °C (158 °F) or higher.	
Transmission Length	Preamp to receiving instrument: 1 kilometer max. Sensor to preamp: 200 meters max. (separately-mounted type)	
Communication	HART protocol communications See NOTE *2.	
Calculation	• Actual flow (liquid, gas) • Corrected for temp. and press. (gas) • Saturated steam • Superheated steam	

Table 16.3

※1 : Displayed flow units can be chosen from the table below by type of calculation. Instantaneous flowrate units may be combined within the frame of heavy lines.

Units of Indicated Flowrate	Top: Instantaneous rate units Bottom: Totalized flow units	Calculation on actual flow	Calculation corrected for temp. and press.	Saturated steam calculation	Superheated steam calculation
L/min, L/h, m^3/min, m^3/h, KL/min, kL/h	L, m^3, kL	○	×	×	×
L/min (normal), L/h (hourly), m^3/min (normal), m^3/h (normal)	L (normal), m^3 (normal)	×	○	×	×
G/min, g/h, kg/min, kg/h, t/min, t/h	G, kg, t	○	○	○	○
ton (U.S.)/min, ton (U.S.)/h	ton (U.S.)	○	○	○	○
gal (U.S.)/min, gal (U.S.)/h	gal (U.S.)	○	×	×	×
Ft^3/sec, Ft^3/min, Ft^3/h	SFt^3	○	×	×	×
SCFS, SCFM, SCFH	NFt^3	×	○	×	×
lb/min, lb/h	lb	○	○	○	○

※2 : With a model provided with pulse output, communications are acceptable under the following requirements:

① At No flow
② Power ON (If communications begin within 15 seconds after power ON, continuous communications are acceptable

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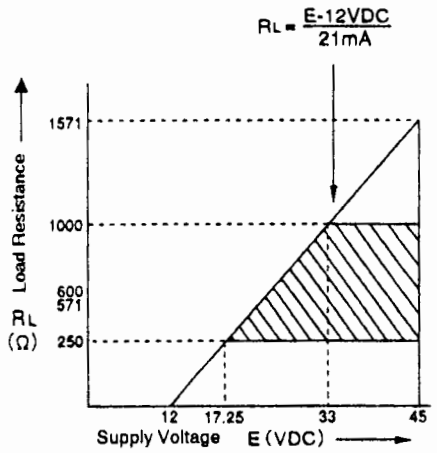
● Load Resistance Range

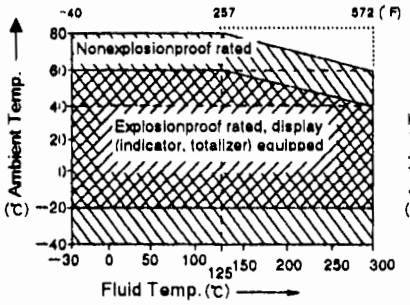


Area: Operating range
Area: Communicable range

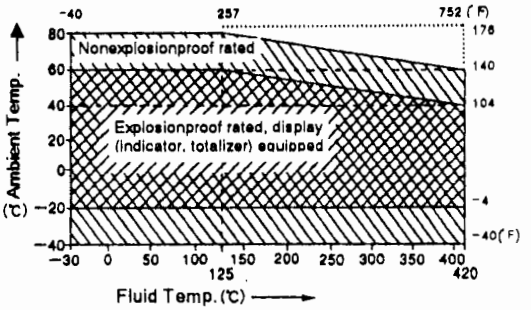
● Ambient Temperature Range

If the liquid temperature exceeds 125 ° C (257 ° F), it is necessary that the ambient temperature range be derated as shown.

●Fixed sensor type



●Replaceable sensor type



● Preamplifier Output Units and indicated Measurement Units

Shown in this table are the output units at volumetric flowrates. For fixed conversion into measurement units other than volumetric flowrate, determine from Tables A through H (pages 46 through 47).

Applicable Fluid	Nominal Dia. mm (Inch)	Max. Flowrate, mm^3/h (Unscaled pulse frequency, Hz)	Nominal Meter Factor, L/P (Nominal unscaled pulse unit)	Output Frequency (Hz) *1	Preamplifier PA25		
					Unscaled Pulse Output		
					Min	Standard	Max
Liquid	15 (1/2)	6.0 (312.2)	0.005338	52.0Q	1 L/P	10 L/P	100 L/P
	25 (1)	20 (343.6)	0.01617	17.2Q	1 L/P	10 L/P	1 m^3/P
	40 (11/2)	48 (292.7)	0.04556	6.10Q	10 L/P	100 L/P	1 m^3/P
	50 (2)	79 (219.2)	0.1001	2.78Q	10 L/P	100 L/P	10 m^3/P
	80 (3)	172 (143.6)	0.3328	0.835Q	10 L/P	100 L/P	10 m^3/P
	100 (4)	296 (108.7)	0.7567	0.367Q	10 L/P	100 L/P	10 m^3/P
	150 (6)	645 (74.0)	2.422	0.115Q	100 L/P	1 m^3/P	100 m^3/P
	200 (8)	1130 (44.7)	7.021	0.0396Q	100 L/P	1 m^3/P	100 m^3/P
	250 (10)	1750 (35.9)	13.54	0.0205Q	1 m^3/P	1 m^3/P	1000 m^3/P
	300 (12)	2510 (30.0)	23.24	0.012Q	1 m^3/P	1 m^3/P	1000 m^3/P
Gas	15 (1/2)	33 (1717)	0.005338	52.0Q	1 L/P	10 L/P	100 L/P
	25 (1)	130 (2233)	0.01617	17.2Q	10 L/P	100 L/P	1 m^3/P
	40 (11/2)	290 (1768)	0.04556	6.10Q	10 L/P	100 L/P	1 m^3/P
	50 (2)	490 (1360)	0.1001	2.78Q	100 L/P	1 m^3/P	10 m^3/P
	80 (3)	1380 (1152)	0.3328	0.835Q	100 L/P	1 m^3/P	10 m^3/P
	100 (4)	2370 (870.0)	0.7567	0.367Q	100 L/P	1 m^3/P	10 m^3/P
	150 (6)	5160 (591.8)	2.422	0.115Q	1 m^3/P	10 m^3/P	100 m^3/P
	200 (8)	9100 (360)	7.021	0.0396Q	1 m^3/P	10 m^3/P	100 m^3/P
	250 (10)	14000 (267)	13.54	0.0205Q	1 m^3/P	10 m^3/P	1000 m^3/P
	300 (12)	20100 (240)	23.24	0.012Q	1 m^3/P	10 m^3/P	1000 m^3/P

*1. Q : Volumetric flowrate in m^3/h

■ Scaled Pulse Units for Fixed Conversion

When it is required that a volumetric flowrate (volume flow) be reduced to the equivalent flowrate under standard conditions (normal) flowrate) or to the mass flowrate in a fixed conversion by multiplying a conversion factor, the scaled pulse unit is determined by the unit selector graphs given below.

Fluid Type	Fixed Conversion Type	Unit Selector
Gas	Conversion into standard conditions (normal flowrate)	Tables A, B
Saturated Steam	Conversion into mass flowrate	Tables C, D
Superheated Steam	Conversion into mass flowrate	Tables E, F
Liquid	Conversion into mass flowrate	Tables G, H

Continued on next page.

