Vortex Flowmeter with Converter

Instruction Manual

Model： **DYVF-25mm c/w Pressure,Temp sensor,온압보정**
FDSWP-802 Monitor
DYVF-40mm c/w Pressure,Temp sensor 온압보정
FDSWP-802 Monitor

CONTENTS

HANDLING

This manual mainly describes the installation, operation and maintenance of the Vortex flowmeter.

Read this manual thoroughly before use.Note that customer features have not been described and that the manual may not be revised every time there are changes in specifications, construction or parts when it is estimated that those changes will cause no problems in the functions or performance.
The Vortex flowmeter model DYVF100 and Vortex flow converter model DYVFA11 are thoroughly tested at the factory before shipment. When these instruments are delivered, perform a visual check to ascertain that no damage occurred during shipment. If you have any problems or questions, contact your nearest our service center or sales representative describing in concise details the development of the failure and clearly showing the instrument model and serial numbers.

1.INTRODUCTION

1.1 Model and specifications

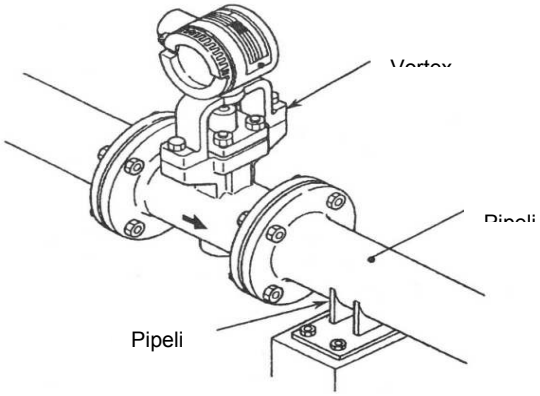
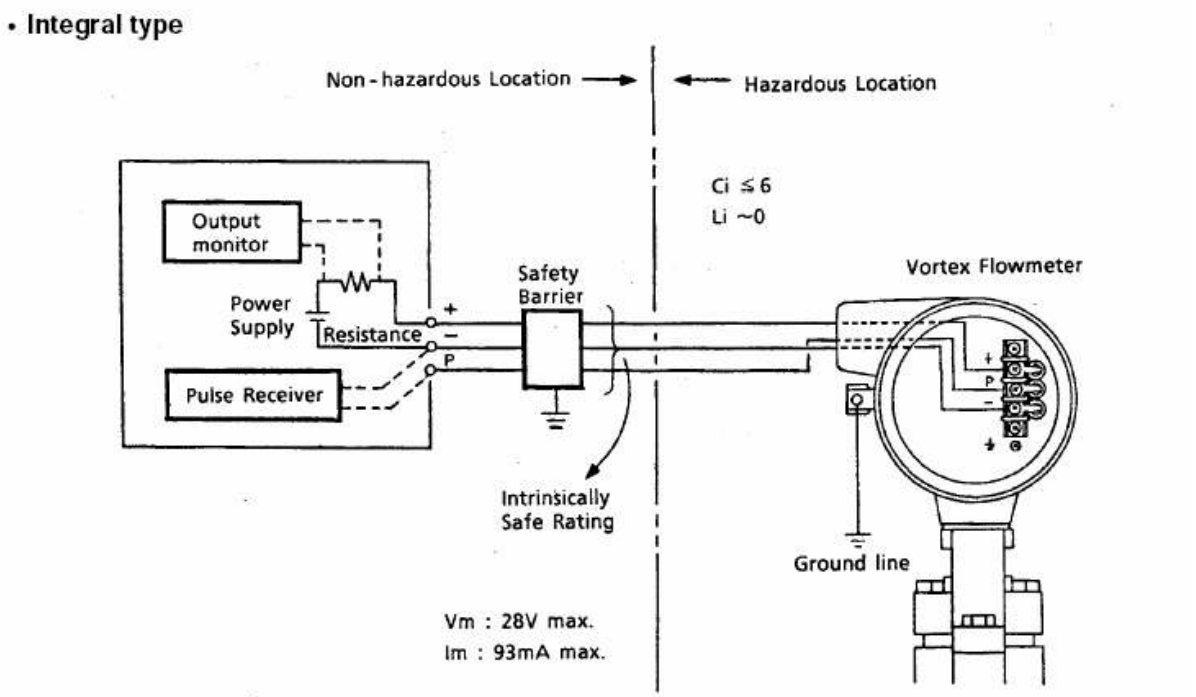


Fig. 1.1 Recommended pipeline support

• Insulation resistance test procedure

1. Short-circuit the + and - (4 to 20 mA version) or +, P and - (pulse version) terminals in the terminal box.
2. Connect a plus (+) insulation tester leadwire to these terminals and the minus (-) leadwire to ground.
3. Turn the insulation tester power ON and measure the resistance between the two leads. The voltage application should be within 2 minutes.
4. After completing this test, disconnect the insulation tester. The short-circuiting wire between the + and – terminals should be connected to the ground terminal through a 100 kΩ resistor to discharge any internally charged static voltage. Do not make physical contact with these terminals until the voltage is completely discharged.

• Integral type



• Remote type

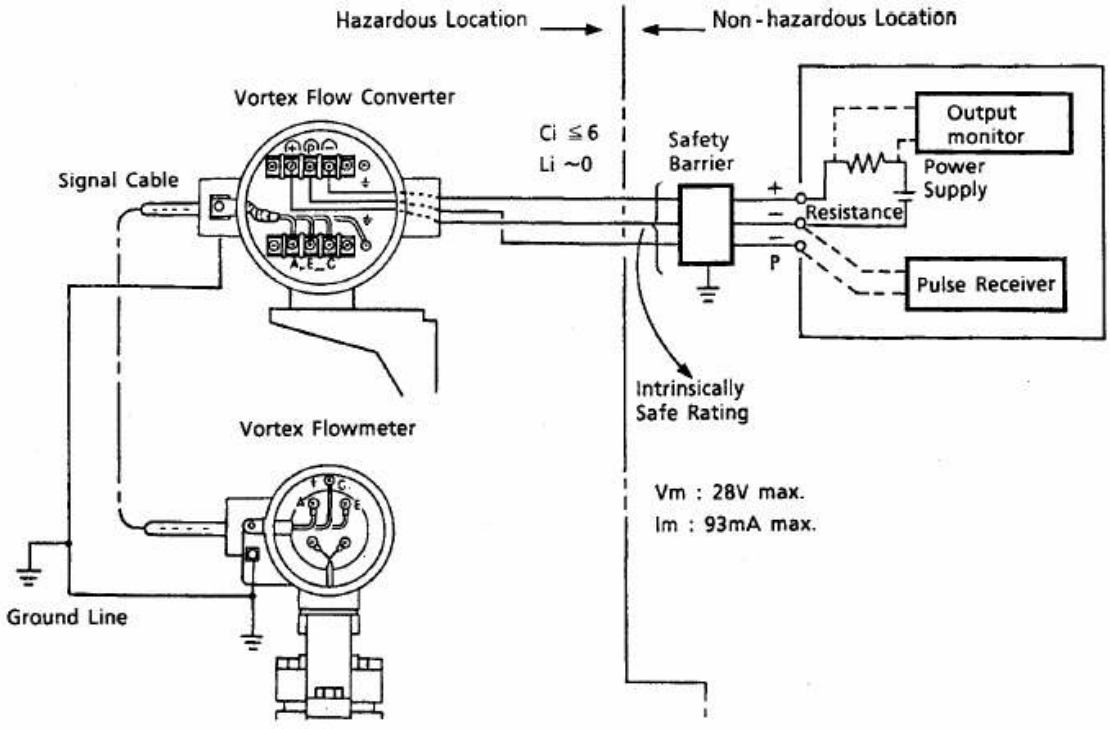


Fig. 1.2 Wiring for NEPSI intrinsic safety

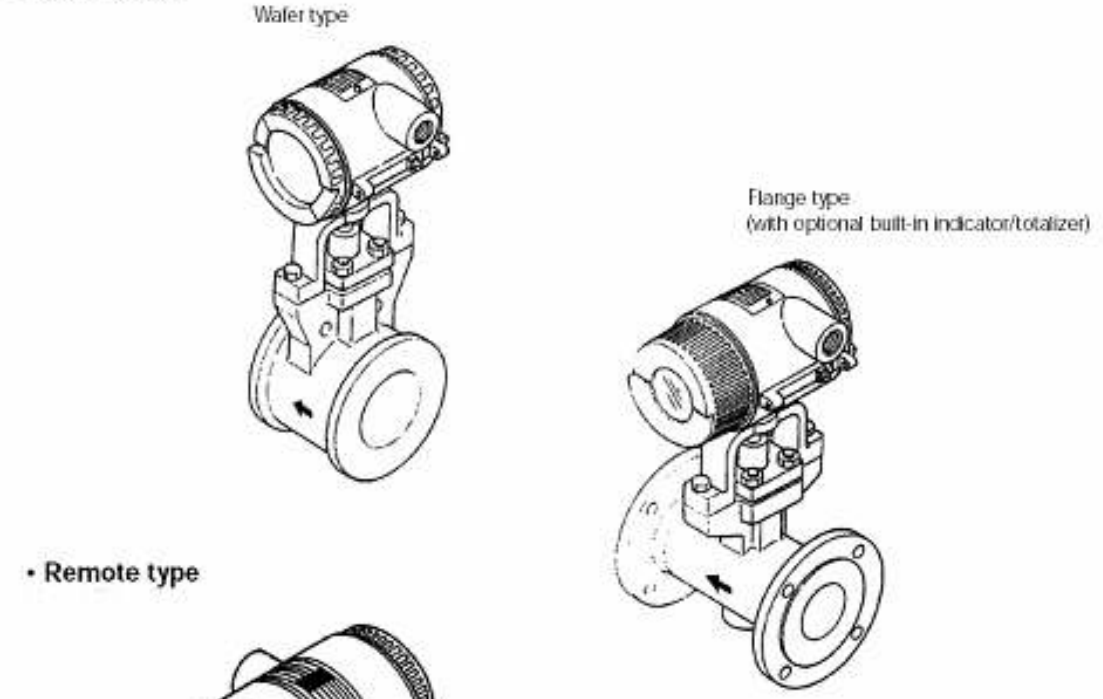
2. GENERAL DESCRIPTION

2.1 Outline

This Vortex flowmeter measures liquid, gas and steam flow rates and converts them to a 4 to 20 mA DC output or pulse output signal.

The Model VF100-A has an integral converter. The remote type (Model VF100-NNN) is used with the Model VFA11 Vortex flow converter. A special cable (Model VF011) is used between these instruments. Since the converter of the remote type is mounted independently from the flowmeter, it permits remote flow measurements of high temperature liquid, steam, etc.

• **Integral type**



• **Remote type**

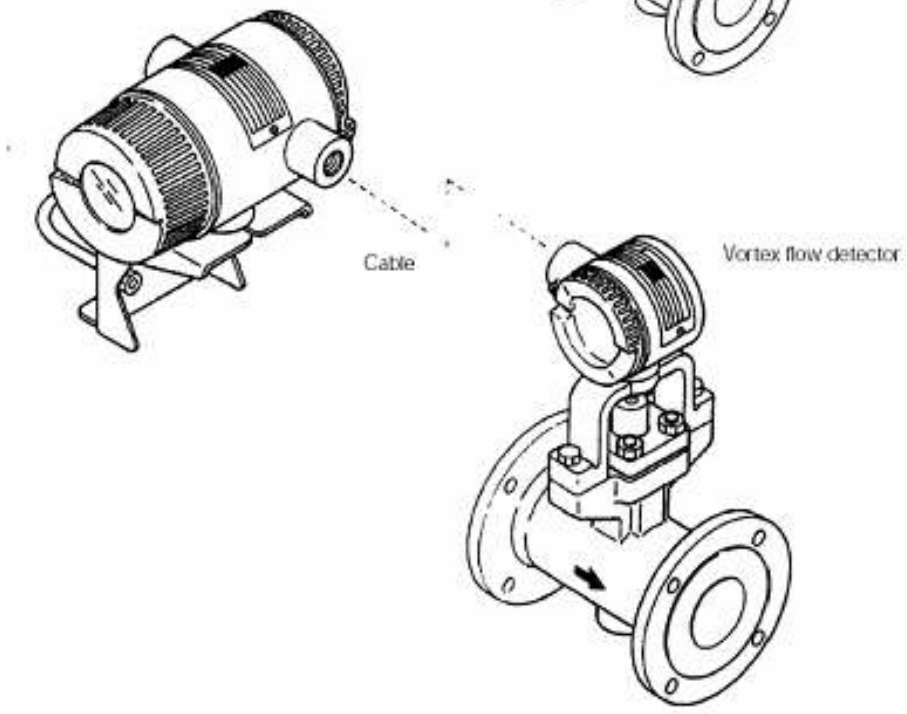


Fig. 2.1 External view

2.2 Standard specifications

Fluid to be measured : Liquid, gas or steam

Measuring range: Normal: Reynolds number: 2×10^4 to 7×10^6(15A～100A)

Reynolds number: 4×10^4 to 7×10^6(150A～300A)

Velocity:≤10m/s(for liquid)

≤80m/s(for gas and steam)

The relationship between the flow velocity and kinematic viscosity is shown in Fig. 6.1.

The relationship beween the minimum measurable flow rate and density is shown in Fig. 6.2. If the flow rate corresponds to a Reynolds number between 5 x 10^3 and 2 x 10^4 (4 x 10^4), refer to section 6.1, table 6.1.

Output signal

- Analog output : 4 to 20 mA DC
-Communication signal : HART communication signal (superimposed on a 4 to 20 mA DC signal)
- Pulse output : • Low level : 0 - 2 V
  • High level : Vs - 2V (Vs: input supply voltage)
  • Pulse width : Approx. 50 % duty cycle
  See table 2-1 for the nominal pulse rate.

Accuracy

- Analog output : ±1,0 % of reading plus ±0.1 % of full scale
  ±1.5 % of reading plus ±0.1 % of full scale for gas or steam flow velocity more than 35 m/s
- Pulse output : ±1,0 % of reading
  ±1,5 % of reading for gas or steam flow velocity more than 35 m/s

Ambient temperature limits

- Standard : -40 to +80 °C
- With totalizer/indicator : -30 to +80 °C
- Intrinsically safe
  Integral type : -40 to +50 °C
  Remote type : -40 to +80 °C
  Remote converter : -40 to +50 °C
- Explosion proof
  Integral type : See Fig. 2.2
  Remote type : -40 to +80 °C

Process temperature limits : -40 to +300 °C (refer to Fig. 2-3 for integral type).

Ambient humidity limits : 5 to 100% R.H.

Process pressure limits : Less than flange ratings.

Wetted parts materials

- Body : SCS14(ANSI 316)
- Vortex shedder : ANSI 316 or Duplex stainless steel

Non-wetted parts materials

- Amplifier case assembly : Aluminium alloy casting

Coating finish

- Amplifier case : Polyurethane resin baked coating ;
Frosty white
- Amplifier cover : Polyurethane resin baked coating ;
Deep sea moss green

Power supply and load resistance

Analog output : 17 to 42 V DC, see Fig. 2-4

Communication-line conditions

- Load resistance : 250 to 600 Ω (incl. cable resistance)
- Region : within 2 km (within 800 m for IS version) (using ”CEV” cables)
- Load capacitance : 0.22 μF
- Load inductance : 3.3 mH

NOTES:

1. Communication cables must be at least 15 cm away from power lines. Do not lay the cables parallel to power lines.
2. Input impedance of connected instruments: 10 kΩ or more (at 2.4 kHz)

Pulse output

- Supply voltage : 14 to 30 V DC
- Load resistance : 50 Ω max. (see fig. 2-5)
- Line capacitance : 0.22 μF max.

Enclosure classification : IP65

Electrical classification : Approved by NEPSI

EEx d Ⅱ CT1～T6

Electrical connection : GB G 1/2 female

Weight : See external dimensions

Signal cable : Model VF011 cable (used between remote detector and converter)

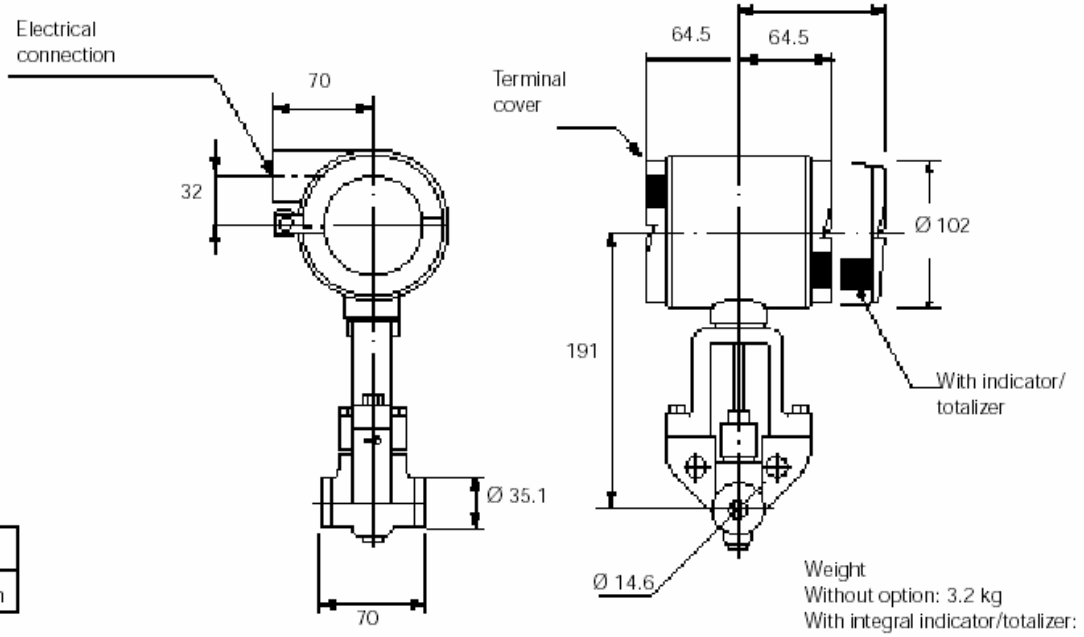
• Outer sheath material : Black heat resistance polyethylene
• Durable Temperature : -40 to +105 °C
Maximum length : 20 m.