● Scaled Pulse Units for Fixed Conversion into Standard State (normal flowrate)

1. "Conversion factor is calculated by the following equation:

$$\text{Conversion factor} = \frac{273.15}{T + 273.15} \times \frac{P + 1.0332}{1.0332} \times \frac{Z_0}{Z}$$

(Except where significant influence is anticipated, it is assumed that $Z_0/Z = 1$.)
where T = Operating temp., ° C (° F) Z_0 = Compressibility coefficient under standard conditions
P = Operating press. (kgf/cm² gage) Z = Compressibility coefficient under operating conditions.

2. Follow your way to the right in the nominal diameter column of the given meter in Table A and find the segment number (①, ②, etc.) that agrees with the conversion factor you have just computed.
3. In Table B, find the scaled pulse unit relative to the segment number.

Table A ●Conversion Factor ·Segment Graph

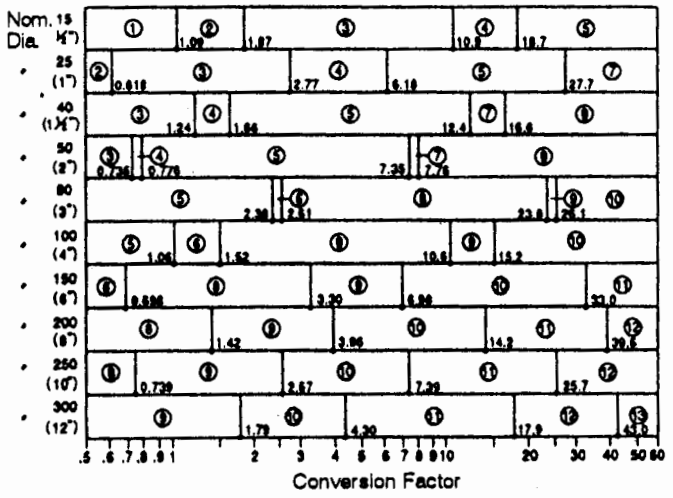


Table B ●Segment ·Scaled Pulse Output Graph

Segment No.	Scaled Pulse Output Unit		Unit: [normal]
	Minimum	Standard	Maximum
①	1 L/P	10L/P	100L/P
②	10L/P	100L/P	100L/P
③			1m³/P
④	100L/P	1m³/P	1m³/P
⑤			10m³/P
⑥			100m³/P
⑦	1m³/P	10m³/P	10m³/P
⑧			100m³/P
⑨			1000m³/P
⑩	10m³/P	100m³/P	1000m³/P
⑪			10000m³/P
⑫	100m³/P	1000m³/P	10000m³/P
⑬			100000m³/P

● Scaled Pulse Units for Saturated Steam Measurement

1. Follow your way to the right in the nominal diameter column of the given meter in Table C and find the segment number (①, ②, etc.) that agrees with the saturated steam pressure.
2. In Table D, find the scaled pulse unit relative to the segment number.

Table C ● Pressuretight (Gage Press.)

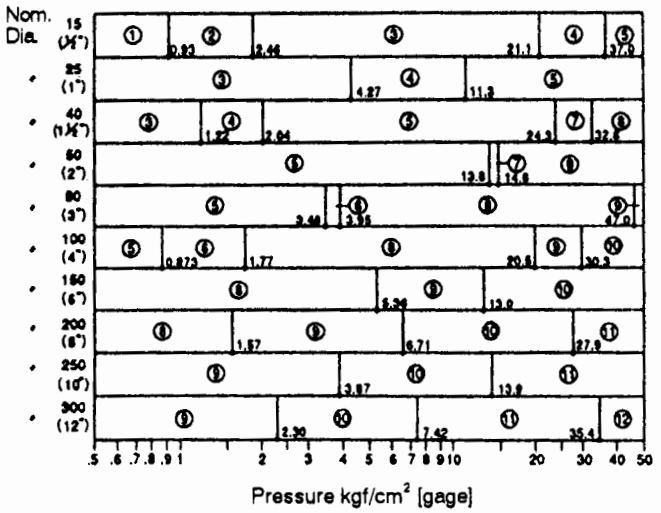


Table D ● Segment - Scaled Pulse Output Graph

Segment No.	Scaled Pulse Output Unit		Unit: [normal]
	Minimum	Standard	Maximum
①	1 g/P	10 g/P	100 g/P
②	10 g/P	100 g/P	100 g/P
③			1kg/P
④	100 g/P	1kg/P	1kg/P
⑤			10kg/P
⑥			100kg/P
⑦	1kg/P	10kg/P	10kg/P
⑧			100kg/P
⑨			1 t/P
⑩	10kg/P	100kg/P	1 t/P
⑪			10 t/P
⑫	100kg/P	1 t/P	10 t/P

● Scaled Pulse Units for Fixed Conversion into Mass Flowrate (For Superheated steam and gas)

1. Follow your way to the right in the nominal diameter column of the given meter in Table E and find the segment number (①, ②, etc.) that agrees with the density when in use.
2. In Table E, find the scaled pulse unit relative to the segment number.

Table E ● Density - Segment Graph

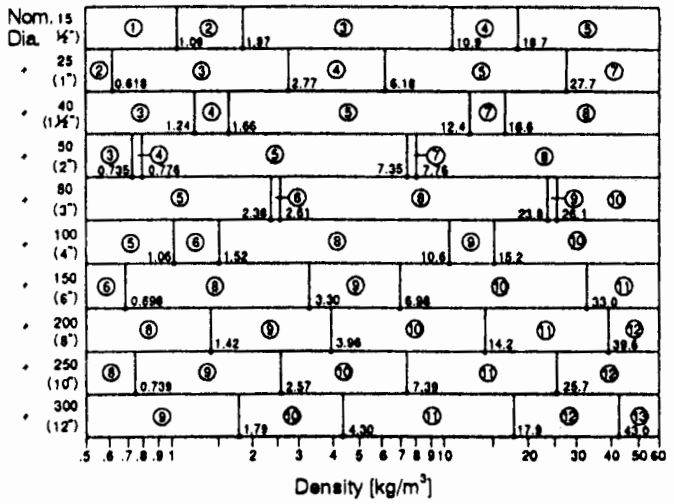


Table F ● Segment - Scaled Pulse Output Graph

Segment No.	Scaled Pulse Output Unit/h Unit: [normal]		
	Minimum	Standard	Maximum
①	1 g/P	10 g/P	100 g/P
②	10 g/P	100 g/P	100 g/P
③			1kg/P
④	100kg/P	1kg/P	1kg/P
⑤			10kg/P
⑥			100kg/P
⑦	1kg/P	10kg/P	10kg/P
⑧			100kg/P
⑨			1 t/P
⑩	10kg/P	100kg/P	1 t/P
⑪			10 t/P
⑫	100kg/P	1 t/P	10 t/P
⑬			100 t/P

● Scaled Pulse Units for Fixed Conversion into Mass Flowrate (Liquids)

1. Follow your way to the right in the nominal diameter column of the given meter in Table G and find the segment number (①, ②, etc.) that agrees with the specific gravity when in use.
2. In Table H, find the scaled pulse unit relative to the segment number.

Table G ● Specific Gravity - Segment Graph

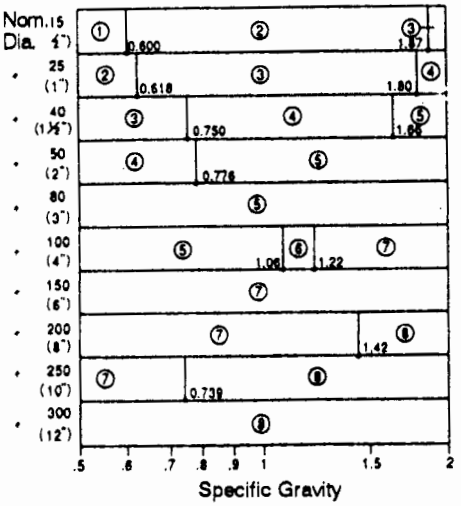


Table H ● Segment – Scaled Pulse Output Graph

Segment No.	Scaled Pulse Output Unit/h Unit: [normal]		
	Minimum	Standard	Maximum
①	100 g/P	1kg/P	10kg/P
②	1kg/P	10kg/P	100kg/P
③	1kg/P	10kg/P	1 t/P
④	10kg/P	100kg/P	1 t/P
⑤	10kg/P	100kg/P	10 t/P
⑥	100kg/P	1 t/P	10 t/P
⑦	100kg/P	1 t/P	100 t/P
⑧	1 t/P	10 t/P	1000 t/P

16.3 PRESSURE LOSSES

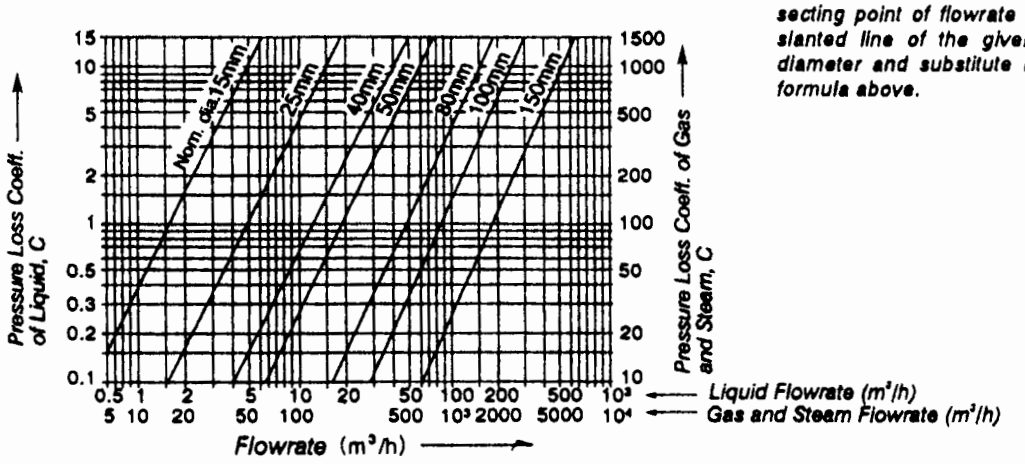
16.3.1 EX Delta Pressure Losses

● **Nom. Diameters 15 – 150mm**

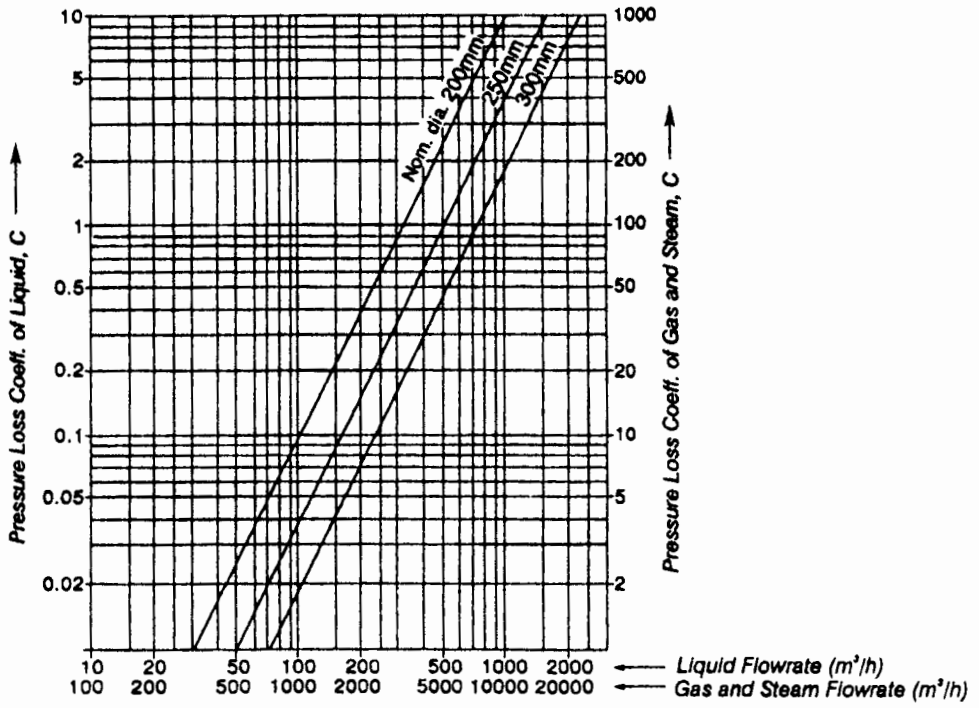
$$\Delta P = \frac{C \times \rho}{100}$$

where ΔP*: Pressure loss (MPa)*
ρ *: Density (kg/m³)*

To determine the pressure loss, find the value C at the intersecting point of flowrate (Q) and slanted line of the given meter diameter and substitute it to the formula above.

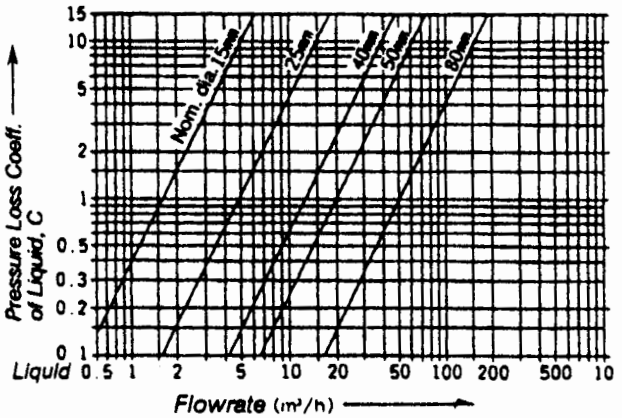


● **Nom. Diameters 200, 250, 300mm**



16.3.2 EX Delta Dia pressure Losses

● **Nom. Diameters 15 – 80mm**



$$\Delta P = \frac{C \times \rho}{100}$$

where ΔP*: Pressure loss (MPa)*
ρ *: Density (kg/m³)*

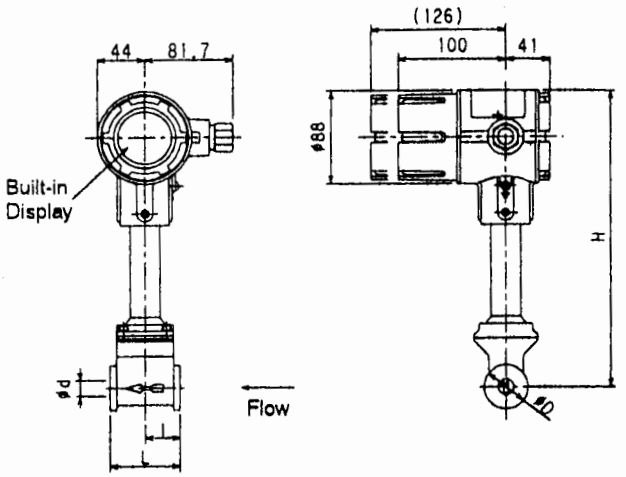
To determine the pressure loss, find the value C at the intersecting point of flowrate (Q) and slanted line of the given meter diameter and substitute it to the formula above.