2.4 External dimensions

2.4.1 Integral type

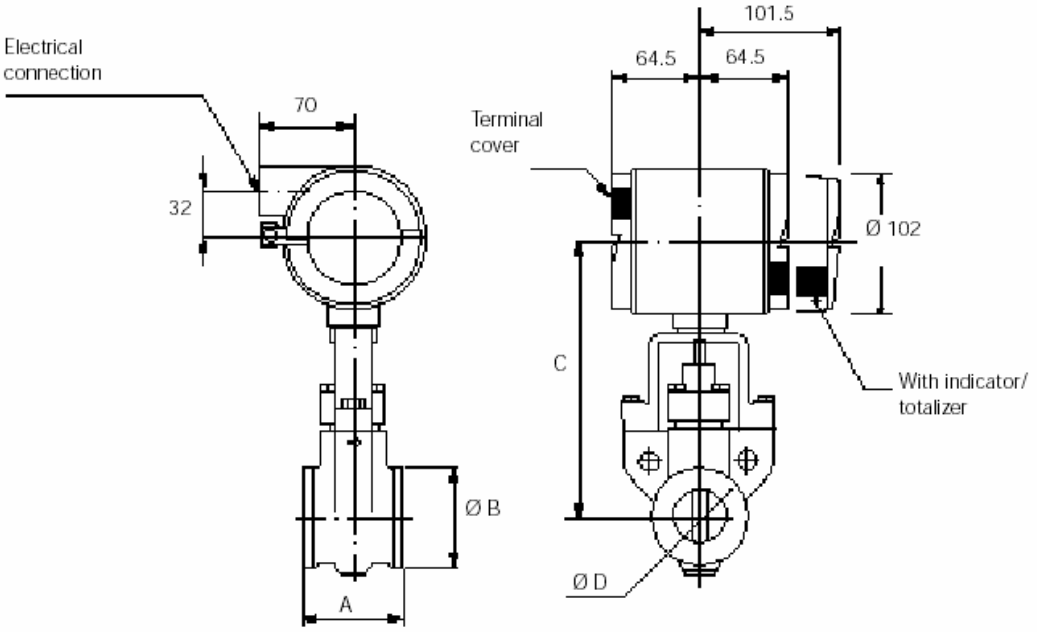
• **Wafer type**

Unit: mm



Model
15 mm

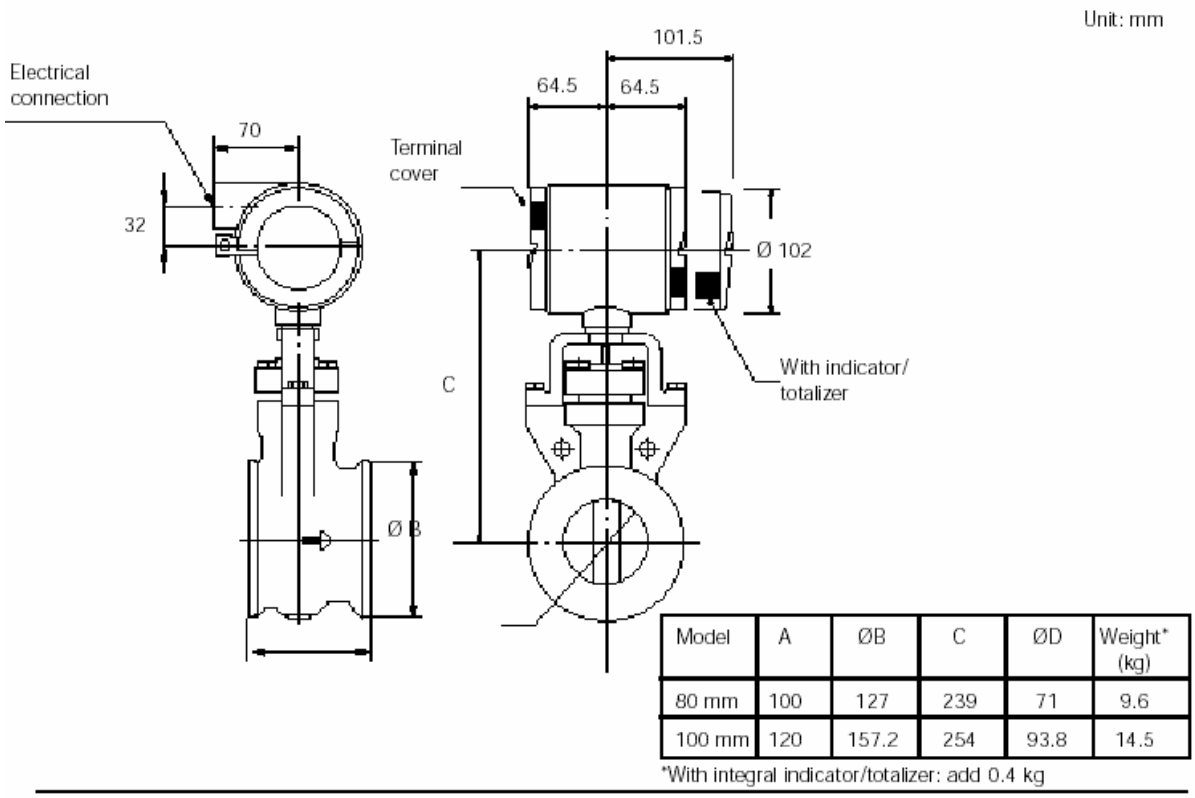
Weight
Without option: 3.2 kg
With integral indicator/totalizer: add 0,4 kg



Model	A	ØB	C	ØD	Weight* (kg)
25 mm	70	50.8	193	25.7	3.9
40 mm	70	73	200	39.7	4.2
50 mm	75	92	222	51.1	5.5

*With integral indicator/totalizer: add 0.4 kg

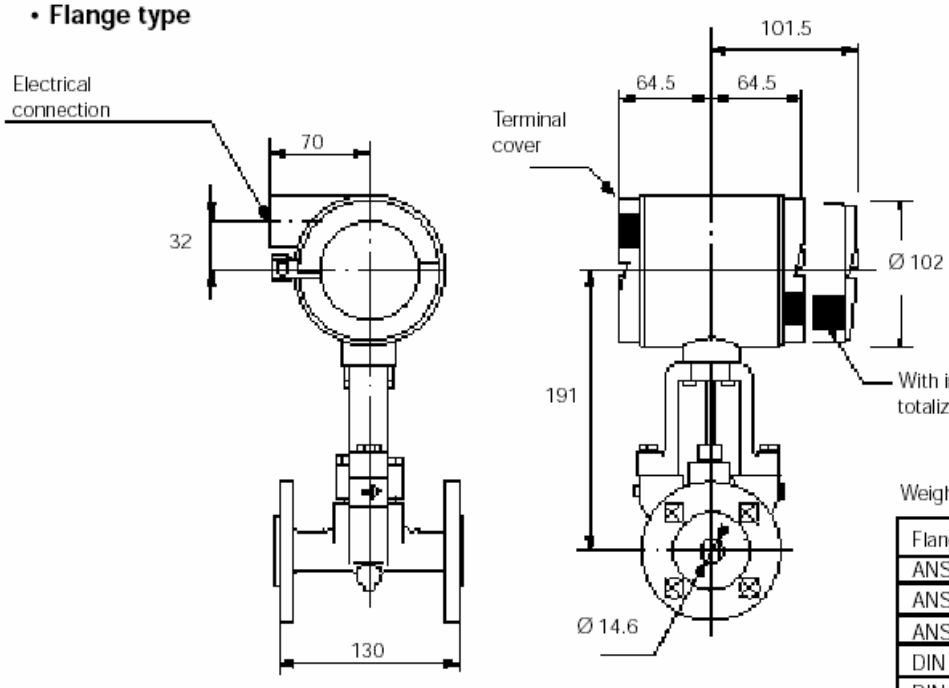
Fig. 2.4a



Model	A	ØB	C	ØD	Weight* (kg)
80 mm	100	127	239	71	9.6
100 mm	120	157.2	254	93.8	14.5

*With integral indicator/totalizer: add 0.4 kg

• **Flange type**



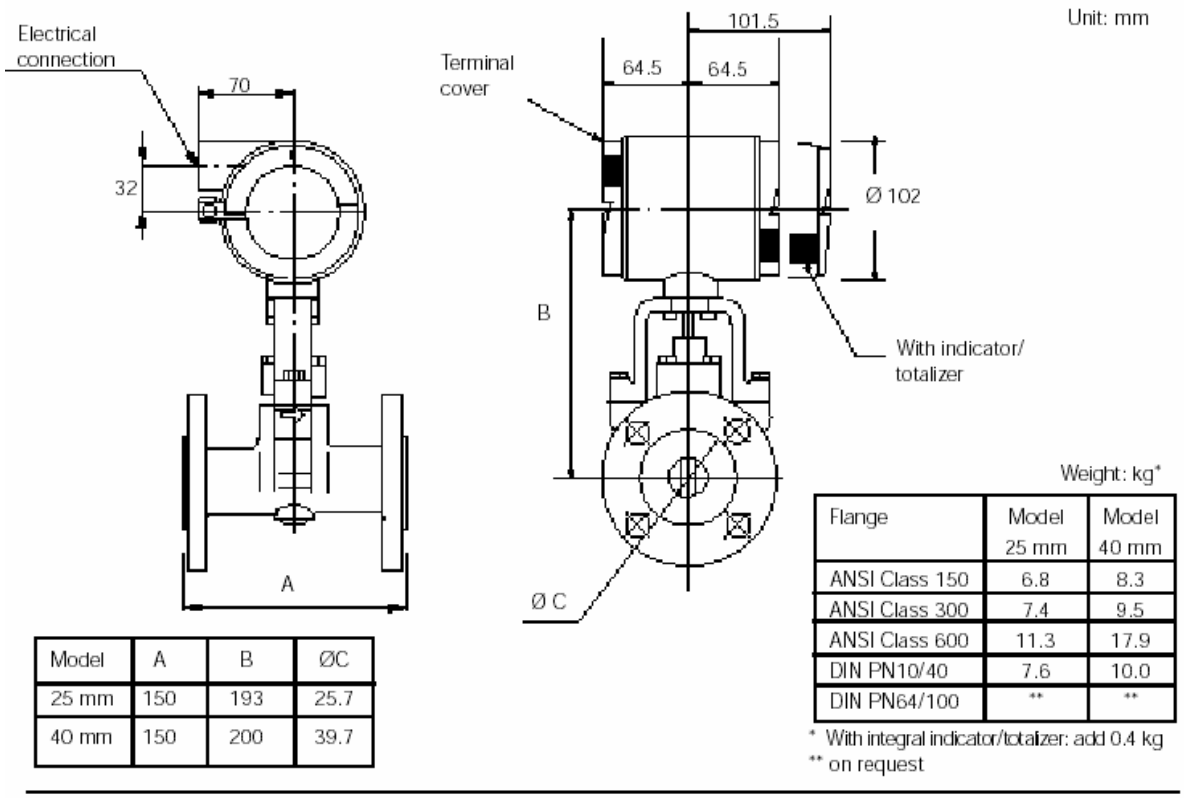
Model
15 mm

Weight: kg*

Flange	Weight*
ANSI Class 150	4.3
ANSI Class 300	4.5
ANSI Class 600	5.0
DIN PN10/40	5.0
DIN PN64/100	6.0

*With integral indicator/totalizer: add 0.4 kg

Fig. 2.4b

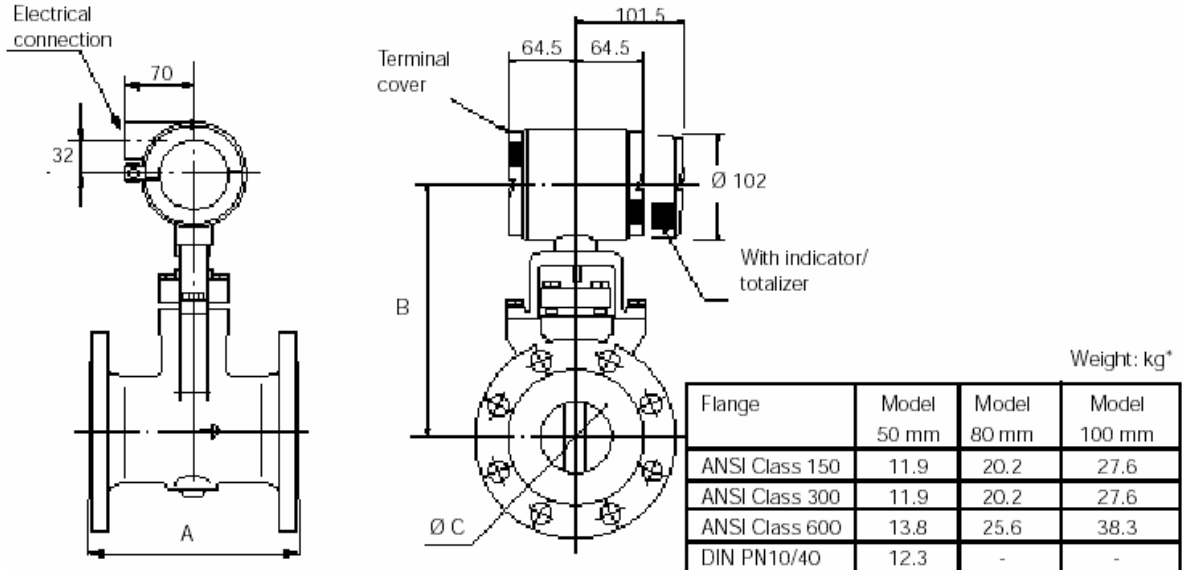


Model	A	B	ØC
25 mm	150	193	25.7
40 mm	150	200	39.7

Weight: kg*

Flange	Model 25 mm	Model 40 mm
ANSI Class 150	6.8	8.3
ANSI Class 300	7.4	9.5
ANSI Class 600	11.3	17.9
DIN PN10/40	7.6	10.0
DIN PN64/100	**	**

* With integral indicator/totalizer: add 0.4 kg
** on request



Model	A	B	ØC
50 mm	170	222	51.1
80 mm	200	239	71
100 mm	220*	254	93.8

*For ANSI Class 600: A=240

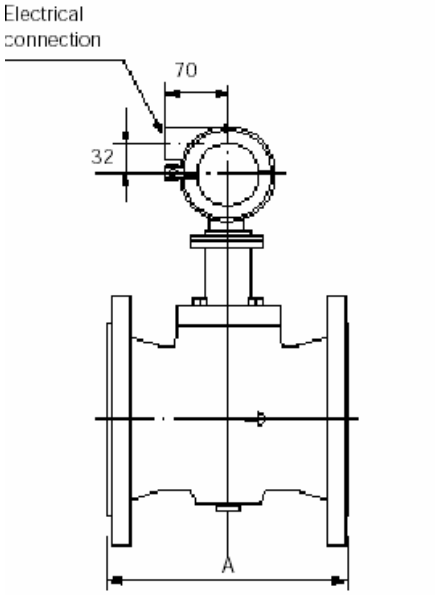
Weight: kg*

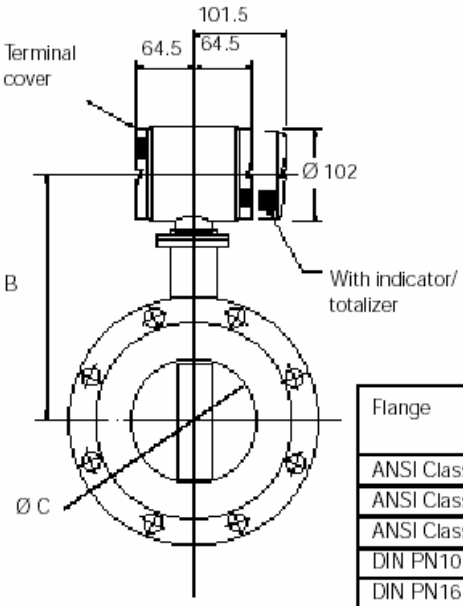
Flange	Model 50 mm	Model 80 mm	Model 100 mm
ANSI Class 150	11.9	20.2	27.6
ANSI Class 300	11.9	20.2	27.6
ANSI Class 600	13.8	25.6	38.3
DIN PN10/40	12.3	-	-
DIN PN10/16	-	21.5	26.9
DIN PN25/40	-	21.5	28.5
DIN PN64	-	-	-
DIN PN64/100	**	**	-
DIN PN100	-	-	38

* With integral indicator/totalizer: add 0.4 kg
** on request

Fig. 2.4c

Unit: mm





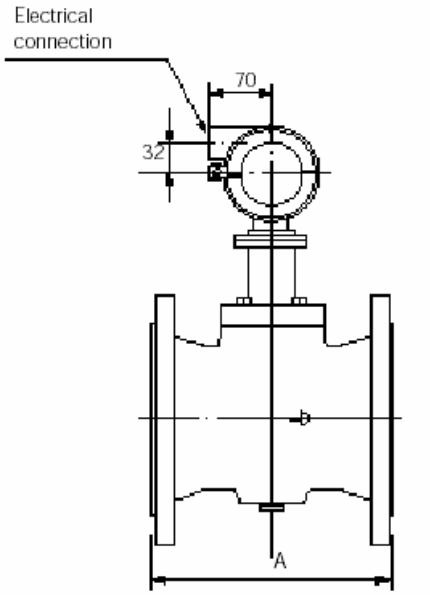
Model	A	B	ØC
150 mm	270*	271	138.8
200 mm	310	303	185.6

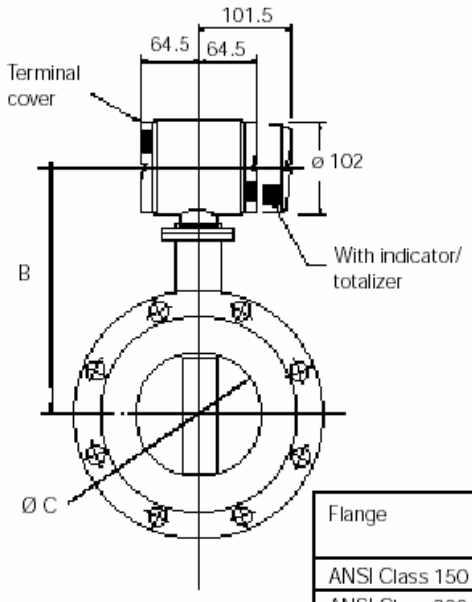
*For ANSI Class 600: A=310

Weight: kg*

Flange	Model 150 mm	Model 200 mm
ANSI Class 150	36.6	55.6
ANSI Class 300	54.6	80.6
ANSI Class 600	84.6	-
DIN PN10	-	**
DIN PN16	-	51.5
DIN PN10/16	**	-
DIN PN25	-	**
DIN PN40	39.1	58.1
DIN PN64	41.5	-
DIN PN100	**	-

* With integral indicator/totalizer: add 0.4 kg
** on request





Model	A	B	ØC
250 mm	370	340	230.8
300 mm	400	370	276.2

Weight: kg*

Flange	Model 250 mm	Model 300 mm
ANSI Class 150	90	140
ANSI Class 300	125	178
ANSI Class 600	-	-
DIN PN10	95	140
DIN PN25	130	185

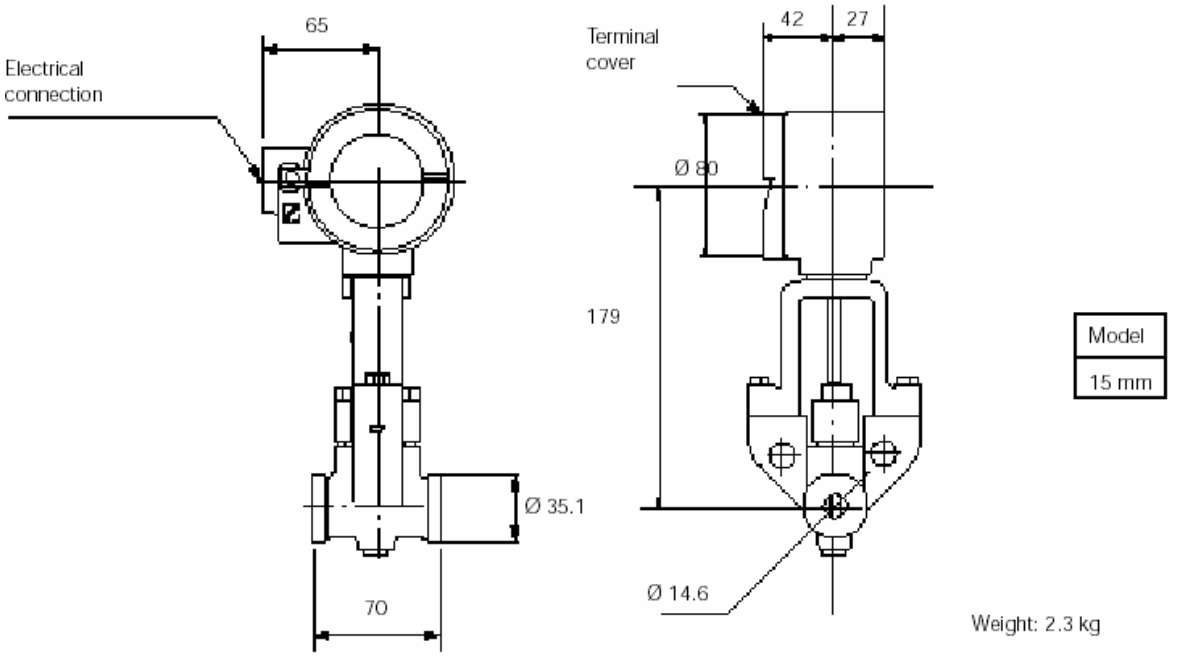
*With integral indicator/totalizer: add 0.4 kg

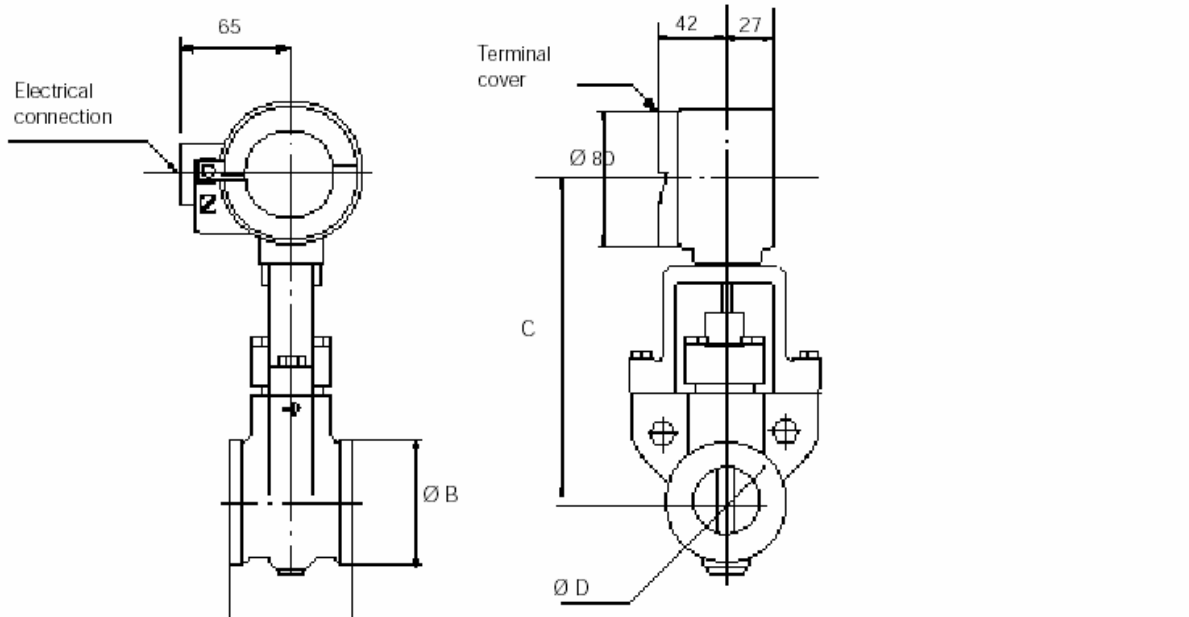
Fig. 2.4d

2.4.2 Remote converter type

• **Wafer type**

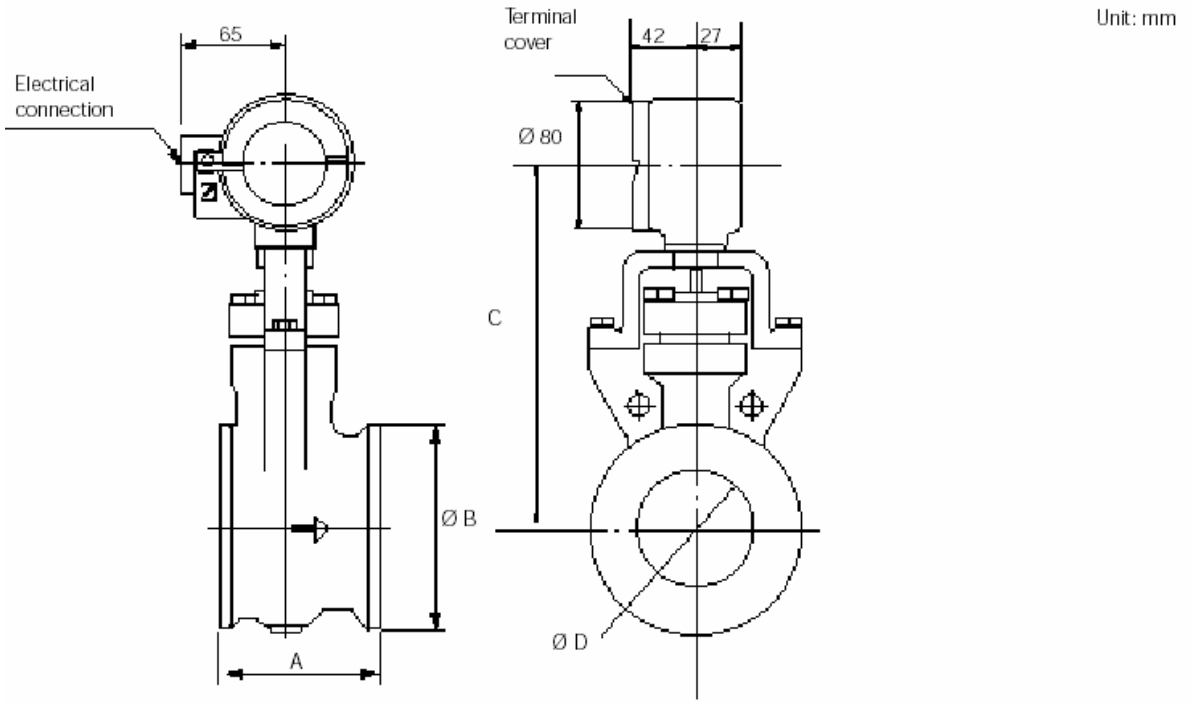
Unit: mm





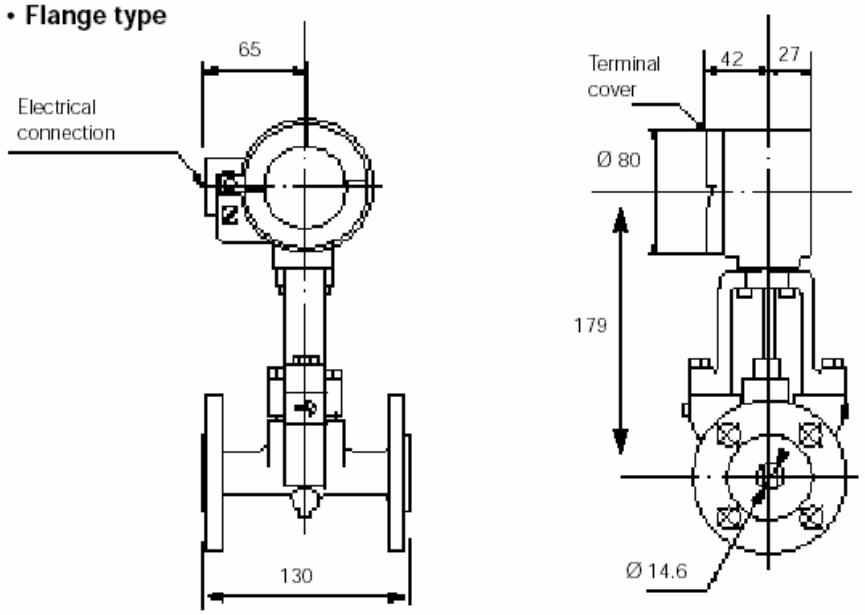
Model	A	ØB	C	ØD	Weight (kg)
25 mm	70	50.8	181	25.7	3.2
40 mm	70	73	188	39.7	3.8
50 mm	75	92	210	51.1	5.5

Fig. 2.5a



Model	A	ØB	C	ØD	Weight (kg)
80 mm	100	127	227	71	8.9
100 mm	120	157.2	242	93.8	12.3

• **Flange type**



Model
15 mm

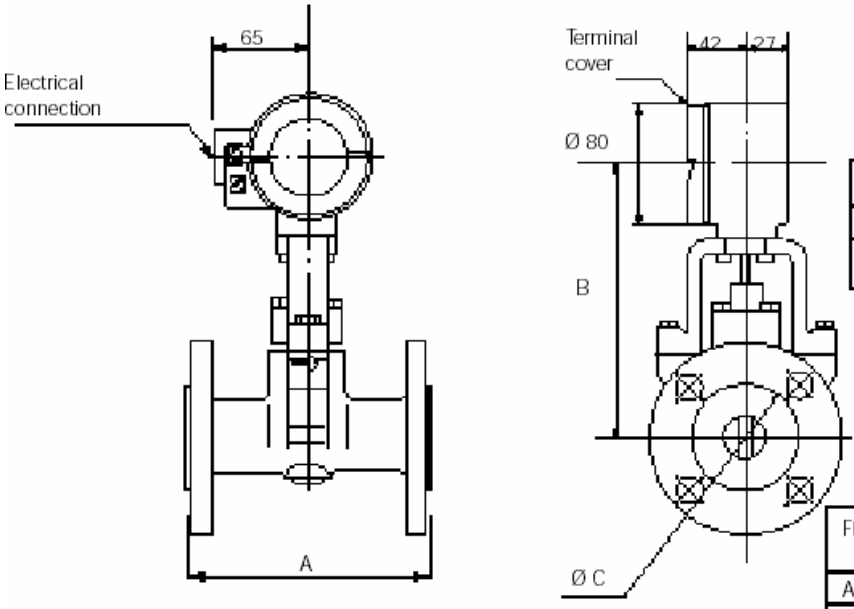
Weight: kg

Flange	Weight
ANSI Class 150	3.6
ANSI Class 300	3.8
ANSI Class 600	4.8
DIN PN10/40	3.8
DIN PN64/100	**

** on request

Fig. 2.5b

Unit: mm

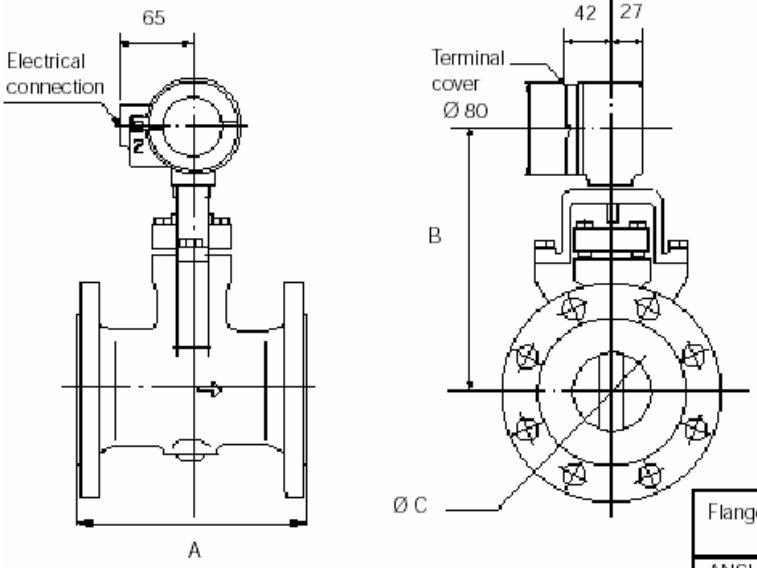


Model	A	B	ØC
25 mm	150	181	25.7
40 mm	150	188	39.7

Weight: kg

Flange	Model 25 mm	Model 40 mm
ANSI Class 150	6.1	7.6
ANSI Class 300	6.7	8.8
ANSI Class 600	10.6	17.2
DIN PN10/40	6.4	9.1
DIN PN64/100	**	**

** on request



Model	A	B	ØC
50 mm	170	210	51.1
80 mm	200	227	71
100 mm	220*	242	93.8

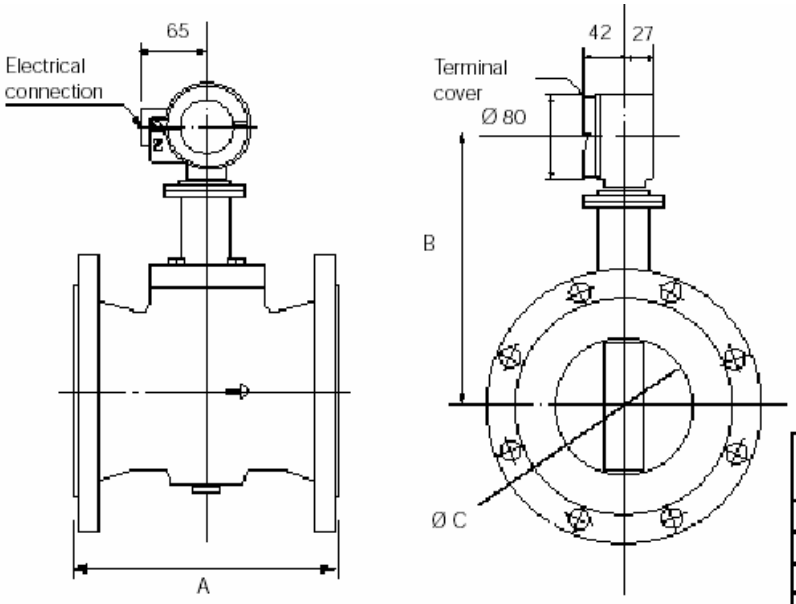
* For ANSI Class 600: A = 240

Weight: kg

Flange	Model 50 mm	Model 80 mm	Model 100 mm
ANSI Class 150	11.2	19.4	26.9
ANSI Class 300	11.2	19.4	26.9
ANSI Class 600	13.1	24.9	50.3
DIN PN10/40	12.3	-	-
DIN PN10/16	-	20.5	25.9
DIN PN25/40	-	20.5	27.5
DIN PN64	-	-	**
DIN PN64/100	**	**	**
DIN PN100	-	-	**