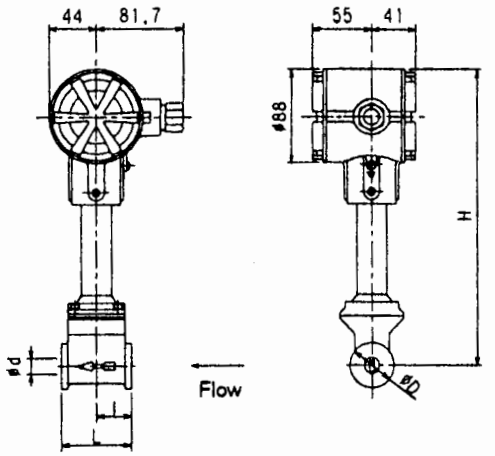
17. OUTLINE DIMENSIONS

17.1 EX Delta, Wafer Type

All dimensions in millimeters
NOTE: Figures in brackets ( ) show meter with built-in display.

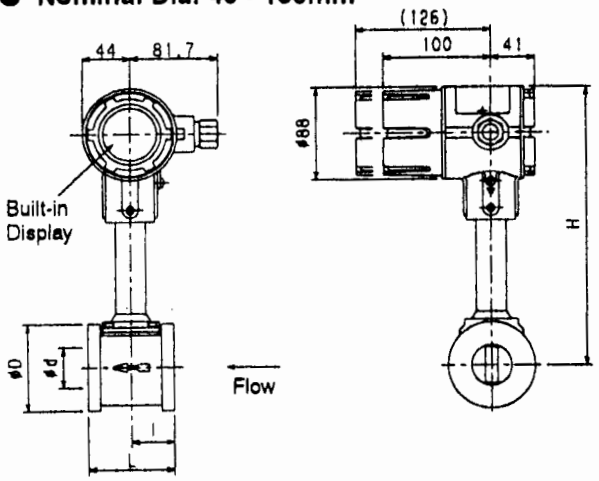
● **Nominal Dia. 15, 25mm**

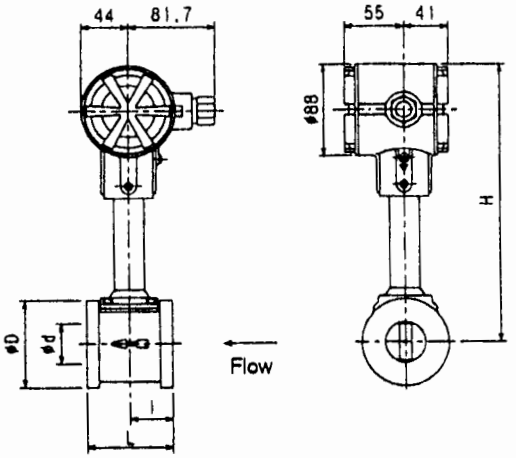




Separately-mounted Preamplifier Type

● **Nominal Dia. 40 - 150mm**





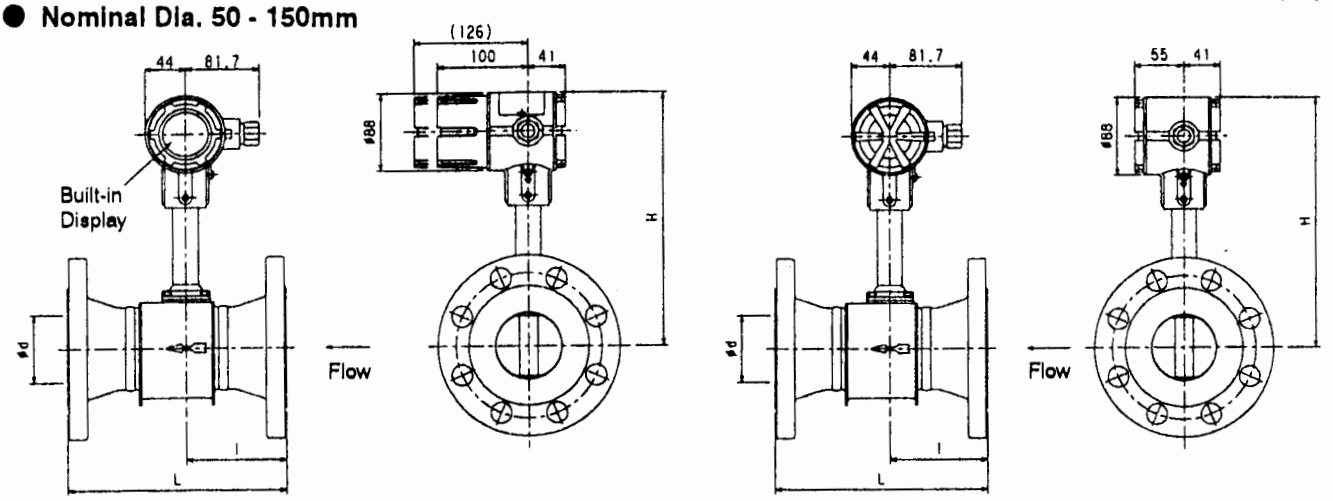
Separately-mounted Preamplifier Type

Nominal Dia. mm (in.)	L	I	ϕ d (Meter I.D.)	ϕ D	H	Approx. Mass (kg)		
						Less display	Display provided	Separate terminal box provided
15 (1/2″)	65	32.5	14.5	40	277	2.6	2.9	2.4
25 (1″)	65	32.5	26.6	67	277	3.2	3.5	3.0
40 (1-1/2″)	80	40	37.6	81	262	3.9	4.2	3.7
50 (2″)	80	40	48.5	91	266	4.0	4.3	3.8
80 (3″)	100	40	72.4	126	282	6.8	7.1	6.6
100 (4″)	125	48	95.2	156.2	302	10.5	10.8	10.3
150 (6″)	165	54	140.3	214.9	332	20.4	20.7	20.2

17.2 EX Delta, Flanged Type

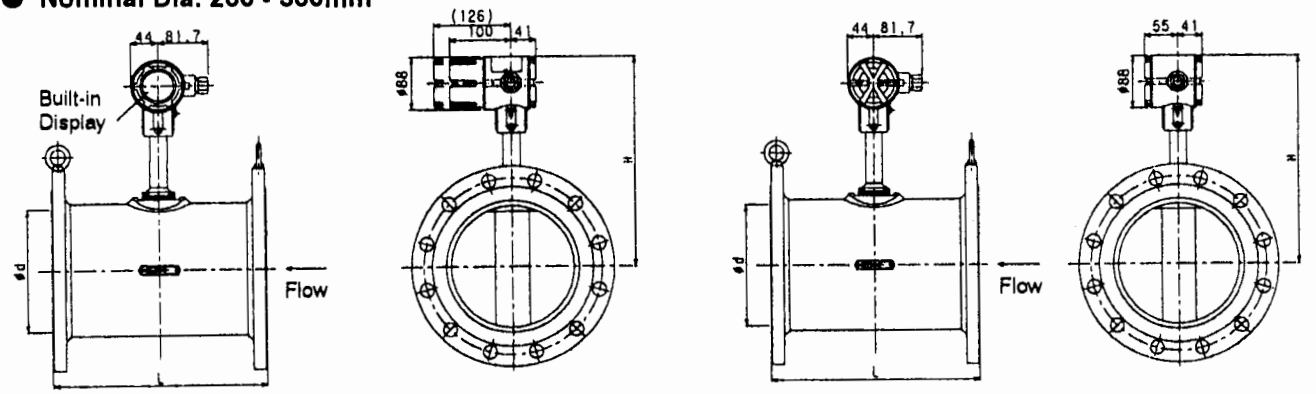
All dimensions in millimeters
NOTE: Figures in brackets ( ) show meter with built-in display.