** on request

Fig. 2.5c



Unit: mm

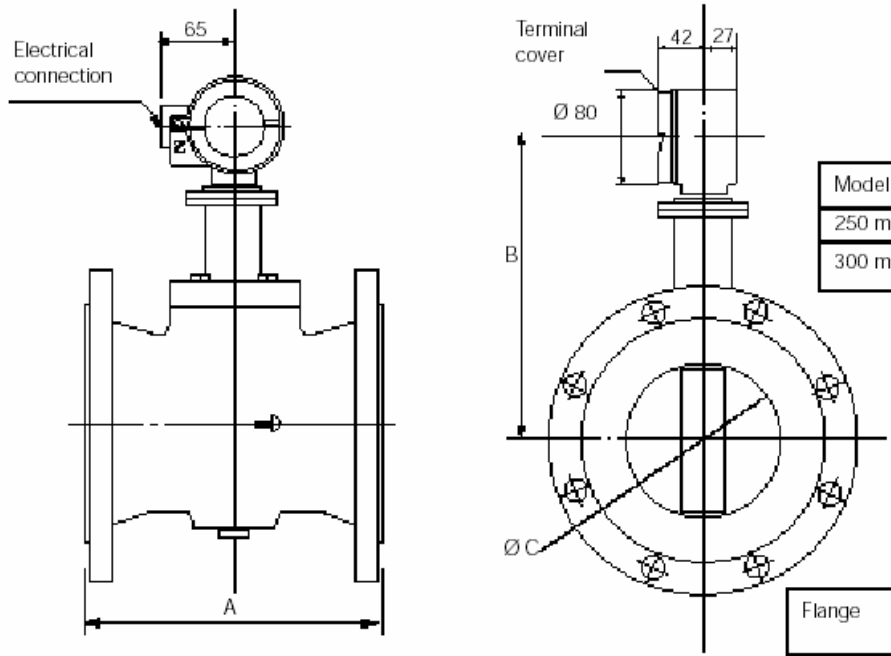
Model	A	B	ØC
150 mm	270*	260	138.8
200 mm	310	292	185.6

*For ANSI Class 600: A=310

Weight: kg

Flange	Model 150 mm	Model 200 mm
ANSI Class 150	36	55
ANSI Class 300	54	80
ANSI Class 600	84	-
DIN PN10	-	**
DIN PN16	-	55.1
DIN PN10/16	38.1	-
DIN PN25	-	**
DIN PN40	-	80.6
DIN PN25/40	40.5	-
DIN PN64	**	-
DIN PN100	**	-

** on request



Model	A	B	ØC
250 mm	370	329	230.8
300 mm	400	359	276.2

Weight: kg

Flange	Model 250 mm	Model 300 mm
ANSI Class 150	90	140
ANSI Class 300	125	178
DIN PN10	95	140
DIN PN25	130	185

Fig. 2.5d

Remote converter

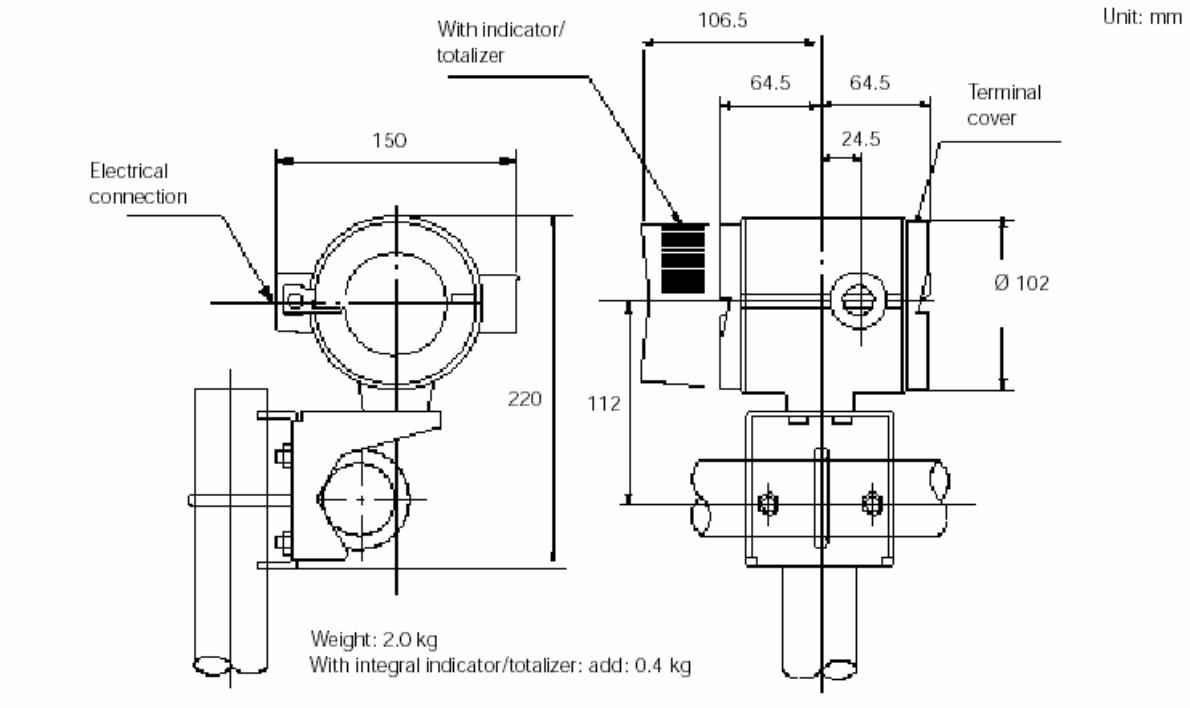
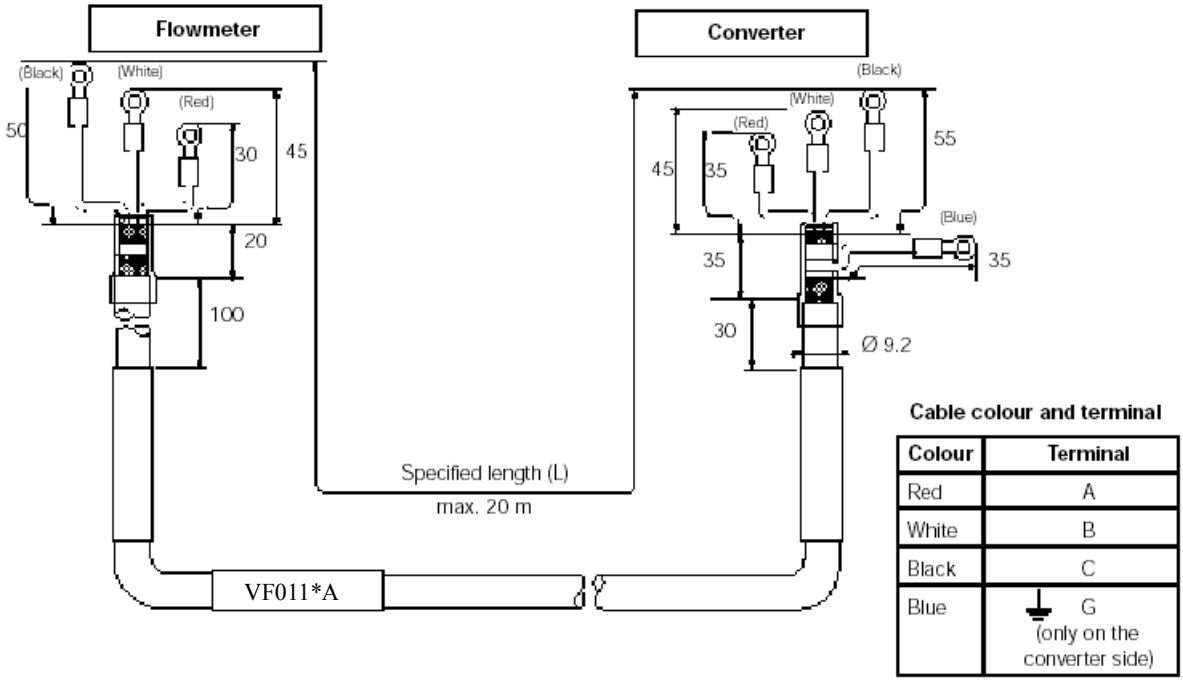


Fig. 2.6a

Signal cable for remote type



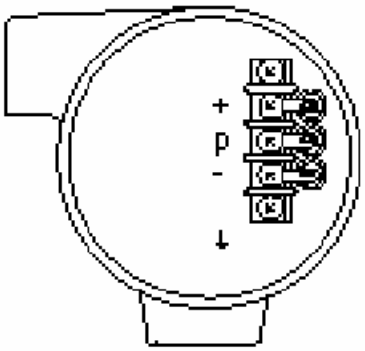
Cable colour and terminal

Colour	Terminal
Red	A
White	B
Black	C
Blue	⏚ G (only on the converter side)

Fig. 2.6b

Terminal configuration and terminal wiring

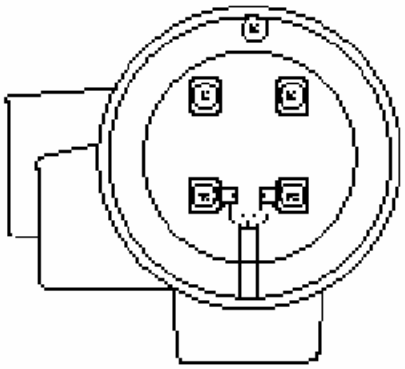
- **Integral type**



Integral converter type

+ - P	4 to 20 mA DC output version > Power supply and output signal terminals
+ - P	Voltage pulse output version > Power supply terminals > Pulse output terminals
⏚	Ground terminal

- **Remote type (terminal case)**

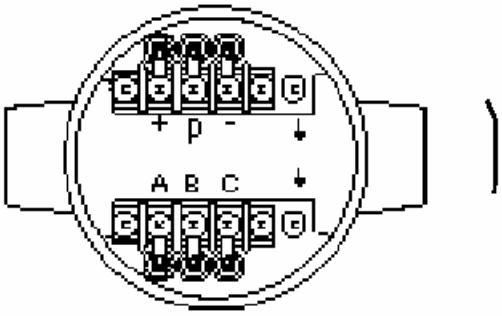


Remote converter type (terminal)

A B	Output terminals to Vortex flow converter
C	Connect to the signal cable C terminal

Note: Use signal cable, Model YF011*E

- **Remote type (converter)**



Remote converter type (converter)

A B C	Input terminals from Vortex flowmeter
+ - P	4 to 20 mA DC output version > Power supply and output signal terminals
+ - P	Voltage pulse output version > Power supply terminals > Pulse output terminals
⏚	Connected to the signal cable G terminal

Note: Use signal cable, Model YF011*E

Fig. 2.7a

3. INSTALLATION

When installing the Vortex flowmeter, refer to:

- paragraph 1-5, ”Installation area selection”
- paragraph 2-2, ”Standard specifications.

3-1. Piping

The upstream and downstream straight pipe requirements are generally recommended to meet to the same as the orifice meter (ASME, fluid meters).

(1). Valve position and straight pipe length

In general, install the Yewflo in the upstream side of a valve (see fig. 3-1).

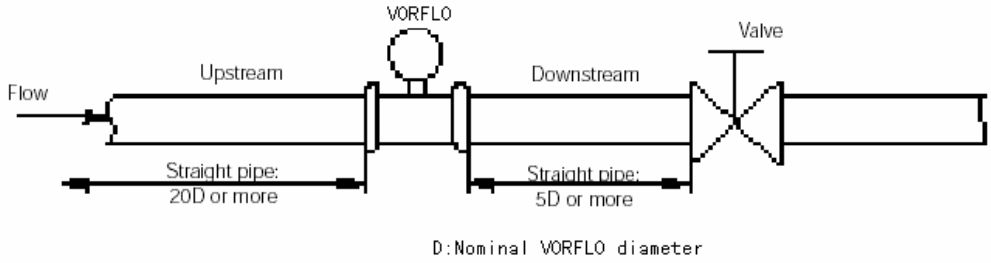


Fig. 3.1

(2). Installing a valve on the upstream side

For a gas line which uses a piston-type or roots-type blower compressor or a high-pressure liquid line (about 10 kg/cm^2 or more) which uses a piston-type or plunger-type pump, fluid vibrations may be produced. In this case, install the valve on the upstream side of the VORFLO (see fig. 3-2).

In addition, for inevitable reason from installation point of view, install a fluid vibration damping device such as a throttling plate or an expansion section on the upstream side of the VORFLO.

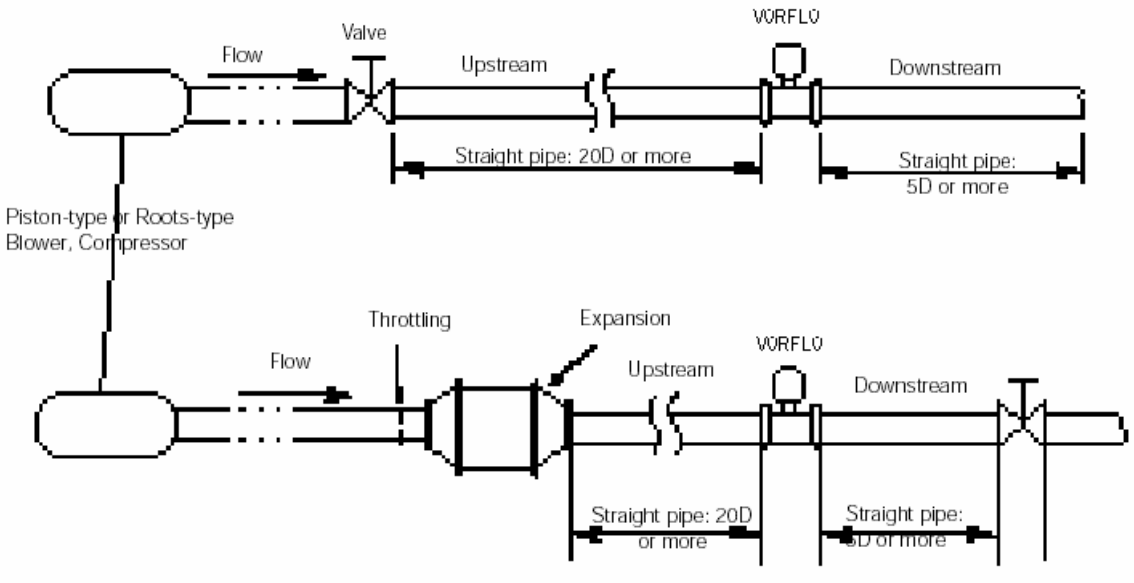


Fig. 3.2

(3). Installing an accumulator on the upstream side

Install the accumulator on the upstream side of the VORFLO to reduce fluid vibrations (see fig. 3-3).

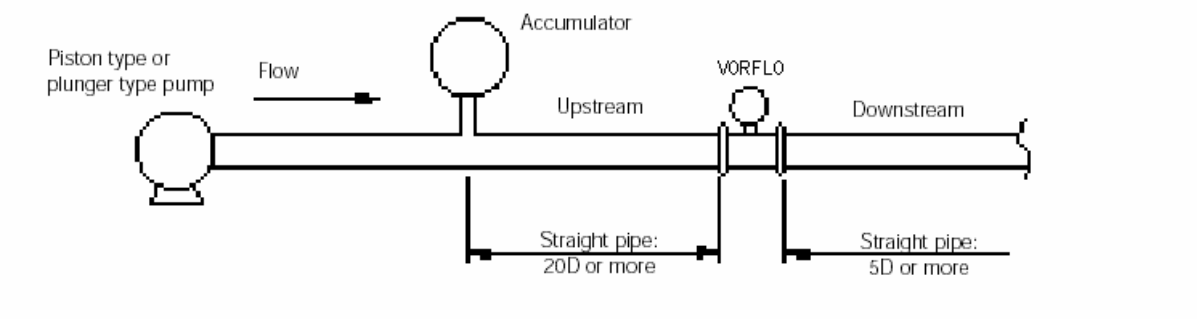


Fig. 3.3

(4). Installation using a single elbow or reducer on the upstream side

If a single elbow or reducer is installed in the upstream of the pipeline, provide a straight pipe 10 times as long as the inner pipe diameter upstream of the Vortex flowmeter and five times as long as the inner pipe diameter downstream of the Vortex flowmeter (see fig. 3-4). If there is an elbow in the pipe, the flowmeter and Vortex shedder should be in the same plane as the elbow.

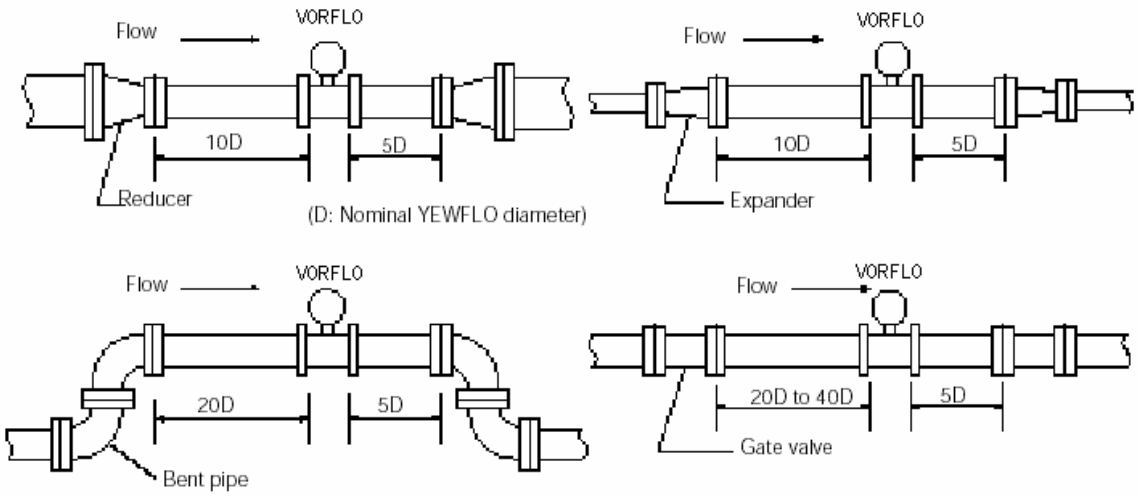


Fig. 3.4

(5). Installation using a shut-off valve on the upstream side

If a shut-off valve is located upstream of the flowmeter, provide a straight pipe - if possible more than 40* times as long as the pipe inside diameter - between it and the flowmeter.* At least 20 times as long as the pipe inside diameter.

ATTENTION:

1. The process pipeline inner diameter should be slightly larger than the Vortex flowmeter inner diameter, schedule 40 or lower pipes should be used for 1/2 to 2 inch flowmeters and schedule 80 or lower pipes for 3 to 8 inch flowmeters.
2. The Vortex flowmeter is of IP65 waterproof construction. However, it cannot be used under water.
3. The flowmeter can be installed vertically, horizontally or at any other angle. However, for liquid measurement, the instrument pipe must be filled with the fluid. In a vertical flowmeter, fluid should flow upward.

(6). Pressure and temperature taps

For pressure measurements (when required), locate the pressure tap 3,5 to 7,5 inner pipe diameters

downstream of the vortex shedder.

For temperature measurements (when required), the temperature tap should be located on 1 to 2 inner pipe diameter downstream of the pressure tap (see Fig. 3-5).

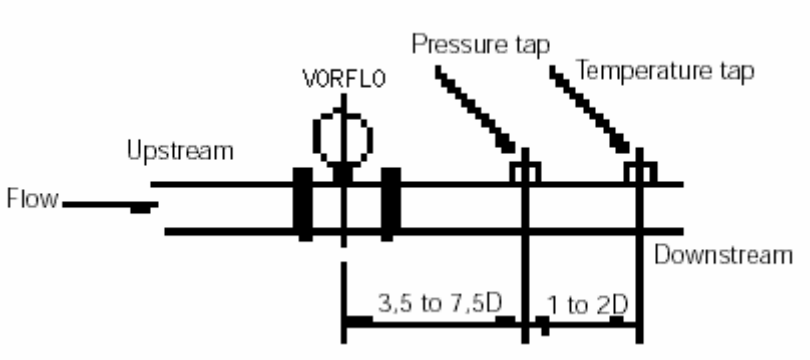


Fig. 3.5 Pressure and temperature taps

(7). Flushing of pipe line (cleaning)

Flush and clean scale, incrustation and sludge on the inside of pipe wall for newly installed pipe line and repaired pipe line before the operation.

When flushing, the flow should flow through bypass-piping to avoid damaging the flowmeter. If there is no bypass piping, install a short pipe instead of the flowmeter.

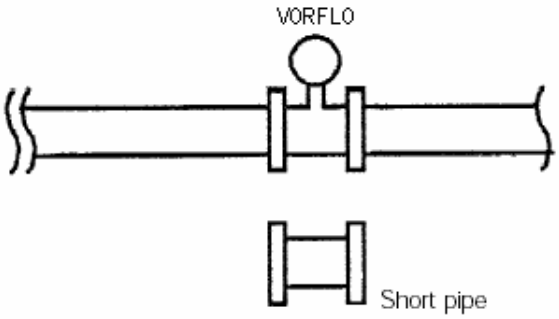


Figure 3.6

(8). Fluids carryings solids

Do not measure fluids that carry solids (e.g. sand and pebbels). Make sure users periodically remove solids adhering to the vortex shedder.

(9). Obstruction of flow fluids

This may cause a chemical reaction and the fluid will be crystalized and hardened and be deposited on the pipe wall and shedder bar. In thoses cases clean the shedder bar.

(10).Temperature drop

If the temperature drops, the remaining-moisture or water becomes ice. Avoid moisture and water, when shutting down the operation.

(11).Multi-phase flow

VORFLO can measure gas, liquid and steam when there is no change in state. However, accurate measurement of mixed flows (e.g. gas and liquid) is not possible.

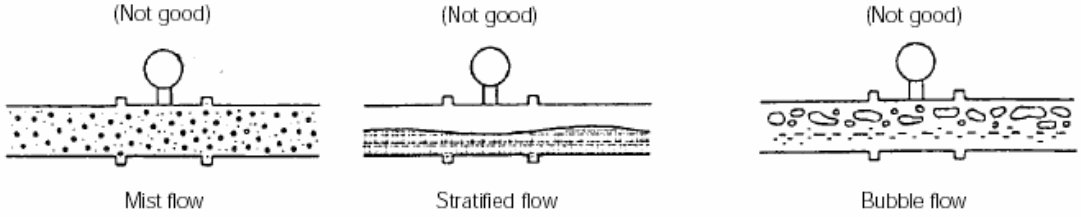


Fig. 3.7

(12).Pipeline diameter and VORFLO

It is recommended that the inner pipeline and the VORFLO diameter are the same. If a difference is unavoidable, employ a VORFLO with a diameter smaller than that of the pipeline, and assure that it is centered in the pipeline.

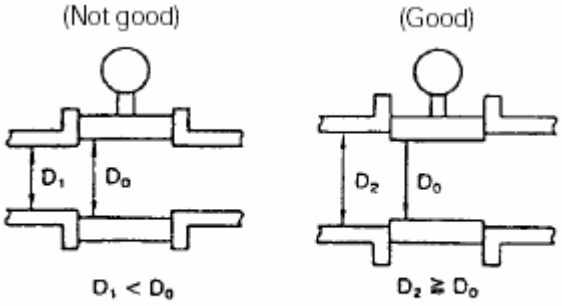


Figure 3.8

(13).Liquid measurement precautions

To ensure accurate measurement, the VORFLO must always have a full pipeline.

- Piping requirements for proper operation

Allow the flow to flow against gravity. When the flow is moving with gravity, lift the downstream pipe length above the VORFLO installation level to maintain full pipeline.

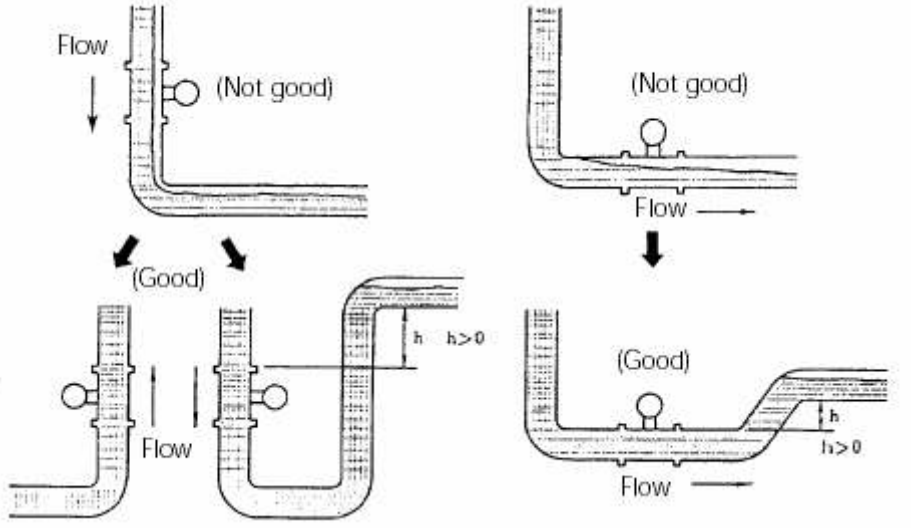


Fig. 3.9

- Piping for avoiding bubbles

Flows containing both gas and liquid cause problems. Avoid gas bubbles in a liquid flow. Piping should be carried out to avoid bubble generation.

Install the valve on the downstream side of the flowmeter because pressure drop across the control valve may cause gas to come out of the solution.

Flow

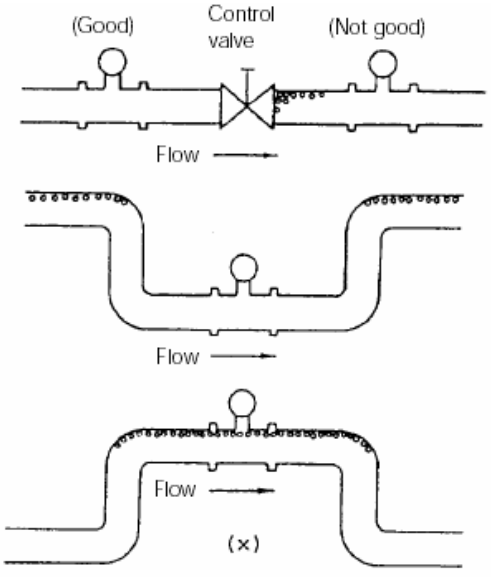


Fig. 3.10

(14).Gas or steam measuring precautions

- Piping to prevent standing liquid

Mount the VORFLO in a vertical pipeline to avoid liquid traps. When the VORFLO is installed horizontally, raise that part of the pipeline in which the VORFLO is installed

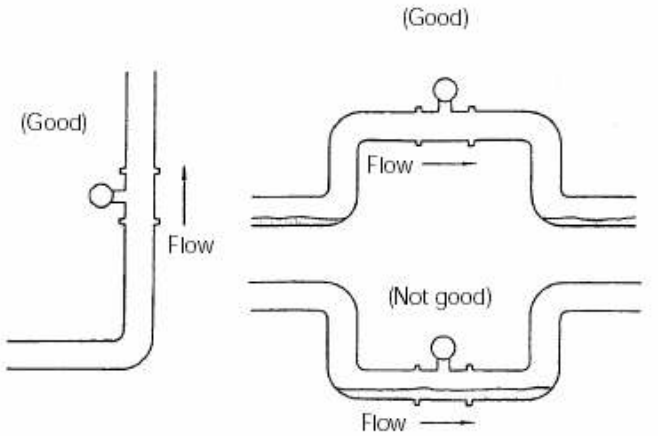


Fig. 3.11

(15). Piping to improve durability

- Bypassing piping

Installing a bypass, as illustrated in the figure below, permits the VORFLO to be checked or cleaned conveniently (vortex shedder, etc.).

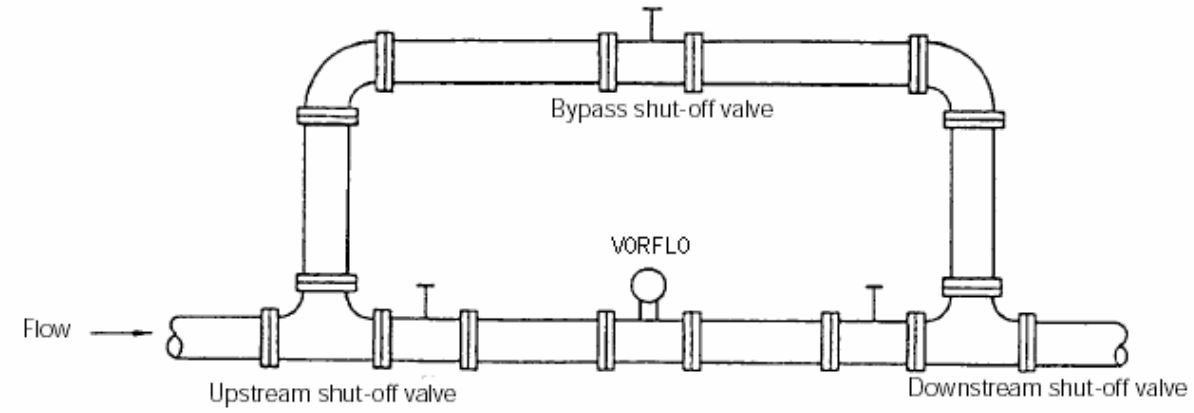


Fig. 3.12

3-2. Installing the Vortex flowmeter

Before installing the instrument verify the direction of flow. This direction should match the arrow mark on the instrument body. When changing the orientation of the terminal box, refer to section 3-3.

3-2-1. Installing the wafer type Vortex flowmeter

When installing the wafer type Vortex flowmeter, it is important to align the instrument bore with the inner diameter of the adjacent piping. To establish alignment, use the four collars supplied with the instrument.

(1). Four collars are supplied for 1/2-inch (15 mm) to 11/2-inch (40 mm), 2-inch (ANSI class 150) and 3-inch (ANSI class 150). Install the instrument as illustrated in Fig. 3-16.

(2). If the adjacent flanges have eight bolt holes, insert the stud bolts in the holes on the instrument shoulder (see Fig. 3-18).

Stainless steel stud bolts and nuts are available on order. When they are to be supplied by the user, refer to table 3-1 for stud bolt length. Gaskets must be supplied by the user.

Table 3-1. Recommended stud bolt for wafer type

Size mm (inch)	Flange	Major diameter of external thread of stud bolt (mm)	Length (mm)
15(1/2)	JIS 10K, 20K JIS 40K GB 1.0MPa, 1.6MPa, 4.0MPa	12 16 12.7	160 160 150
25(1)	JIS 10K, 20K, 40K GB 1.0MPa GB 1.6MPa, 4.0MPa	16 12.7 15.9	160 150 160
40(11/2)	JIS 10K, 20K JIS 40K GB 1.0MPa GB 1.6MPa, 4.0MPa	16 20 12.7 19.1	160 170 150
50(2)	JIS 10K, 20K, 40K GB 1.0MPa, 1.6MPa, 4.0MPa	16 15.9	200
80(3)	JIS 10K JIS 20K, 40K GB 1.0MPa GB 1.6MPa, 4.0MPa	16 20 15.9 19.1	240
100(4)	JIS 10K JIS 20K JIS 40K GB 1.0MPa GB 1.6MPa GB 4.0MPa	16 20 22 15.9 19.1 22.2	240 240 270 240 240 270

3-2-2. Gaskets

Avoid mounting gaskets which protrude into the pipeline (see fig. 3-13). This may cause inaccurate readings. Use gaskets with bolt holes, even if VORFLO is of the wafer type When using a spiral gasket (without bolt holes), confirm the size with the gasket-manufacturer, as standard items may not be used for certain flange ratings (see fig. 3-14).

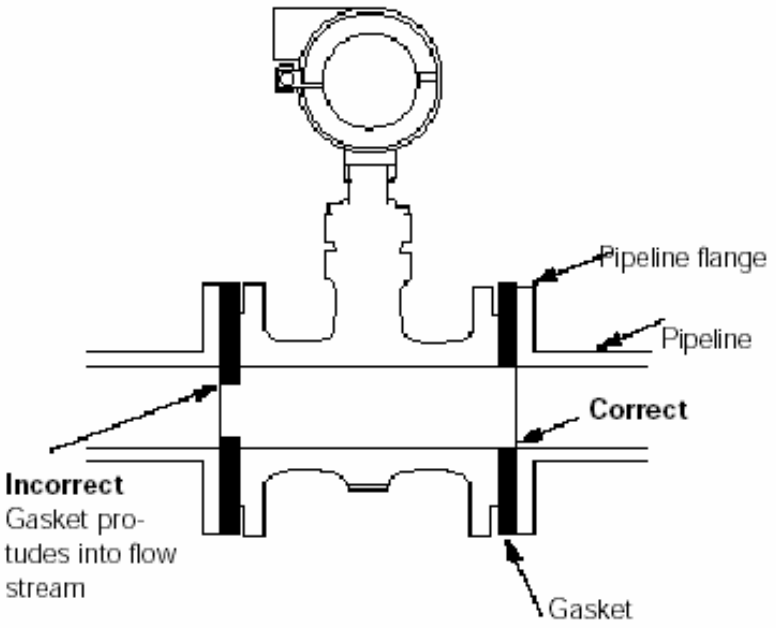


Figure 3-13

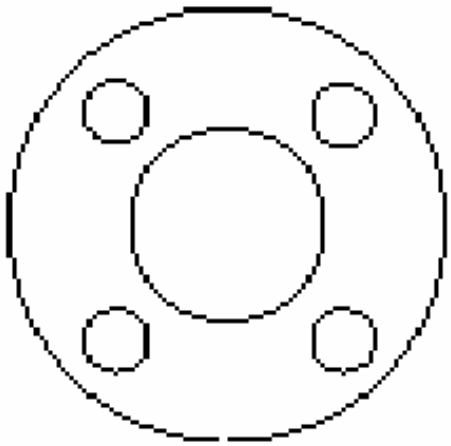


Figure 3.14 Gasket with bolt holes

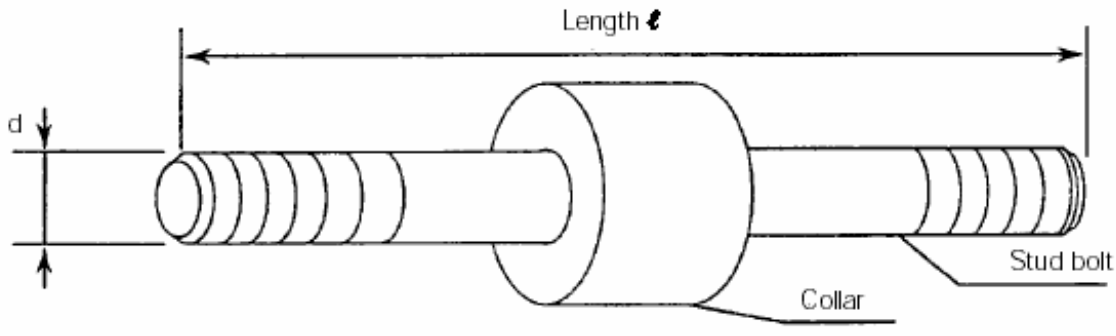


Fig. 3.15 Collar and stud bolt

3-2-3. Mounting examples of the wafer type

3-2-3-1. When installation collars are required

Size mm(inch)	Flange rating
15～40 (1/2~1 1/2)	All ratings
50(2)	JIS 10K, GB 4.0MPa
80(3)	GB 4.0MPa

Four collars are supplied with the flowmeter to properly align the flowmeter bore with the inner diameter of the adjacent piping. These collars establish a predetermined spacing between the mounting bolts and the outside diameter of the flowmeter body. The bolts must be of the proper diameter to establish alignment.

1. Horizontal installation

1. Insert two collars on each of the lower two bolts.
2. Place the flowmeter body on the lower two bolts (see fig. 3-16).
3. Tighten the four bolts (including upper two bolts) and nuts uniformly.
4. Check for leakage from the flange connections.

2. Vertical installation

1. Insert four collars on each of the four bolts and check that all four collars contact the outside diameter of the flowmeter body (see fig. 3-17).
2. Tighten the four bolts uniformly. Check for leakage from the flange connections.

CAUTION:

1. The inside diameter of the gasket must be larger than the pipe inner diameter so that it will not disturb the flow in the pipeline.
2. When installing the flowmeter vertically in the open air, change the electrical connection port direction to the ground.

If the electrical connection port is installed upward, rain water might leak in.