● **Nominal Dia. 50 - 150mm**



Separately-mounted Preamplifier Type

● **Nominal Dia. 200 - 300mm**



Separately-mounted Preamplifier Type

Nominal Dia. Mm (in.)	L	I	ϕ d (Meter I.D.)	H	Approx. Mass (kg)		
					Less display	Display provided	Separate terminal box provided
50 (2″)	173	86.5	48.5	266	9.0	9.3	8.8
80 (3″)	219	99.5	72.4	282	15.2	15.5	15.0
100 (4″)	250	110.5	95.2	302	21.2	21.5	21.0
150 (6″)	322	132.5	140.3	332	43.7	44.0	43.5
200 (8″)	350	—	199.9	347	38.3	39.1	38.6
250 (10″)	450	—	248.8	369	68.8	69.1	68.6
300 (12″)	500	—	297.9	391	88.8	89.1	88.6

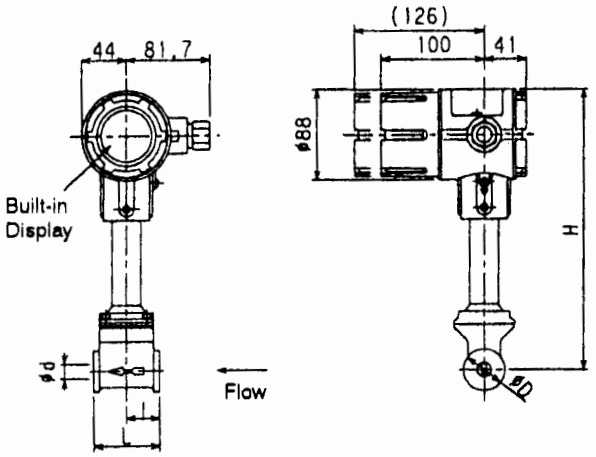
➡ NOTE: Shown here are dimensions and mass of JIS 10K rating.

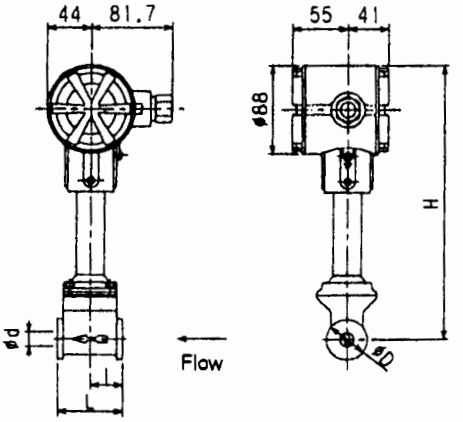
➡ NOTE: See approval drawing for detail dimensions.

17.3 EX Delta Dia, Wafer Type

All dimensions in millimeters
NOTE: Figures in brackets ( ) show meter with built-in display.