• **Horizontal installation**

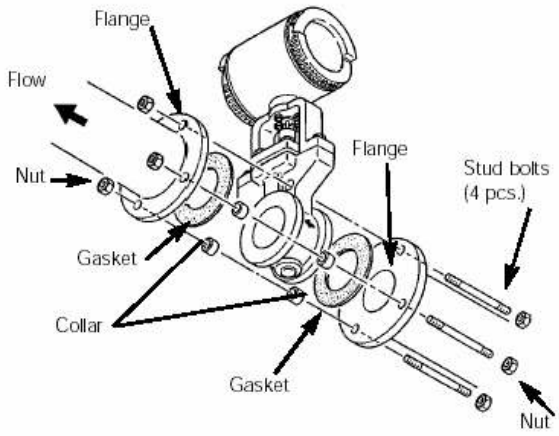


Figure 3-16

• **Vertical installation**

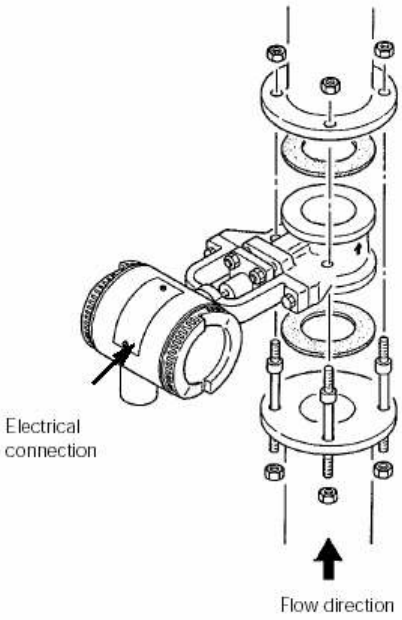


Figure 3.17

3-2-3-2. When installation collars are not required.

Size mm(inch)	Flange rating
50(2)	JIS 20K, 40K GB 1.6MPa，4.0MPa
80(3)	JIS 10K, 20K, 40K GB 1.6MPa，4.0MPa
100(4)	JIS 10K, 20K, 40K GB 1.0MPa, 1.6MPa，4.0MPa

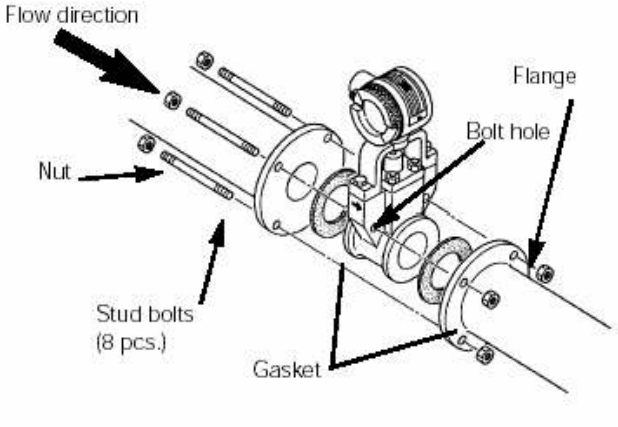


Figure 3-18

1. Horizontal installation

1. Insert two stud bolts in the bolt holes on the flowmeter shoulder to align the instrument body with the inner diameter of the adjacent piping (see fig. 3-18).
2. Tighten all bolts uniformly and check for leakage from the flange connections.

2. Vertical installation

1. Insert two stud bolts in the bolt holes on the flowmeter shoulder to align the instrument body with the inner diameter of the adjacent piping (see fig. 3-19).
2. Tighten all bolts uniformly. Check for leakage from the flange connections.

CAUTION:

1. The inside diameter of the gasket must be larger than the pipe inner diameter so that it will not disturb the flow in the pipeline.
2. When installing the flowmeter vertically in the open air, change the electrical connection port direction to the ground.

If the electrical connection port is installed upward, rain water might leak in.

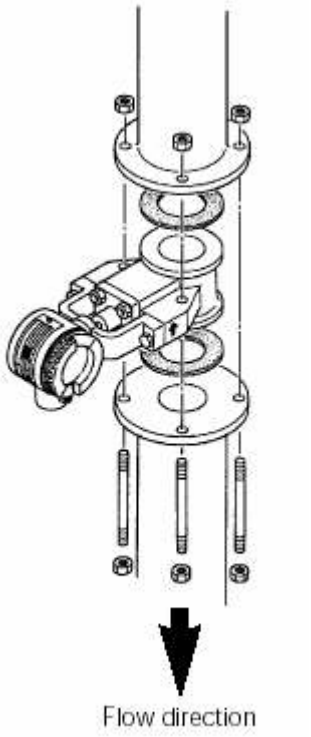


Figure 3-19

3-2-4. Installing the flanged Vortex flowmeter

Use the stud bolts and nuts supplied with the flowmeter or the user. The gaskets should be supplied by the user.

1. Horizontal installation

Install the flowmeter as illustrated in Fig. 3-

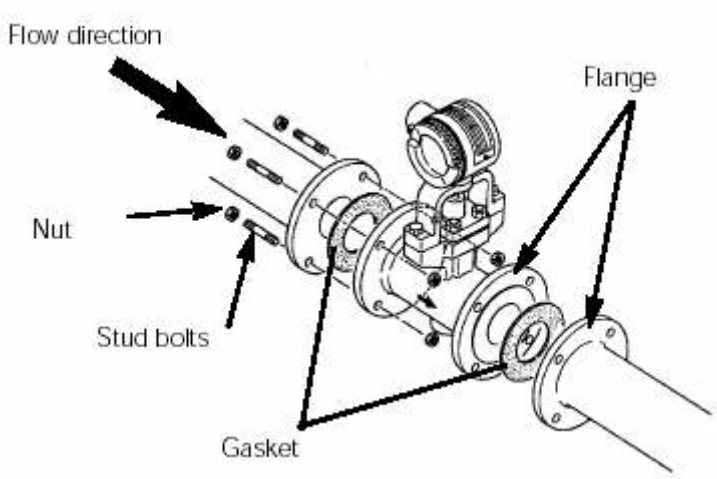


Figure 3-20

2. Vertical installation

Install the flowmeter as illustrated in Fig. 3-21.

CAUTION:

1. The inside diameter of the gasket must be larger than the pipe inner diameter so that it will not disturb the flow in the pipeline.
2. When installing the flowmeter vertically in the open air, change the electrical connection port direction to the ground.
If the electrical connection port is installed upward, rain water might leak in.

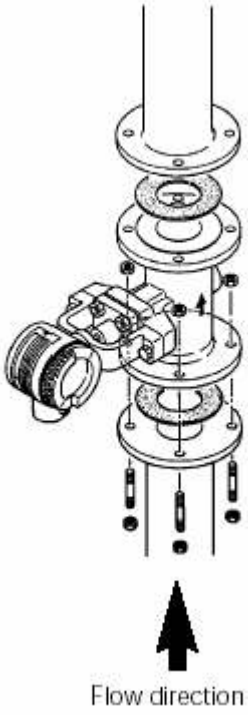


Figure 3-21

3-2-5. Installing the Vortex flow converter

A signal cable (VF011) is used between the remote type flowmeter and the converter. The maximum signal cable length is 20 m.

The converter is mounted on a 2-inch (60,5 mm outer diameter) stanchion or horizontal pipe (see Fig. 3-22).

Do not mount the converter on a vertical pipe. It makes wiring and maintenance difficult. The converter mounting orientation can be changed as illustrated in Fig. 3-25.

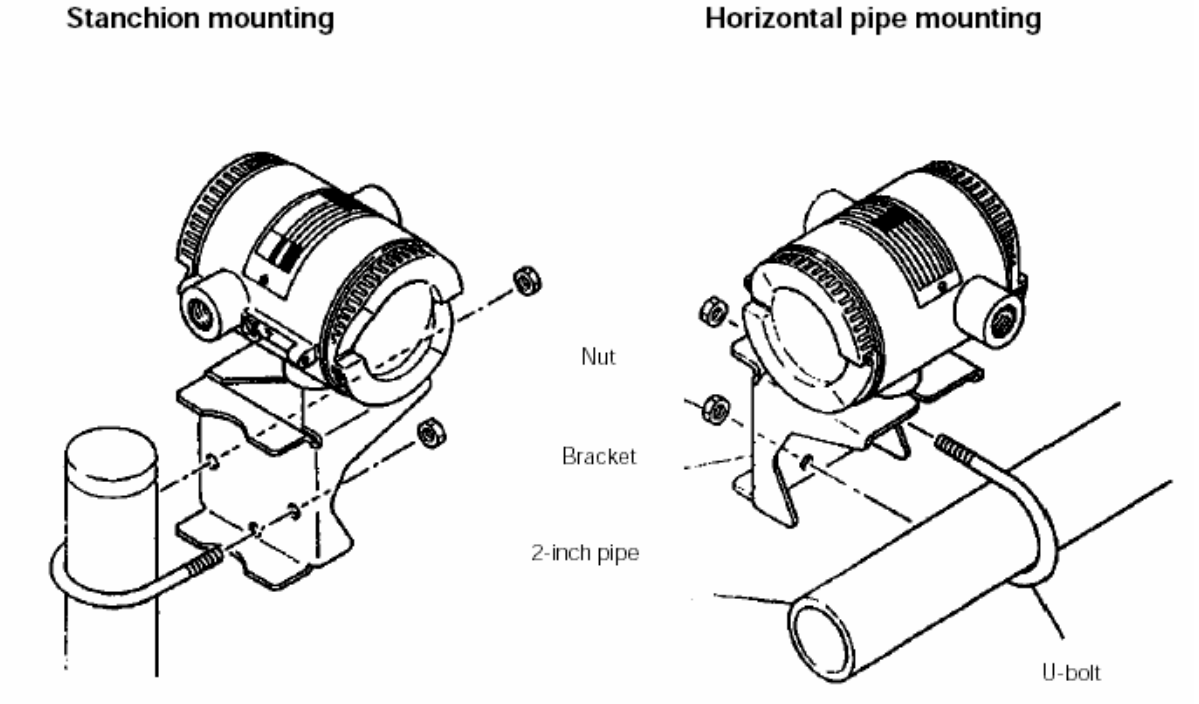


Fig. 3-22

3-3. Changing the orientation

3-3-1. Integral type Vortex flowmeter

The converter can be changed in four directions with respect to the flow direction (see Fig. 3-23).

1. Remove the converter cover.
2. For amplifier unit removal, refer to paragraph 9-3-2.
3. Disconnect the Vortex shedder assembly lead-wires from the converter.
4. Remove the bracket mounting bolts and remove the converter and bracket from the flowmeter body. The bracket applies to the 25 mm (1-inch) to 100 mm (4-inch) flowmeters.
5. Remove the four Allen bolts securing the converter to the bracket.
6. Turn the converter to the desired orientation. When reassembling the converter, reverse the above procedure.

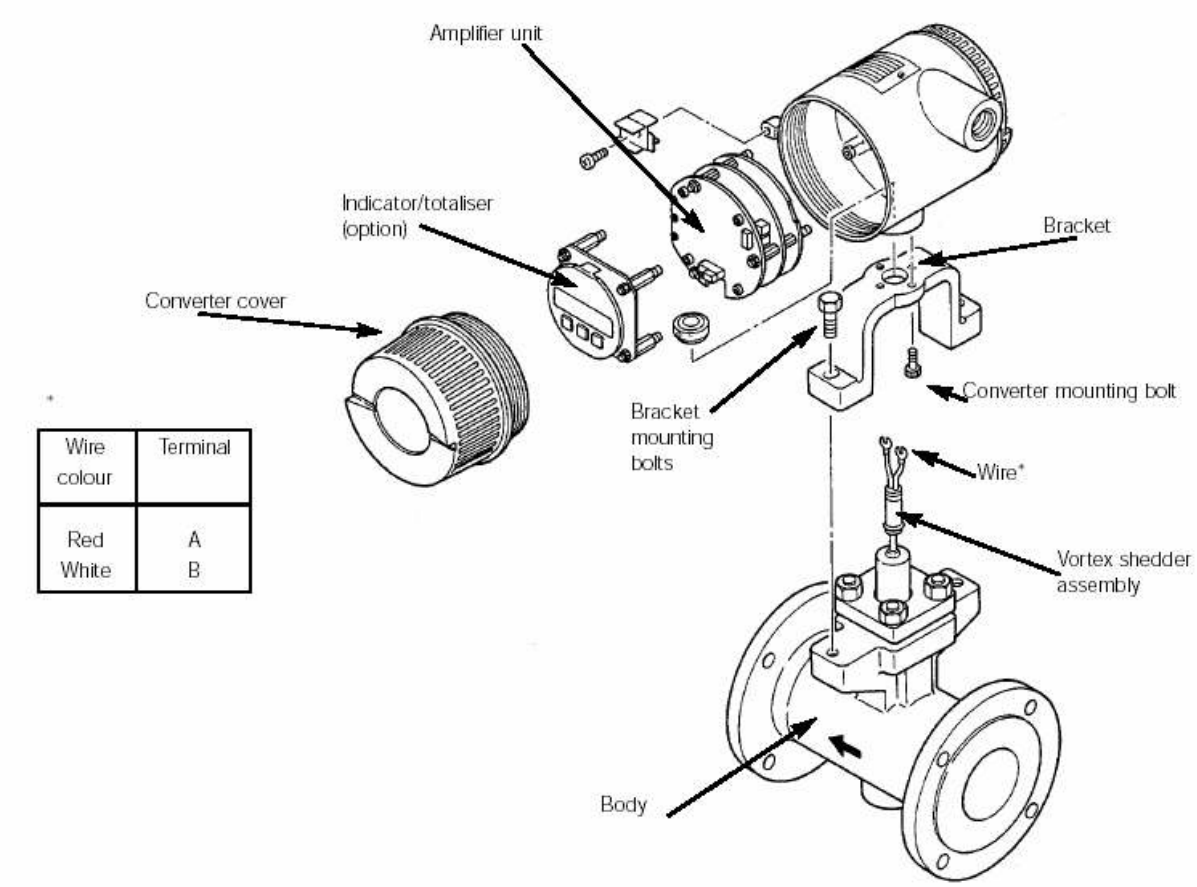


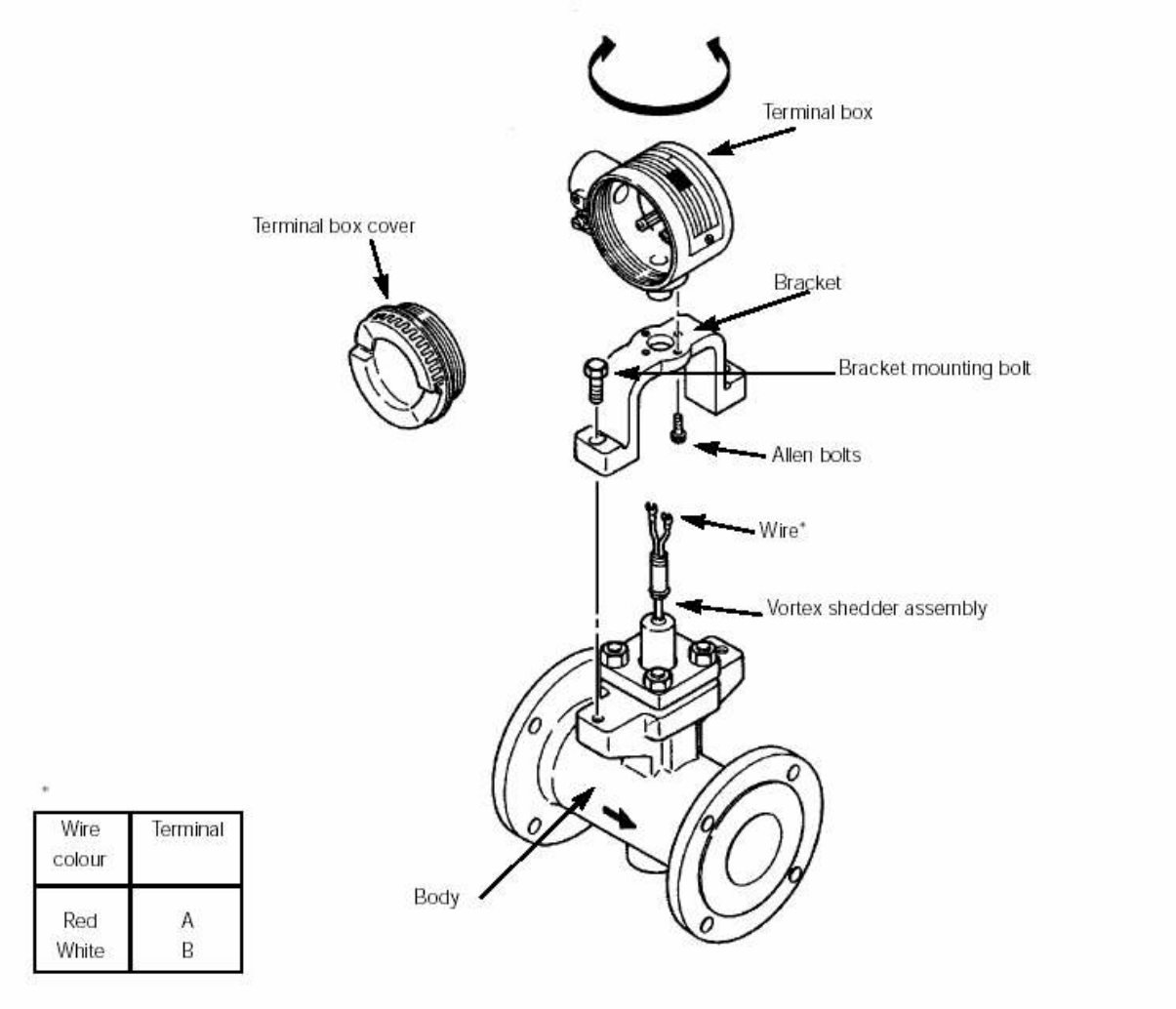
Fig. 3-23

3-3-2. Remote type Vortex flowmeter

3-3-2-1. Changing the terminal box orientation

The terminal box can be changed in four directions with respect to the flow direction (see Fig. 3-24).