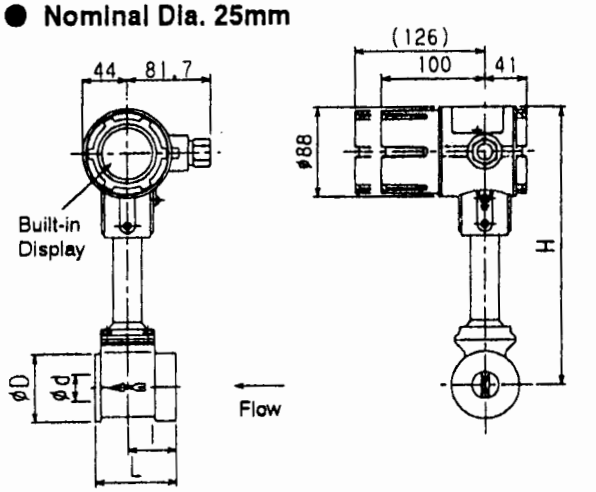
● Nominal Dia. 15mm

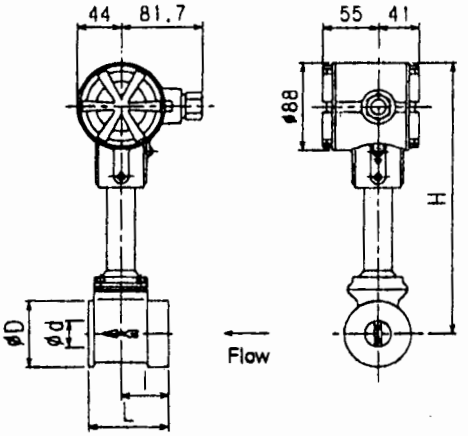




Separately-mounted Preamplifier Type

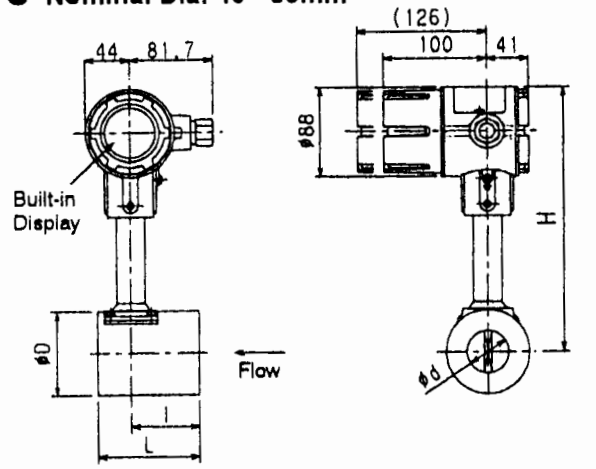
● Nominal Dia. 25mm

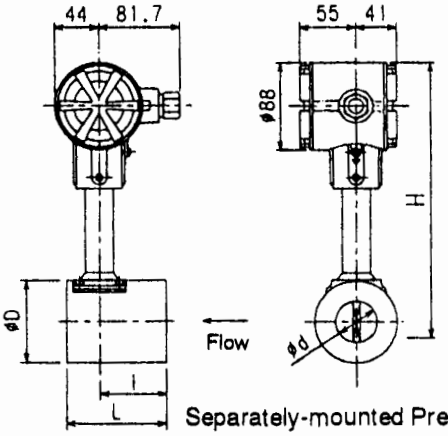




Separately-mounted Preamplifier Type

● Nominal Dia. 40 - 80mm





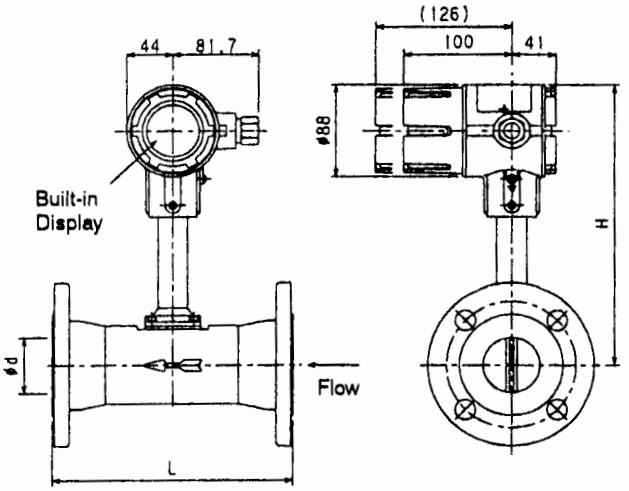
Separately-mounted Preamplifier Type

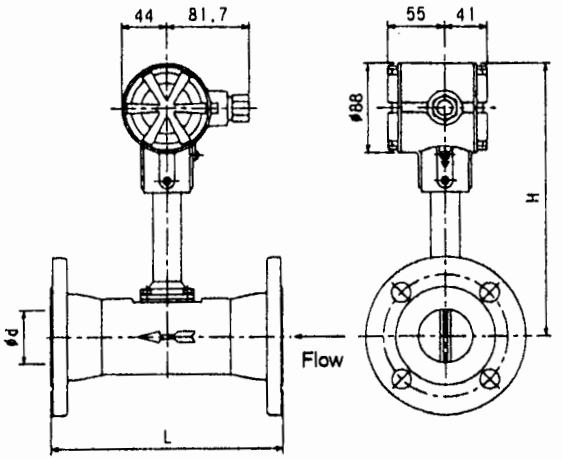
Nominal Dia. Mm (in.)	L	I	ϕ d (Meter I.D.)	ϕ D	H	Approx. Mass (kg)		
						Less display	Display provided	Separate terminal box provided
15 (1/2″)	65	32.5	14.5	40	277	2.6	2.9	2.4
25 (1″)	80	47.5	26.6	67	277	3.2	3.5	3.0
40 (1-1/2″)	100	67	41.2	82	261	3.9	4.2	3.7
50 (2″)	125	85	52.7	92	266	4.0	4.3	3.8
80 (3″)	125	85	78.1	127	282	6.8	7.1	6.6

17.4 EX Delta Dia, Flanged Type

All dimensions in millimeters
NOTE: Figures in brackets ( )
show meter with built-in display.

● **Nominal Dia. 50, 80mm**





Separately-mounted Preamplifier Type

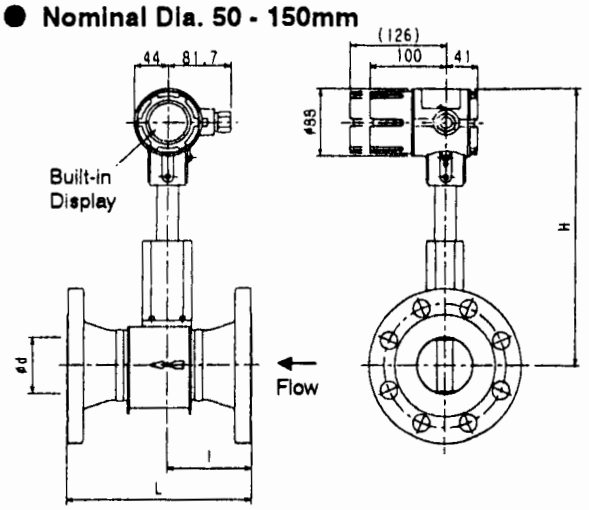
Nominal Dia. Mm (in.)	L	ϕ d (Meter I.D.)	H
50 (2″)	229	52.7	266
80 (3″)	254	78.1	282

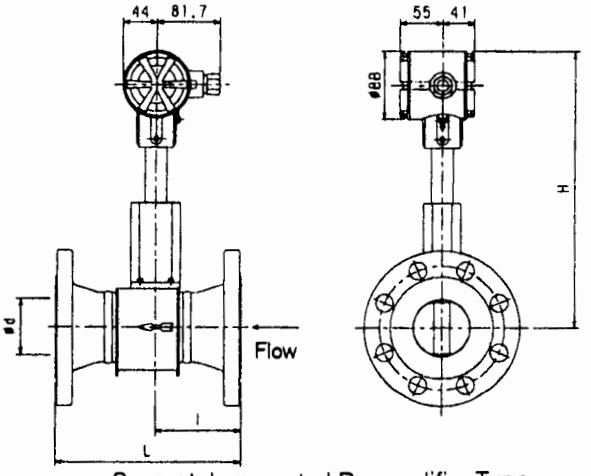
17.5 Replaceable Sensor Type

17.5.1 EX Delta, Flanged Type

All dimensions in millimeters
NOTES: 1. Figures in brackets ( ) show meter with built-in display.
2. Dimension ϕd indicates the inside diameter of the bluff body.

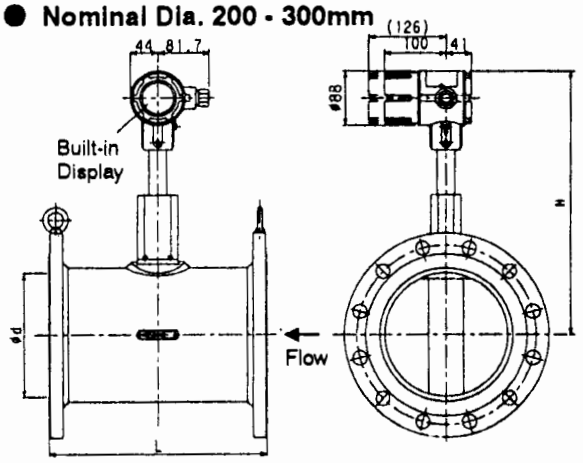
● **Nominal Dia. 50 - 150mm**

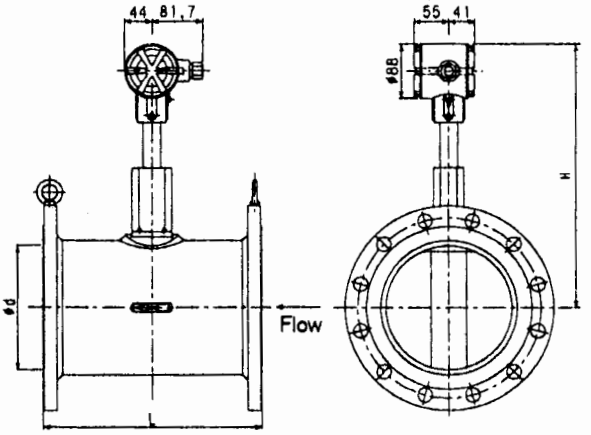




Separately-mounted Preamplifier Type

● **Nominal Dia. 200 - 300mm**





Separately-mounted Preamplifier Type

Nominal Dia. Mm (in.)	L	I	ϕ d (Meter I.D.)	H	Approx. Mass (kg)		
					Less display	Display provided	Separate terminal box provided
50 (2″)	173	86.5	48.5	347	9.6	9.9	9.4
80 (3″)	219	99.5	72.4	363	15.8	16.1	15.6
100 (4″)	250	110.5	95.2	383	21.8	22.1	21.6
150 (6″)	322	132.5	140.3	413	44.3	44.6	44.1
200 (8″)	350	—	199.9	428	39.4	39.7	39.4
250 (10″)	450	—	248.8	450	69.4	69.7	69.4
300 (12″)	500	—	297.9	472	89.4	89.7	89.4