1. Remove the terminal box cover.
2. Loosen two screws to disconnect leadwires from shedder bar.
3. Remove the bracket mounting bolts and remove the terminal box and bracket from the flowmeter body. The bracket applies to the 25 mm (1-inch) to 100 mm (4-inch) flowmeters.
4. Remove the four Allen bolts securing the terminal box to the bracket.
5. Turn the terminal box to the desired orientation. When reassembling the terminal box, reverse the above procedure.



*

Wire colour	Terminal
Red	A
White	B

Fig. 3-24

3-3-2-2. Changing the converter orientation

The Vortex flow converter orientation can be changed by rotating it 180° (see Fig. 3-25). Change the orientation as follows:

1. If the power and signal cables are connected, turn the power OFF and disconnect these cables from the instrument.
2. Remove two Allen converter mounting bolts.
3. Move the converter to the desired orientation and tighten the bolts.

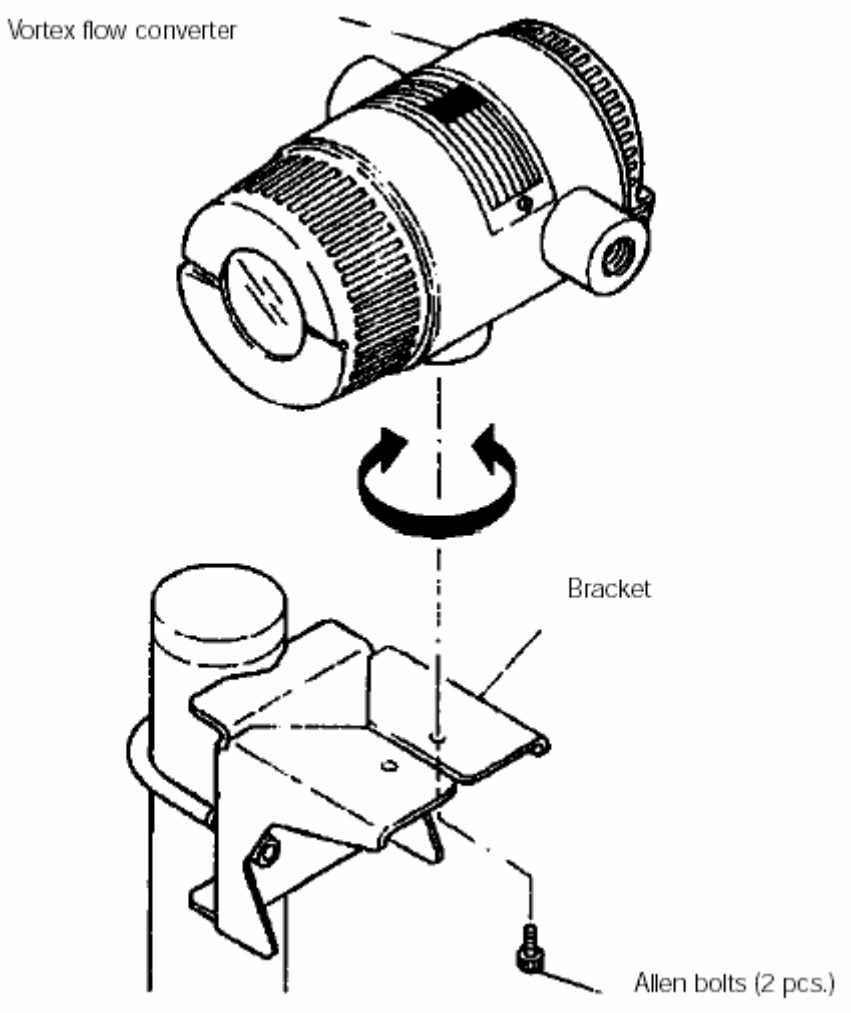


Fig. 3-25

3-4. Changing the indicator/totalizer orientation

The optional indicator/totalizer can be changed in four directions with respect to installation of flowmeter.

When the flowmeter is installed vertically and the indicator/totalizer can be read much easier if the orientation is changed at 90 degrees (see fig. 3-26).

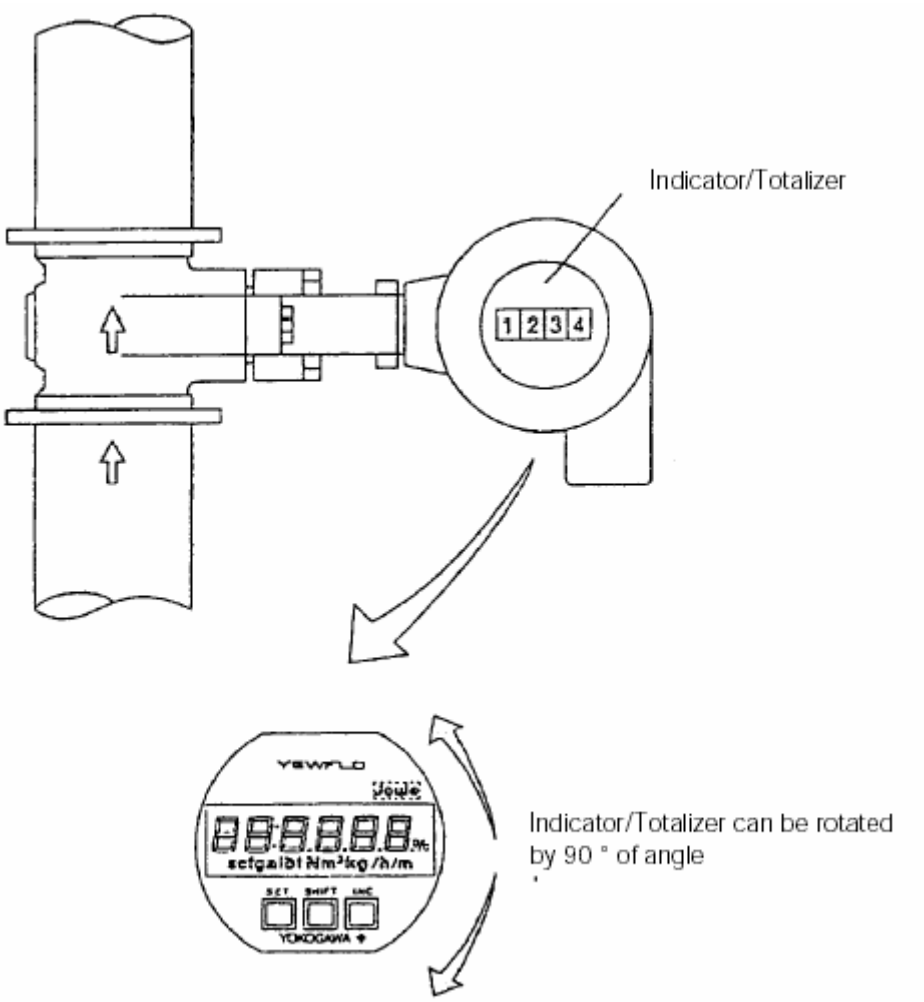


Fig. 3-26

3-5. Heat-insulation for integral type

When an integral-type flowmeter is installed and the pipe carrying high-temperature fluids is heat-insulated, do not wrap adiabatic materials around the installation bracket of the converter.

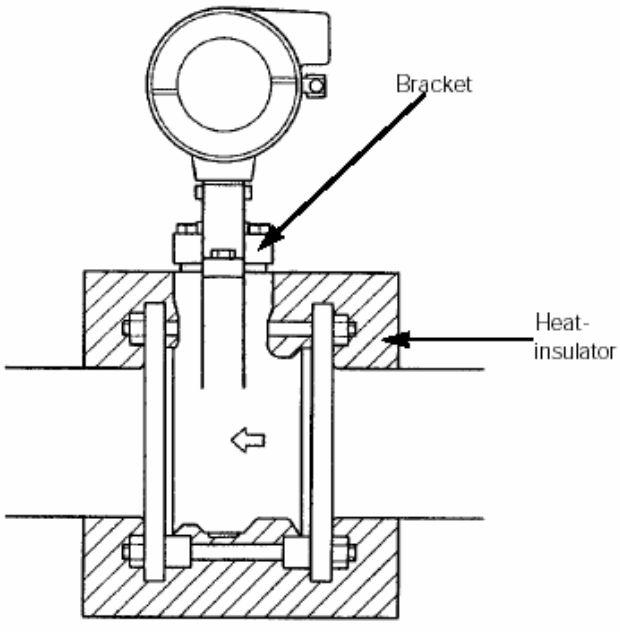


Fig. 3-27

4. WIRING

4-1. Power supply and load resistance

The remote converter type (VF100-N) Vortex flowmeter is used with the Model VFA11 converter (see Fig. 4-4). To connect these instruments, use a special cable (VF011). 20 m is the maximum length.

The integral type vortex flowmeter (VF100-A) measures fluid flow rates and converts them directly to 4 to 20 mA DC output or pulse output signals.

4-1-1. Analog output converter (4 to 20 mA DC)

This converter uses the same two wires for both the signal and power supply. A DC power supply is required in a transmission loop. The total leadwire resistance including the instrument load and power distributor (supplied by the user) must conform to a value in the permissible load resistance range (see Fig. 4-1). Fig. 4-3 shows typical wiring connections.

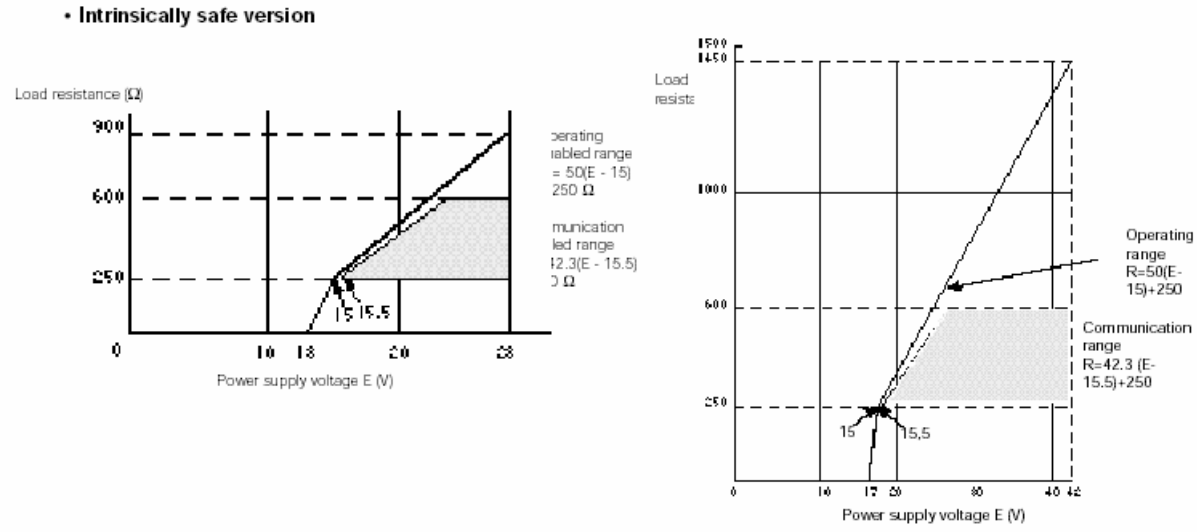


Fig. 4-1. Relationship between power supply voltage and load resistance (4 to 20 mA DC output)

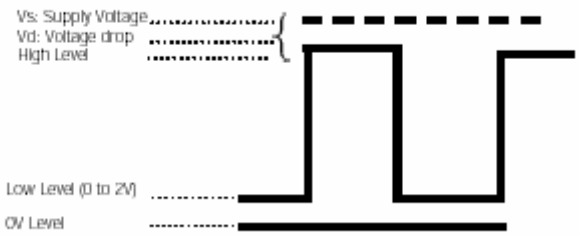


Fig. 4-2. Relationship between power supply voltage and voltage drop (pulse output)

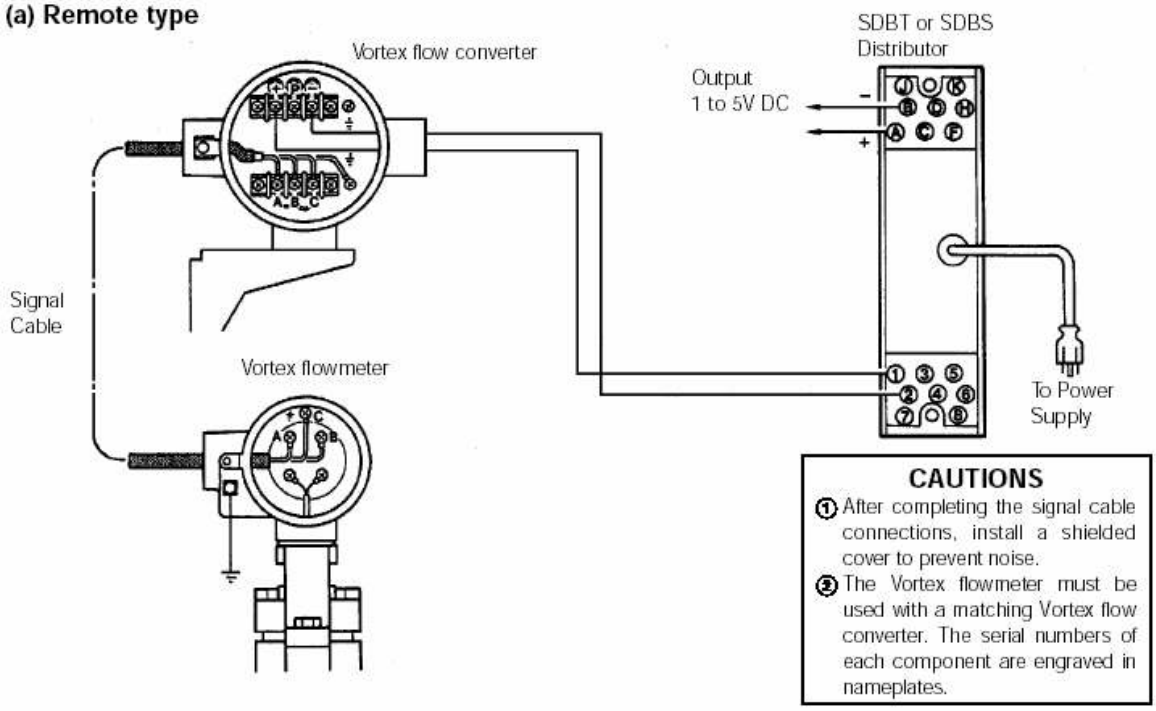
4-1-2. Pulse output converter

This version uses three wires between the converter and the power supply. 14 to 30 V DC power (allowable ripple ±1.5 V or less) is required and pulse output is connected to a pulse receiver (see Fig. 4-4).

The minimum load resistance of the pulse output loop is 10 kΩ, the maximum capacitance 0.22 μF (0.1 μF for output frequency above 2.5 kHz) and the leadwire resistance must be 50 Ω or less.

• **Analog output**

(a) Remote type



(b) Integral Type

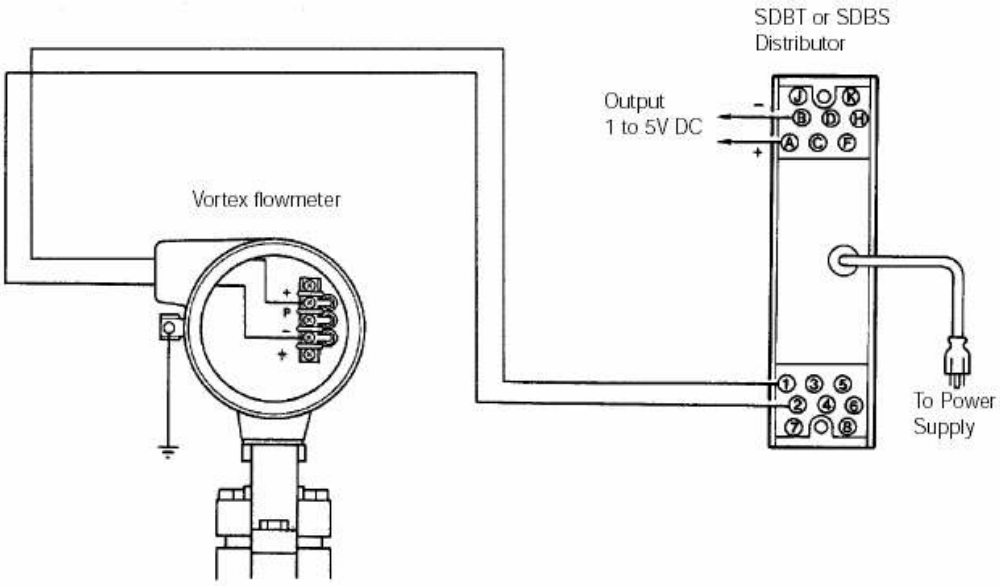
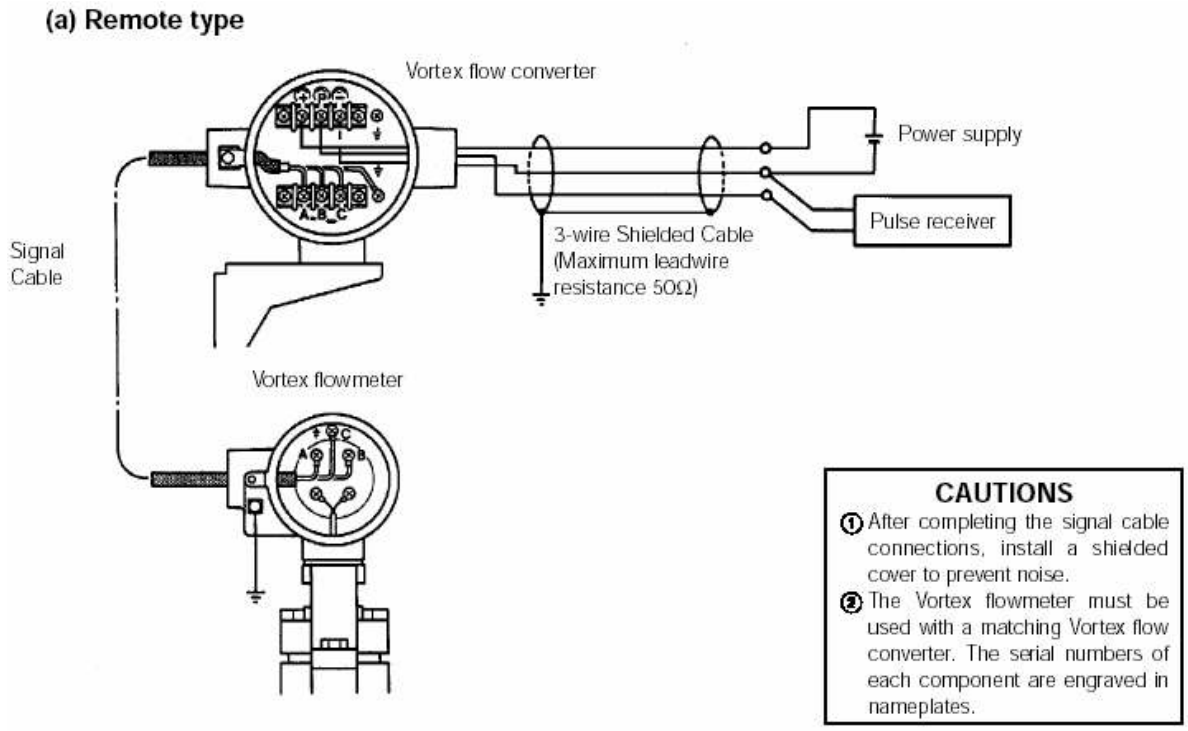