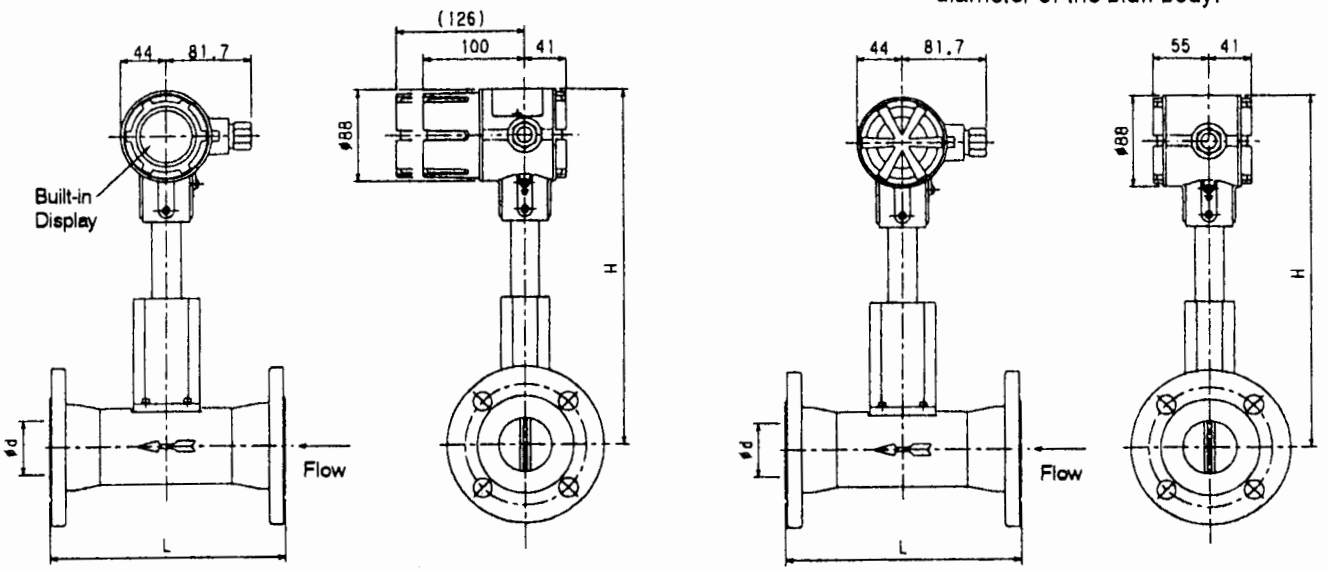
➡ NOTE: Shown here are dimensions and mass of JIS 10K rating.

➡ NOTE: See approval drawing for detail dimensions.

17.5.2 EX Delta Dia, Flanged Type

All dimensions in millimeters
NOTES: 1. Figures in brackets ( ) show meter with built-in display.
2. Dimension ϕd indicates the inside diameter of the bluff body.

● **Nominal Dia. 50, 80mm**

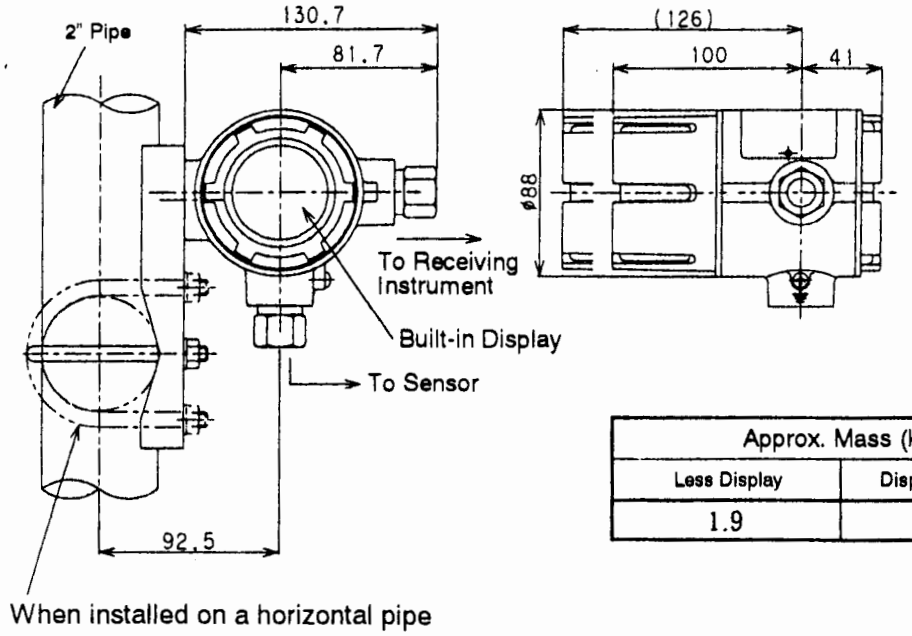


Separately-mounted Preamplifier Type

Nominal Dia. Mm (in.)	L	ϕ d (Meter I.D.)	H
50 (2″)	229	52.7	347
80 (3″)	254	78.1	363

17.6 Separately-mounted Preamplifier

All dimensions in millimeters
NOTE: Figures in brackets ( ) show meter with built-in display.

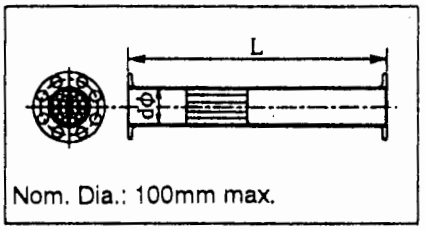


When installed on a horizontal pipe

Approx. Mass (kg)	
Less Display	Display Provided
1.9	2.1

17.7 Flow Straightener and Downstream Short Pipe

Flow Straightener Outline Dimensions

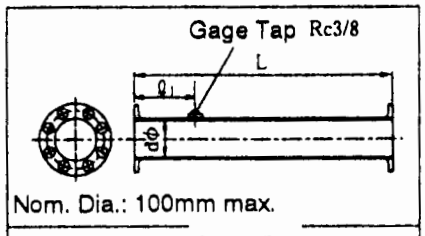


Nom. Dia.: 100mm max.

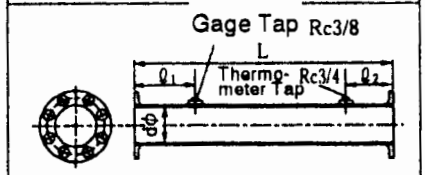
Model	Nom. Dia. mm (in.)	Dimensions (mm)		Approx. Mass (kg)		
		d φ	L	JIS 10K	JIS 20K ANSI 150	JIS 30K ANSI 300
FS 02	20 (3/4)	21.4	240	2.1	2.2	3.7
FS 03	25 (1)	27.2	300	4	4	5
FS 04	40 (1・1/2)	41.2	480	6	6	8
FS 05	50 (2)	52.7	600	8	8	10
FS 08	80 (3)	78.1	960	17	20	24
FS 10	100 (4)	102.3	1200	27	31	40
FS 15	150 (6)	151	1800	66	75	87
FS 20	200 (8)	199.9	2400	130	140	160
FS 25	250 (10)	248.8	3000	220	240	270
FS 30	300 (12)	297.9	3600	340	370	410
FS 35	350 (14)	333.4	4200	470	510	570
FS 40	400 (16)	390.6	4800	490	520 ※	—
FS 50	500 (20)	489	6000	870	930 ※	—
FS 60	600 (24)	584.2	7200	1590	1670 ※	—

NOTE: ※ above 400mm, ANSI Class 150 only.

Downstream Short Pipe Outline Dim.



Nom. Dia.: 100mm max.



Nom. Dia.: 150mm min.

Model	Nom. Dia. mm (in.)	Dimensions (mm)				Approx. Mass (kg)		
		d φ	L	ℓ1	ℓ2	JIS 10K	JIS 20K ANSI 150	JIS 30K ANSI 300
SP 02	20 (3/4)	21.4	125	62.5	—	1.8	2.3	3
SP 03	25 (1)	27.2	125	62.5	—	3	3	4
SP 04	40 (1・1/2)	41.2	200	80	—	4	4	7
SP 05	50 (2)	52.7	250	100	—	6	6	8
SP 08	80 (3)	78.1	400	160	—	10	13	17
SP 10	100 (4)	102.3	500	200	—	15	19	28
SP 15	150 (6)	151	750	300	120	34	42	55
SP 20	200 (8)	199.9	1000	400	200	58	70	92
SP 25	250 (10)	248.8	1250	500	250	100	120	150
SP 30	300 (12)	297.9	1500	600	300	150	180	220
SP 35	350 (14)	333.4	1750	700	350	210	250	310
SP 40	400 (16)	390.6	2000	800	400	210	250 ※	—
SP 50	500 (20)	489	2500	1000	500	370	420 ※	—
SP 60	600 (24)	584.2	3000	1200	600	670	750 ※	—

NOTE: ※ above 400mm, ANSI Class 150 only.

18. PRODUCT CODE EXPLANATION

18.1 EX Delta

Table 18.1

Item	Product Code ①②③④⑤⑥⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	Description		
Model	VX									EX Delta		
Body Style	W									Wafer type(nominal dia.10 to 150mm)		Fixed sensor
	F									Flange type(nominal dia.50mm and Larger)		
	R									Replaceable sensor, flanged (nom.dia. 50mm up) RF standard		
Application	1									Standard		
Nominal Diameter	010									10mm		
	015									15mm		
	025									25mm		
	040									40mm		
	050									50mm		
	080									80mm		
	100									100mm		
	150									150mm		
	200									200mm		
	250									250mm		
	300									300mm		
		—										
Major Parts Material		N								SCS14A(Applicable to 10～150mm in nom. dia.)		
										SUS316相当(Applicable to 200～300mm in nom. dia.)		
		C								SUS316+SFVC2A(Applicable to 200～300mm in nom. dia.)		Note 1
		Z								Special (other than above)		
Frange Rating			1							JIS 10K		
			2							JIS 16K		
			3							JIS 20K		
			4							JIS 30K		
			5							ANSI 150		Note 2
			6							ANSI 300		Note 2
			7							JPI 150		
			8							JPI 300		
			9							Other than above		
Sensor Construction				1						Nom. dia 40mm and larger		
				2						Nom. dia 10, 15, 25mm (separately mounted sensor type)		
Fluids to be Metered					G					Gas and steam	(300℃ max.)	Note 3
					L					Liquid	(300℃max.)	
					S					High temp. service: Gas and steam	(300℃ up to 420℃)	Note 3
					H					High temp. service: Liquid	(300℃ up to 420℃)	
					—							
Preamplifier Construction						1				Integrally-mounted type		
						2				Separately-mounted type (installed on a 2″pipe)		
Explosionproof Construction							0			Noneexplosionproof		
							1			Flameproof (TIIS)		Note 4
							4			Flameproof (FM)		
							5			Flameproof (CSA)		
Display								0		None		
								1		Totalizer and digital indicator		Note 5
Output signal									4	Unfactored pulse: Smart		
									5	Factored pulse: Smart		
									6	Analog: Smart		
									A	Unfactored pulse: HART		
									B	Factored pulse: HART		
									C	Analog: HART		

Note1 Material code "C": Meter body material of nom. dia. 200-300mm is SUS316 pipe + SFVC2A flanges.
Not applicable to meter approved for the high pressure gas safety law.
Note2 ANSI rated meters have serrated flanges conforming to ASME/ANSI B 16.5-1996.
Note3 Steam measurement not acceptable by meters 10mm in nom. dia.
Note4 Explosionproof meters are furnished with dedicated explosionproof Cable glands (pressuretight packings). Do not fail to use them.
Note5 Display with internal swith or EL2300 for ①6-digit total flow, ②digital inst. Flowrate, ③% inst. Flowrate, ④8-segement bar graph

18.2 EX Delta Dia

Table 18.2

Item	Product Code ①②③④⑤⑥⑦	—	⑧⑨⑩⑪	—	⑫⑬⑭⑮	Description
Model	V X					EX Delta
Body Style	W					Wafer type(nominal dia. 15 to 80mm)
	F					Flange type(nominal dia. 50mm and Larger)
	R					Replaceable sensor, Flanged(nominal dia. 50mm up) RF standard
Application	2					Diamond shaped vortex shedding element
Nominal Diameter	0 1 5					15mm
	0 2 5					25mm
	0 4 0					40mm
	0 5 0					50mm
	0 8 0					80mm
		—				
Moajor parts Material			N			SCS14A Applicable to wafer type 15 and 25mm in nominal dia.
			C			SUS316
			Z			Special(other than above)
Frange Rating			1			JIS 10K
			2			JIS 16K
			3			JIS 20K
			4			JIS 30K
			5			ANSI Class 150 Note 1
			6			ANSI Class 300 Note 1
			7			JPI Class 150
			8			JPI Class 300
			9			Special(other than above)
Sensor Construction				2		Separately-mounted sensor type
Fluids to be Metered				L		Liquid below 300°C
				H		Liquid above 300°C up to 420°C
					—	
Preamplifier Construction					1	Integrally-mounted type
					2	Separately-mounted type (installed on a 2″pipe)
Explosionproof Construction					0	Noneexplosionproof
					1	Flameproof (TIIS) Note 2
					4	Flameproof (FM)
					5	Flameproof (CSA)
Display					0	None
					1	Totalizer and digital indicator Note 3
Output signal					4	Unfactored pulse: Smart
					5	Factored pulse: Smart
					6	Analog: Smart
					A	Unfactored pulse: HART
					B	Factored pulse: HART
					C	Analog: HART

Note1 ANSI rated meters have serrated flanges conforming to ASME/ANSI B 16.5-1996.
Note2 Explosionproof meters are furnished with dedicated explosionproof Cable glands (pressuretight packings). Do not fail to use them.
Note3 Display with internal swith or EL2300 for ①6-digit total flow, ②digital inst. Flowrate, ③% inst. Flowrate, ④8-segement bar graph

~ MEMO ~

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