Fig. 4-3. Vortex flowmeter wiring connections (analog output)

• **Pulse output**



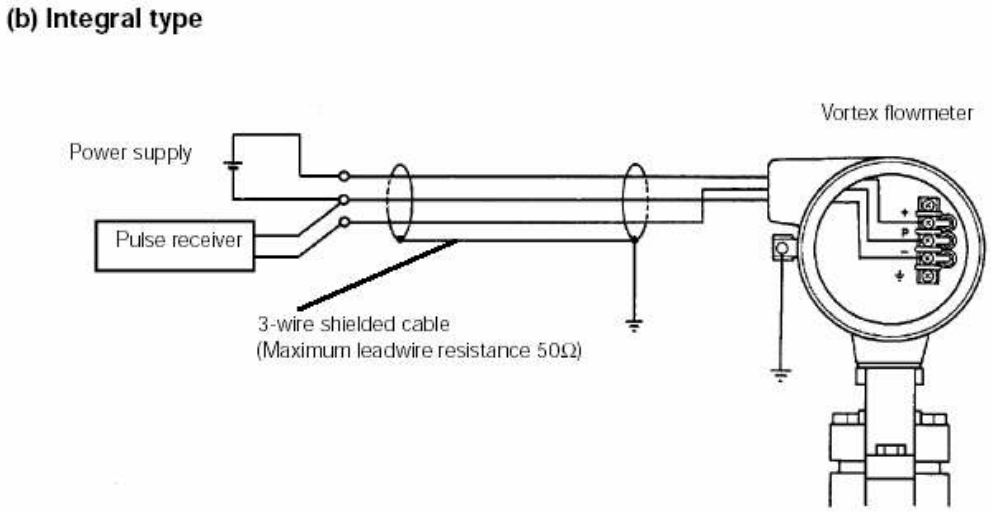


Fig. 4-4. Vortex flowmeter wiring connections (pulse output)

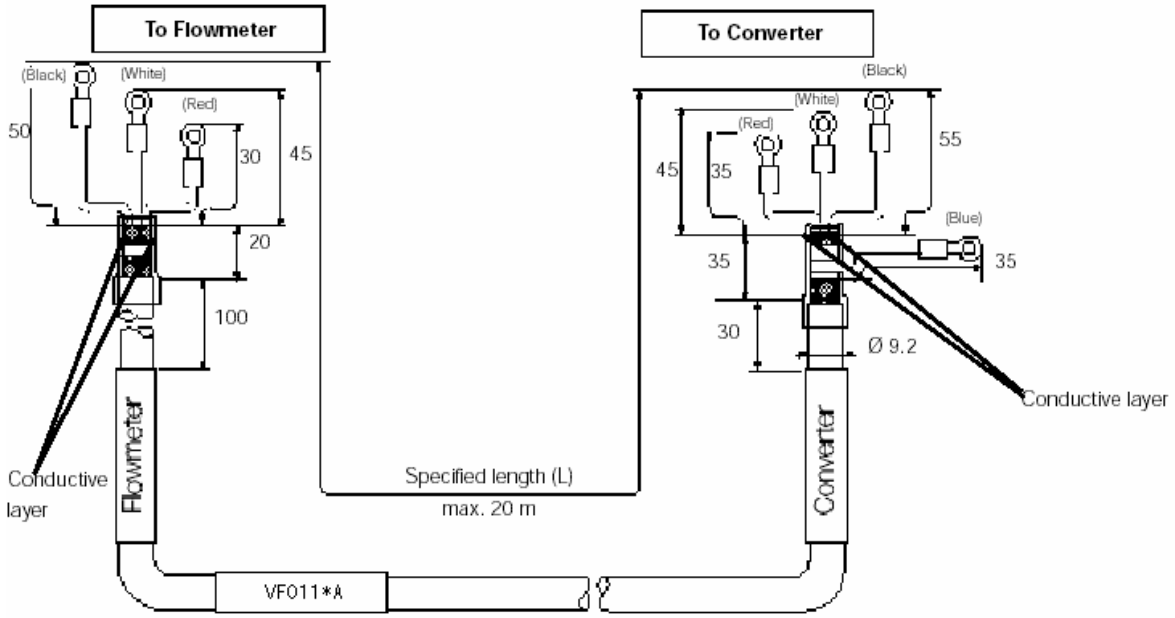
4-2. Wiring cables and wires

4-2-1. Cables and wires

The following should be taken into consideration when selecting cables for use between the converter and distributor.

1. Use 600V PVC insulated wire or equivalent standard wire or cable.
2. Use shielded wire in areas susceptible to electrical noise (both analog and pulse output versions).
3. In areas with high or low ambient temperatures, use wires or cables suitable for such temperatures.
4. In atmospheres where oils or solvents, corrosive gases or liquids may be present, use suitable wires or cables.

4-2-2. Signal cable for remote type



Cable colour and terminal

Colour	Terminal
Red	A
White	B
Black	C
Blue	⏚ G (only on the converter side)

CAUTION

Do not touch the "conductive layer" (black area covering the signal cables A and B) to the converter case, terminal and other leadwires. If it is touched, operation of the converter may be incorrect. When the cable is terminated, remove the conductive layer properly.

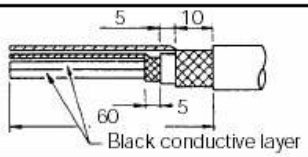
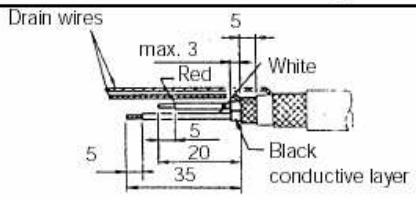
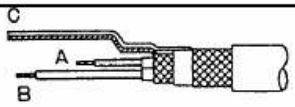
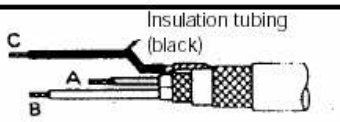
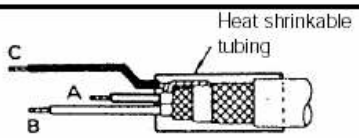
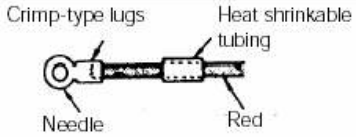
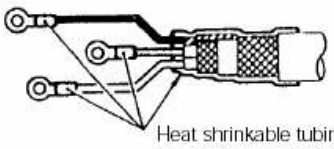
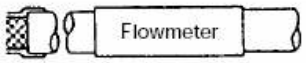
Fig. 4-5. VF011 signal cable

4-2-3. Finishing the signal cable

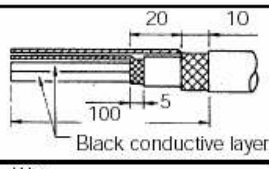
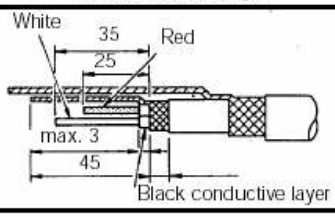
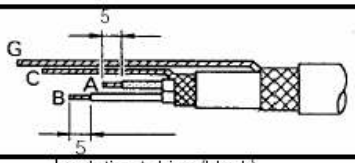
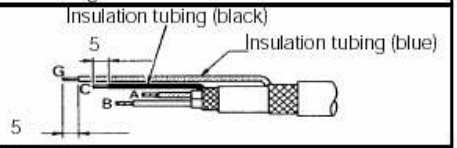
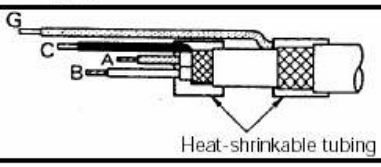
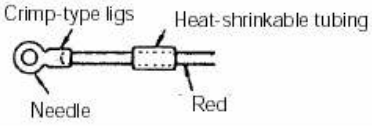
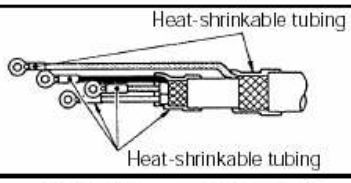
• For connection to Vortex flowmeter (Model VF100-NNN)

If a signal cable kit is supplied by DongYang Instruments Co.,Ltd, both ends of the cable must be finished in accordance with the following instructions:

Unit: mm

	Description	Figure
1	Remove the outer polyethylene jacket, outer braided shield and inner jacket, inner braided shield as per the dimensions in the figure.	
2	Cut of the black conductive layers (covering the two wires) completely (see figure). Twist each of the conductor and drain wires so there are no free strands.	
3	Do not short-circuit the conductive layer and the terminals (A B and C).	
4	Remove the red and white insulation (see figure). Twist the outer drain wire and the inner drain wire to each other.	
5	Insert FEP insulation tubing over inner shield C until it stops inside the braided shield. Cut the tubing off leaving only 5 mm of the inner shield exposed. Remove 5 mm of insulation from the tips of the two wires.	
6	Insert the heat shrinkable tubing so it covers the braided shield and overlaps both the polyethylene jacket and the loose wires A, B and C.	
7	Insert a short piece of heat shrinkable tubing on wires A, B and C. Install crimp-type lugs on the tip of each wire. Crimp and solder each lug.	
8	Move the short pieces of shrinkable tubing over the lug tips. Heat all four pieces of shrinkable tubing with a heat blower or heat gun.	
9	Attach identifying labels to the outside of each signal cable.	 Confirm that the insulation resistance between each wire including the inner shield is 10 MΩ or greater at 500 V DC. Maintain both ends of the wires disconnected (open-circuited) during the insulation resistance test.

• For connection to Vortex flow converter (Model VFA11)

	Description	Figure
1	Remove the outer polyethylene jacket, outer braided shield and inner jacket, inner braided shield (see figure).	
2	Cut of the black conductive layers (covering the two wires) completely (see figure). Twist each of the conductor and drain wires so there are no free strands.	
3	Do not short-circuit the conductive layer and the terminals (A, B, C and G).	
4	Cut off the red and white insulation (see figure). Twist each of the conductor and outer drain wires so there are no free wires strands.	
5	Insert FEP insulation tubing over inner shield C until it stops inside the braided shield. Cut the tubing off leaving only 5 mm of the inner shield exposed. Remove 5 mm of insulation from the tips of the two wires.	
6	Insert the heat shrinkable tubing so it covers the braided shield and overlaps both the polyethylene jacket and the loose wires A, B and C.	
7	Insert a short piece of heat shrinkable tubing on wires A, B, C and G. Install crimp-type lugs on the tip of each wire. Crimp and solder each lug.	
8	Move the short pieces of shrinkable tubing over the lug tips. Heat all four pieces of shrinkable tubing with a heat blower or heat gun.	
9	Attach identifying labels to the outside of each signal cable.	 Confirm that the insulation resistance between each wire including the inner shield is 10 MΩ or greater at 500 V DC. Maintain both ends of the wires disconnected (open-circuit-ed) during the insulation resistance test.

4-3. Wiring cautions

1. Lay wiring as far as possible from electrical noise sources such as large transformers, motors and power supplies.

2. Remove terminal box cover and wiring connection dust-cap before wiring.

3. The remote type converter has two electrical connections (cable inlets). Use the left connection as viewed from the terminal box for the YF011 signal cable and the right connection for the transmission cable.

Note

After completing the signal cable connections, be sure that the shield cover installs over the signal cable terminal.

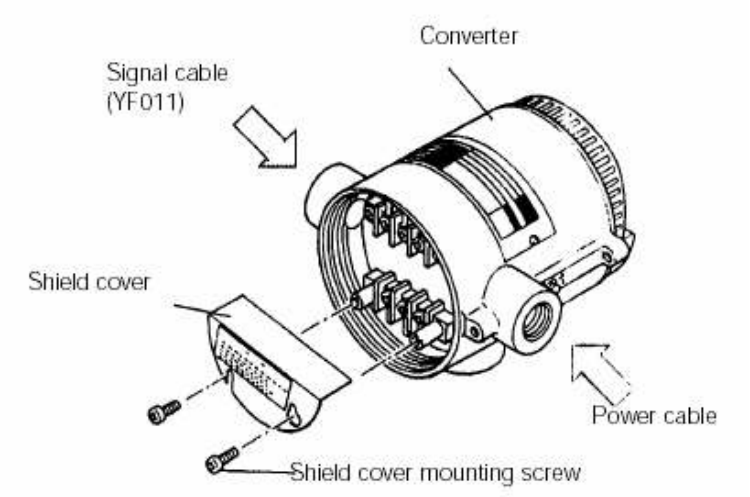


Fig. 4-6. Shield cover Vortex flow converter (remote type)

4. It is recommended that crimp-on type solderless lugs be used for leadwire ends.

5. For general use, it is recommended that conduits and ducts or racks be used to protect wiring from water or mechanical damage. A rigid steel conduit or flexible metal conduit is recommended (see Fig. 4-7).

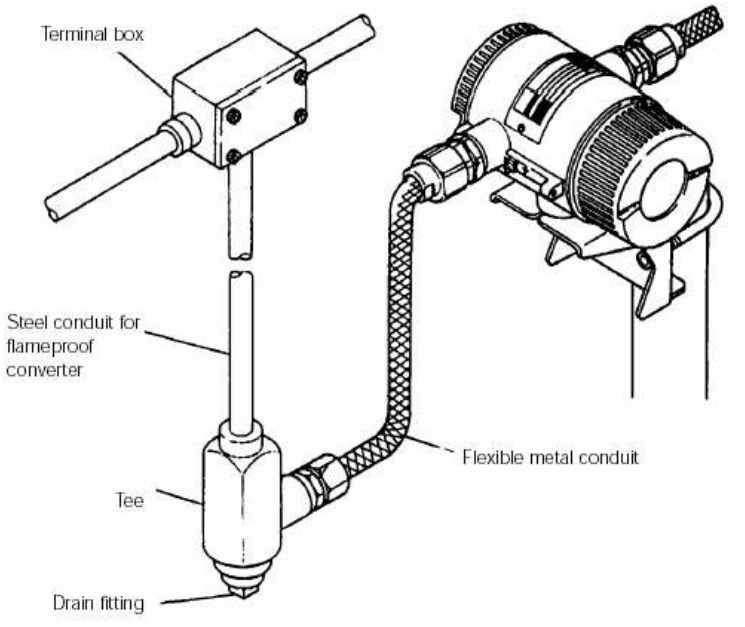


Fig. 4-7. Metal conduit piping for flameproof type

4-4. Grounding

1. For analog output version, ground the primary circuit in the power supply and the ground terminal of the flowmeter terminal box (see Fig. 4-3).
2. For pulse output version, ground the flowmeter as per Fig. 4-4. Also ground the shielded cable between the converter and the pulse receiver.
3. Grounding should satisfy Class 3 requirements (ground resistance 100 Ω or less).
4. Use 600 V PVC insulated wire for grounding.

5. PARAMETERS OF VORTEX FLOWMETER

5.1 Parameter list

Table 5-2 shows the parameter lists. In table 5-1, each title is defined.

Item	Description
Parameter number	Represents the menu item for a parameter.
Name	Parameter name.
R/W	Indicates parameter attributes. R: Display only (writing is not permitted) W: Writing is permitted
Data range	Shows data setting ranges for numerical value entry. Shows data to be selected for data selection. ( ) In parentheses, data code is shown for integral indicator/totalizer (option).
Unit	Engineering unit
Decimal point	Indicates the position of the decimal point or the positions in the data display. The positions in the display are numbered as shown below: 7 6 5 4 3 2 1 0
Remarks	Remarks such as a description of the contents are given.
DH	D: Integral indicator/totalizer (option) can set parameter. H: HART terminal (HART275) can set parameter.
U/D	L: Parameter can be set by UPLOAD and DOWNLOAD.
Initial value	Indicates the initial values (upon shipment from the factory).

Table 5-1 Parameter lists

Item	Name	R/W	Data range ( )	Unit	Decimal point	Remarks	DH	U/D	Initial value
01	MODEL	R				Model			VF100
02	TAG No.	R				Tag numner			
03	SELF CHECK	R	GOOD, ERROR			Self-diagnosic message			
A00	DISPLAY	R				Menu A (display)			
A10	FLOW RATE(%)	R	0.0~110.0	%	1	Flow rate (%)			
A20	FLOW RATE	R	0~65535	B52		Flow rate (in engineering unit)			
A30	TOTAL	R	0~999999		0	Totalized value			
A60	SELF CHECK	R	GOOD, ERROR			Self-diagnostic message			
B00	SET1	R				Menu B (Setting)			
B01	TAG NO.	W	8 alphanumeric characters			Tag number			
B02	OUTPUT	W	4～20mA DC (0) PULSE (1)			Selection of output (refer to item 5-8 to change pins)		L	4~20mADC
B03	SIZE	W	15mm(1/2in.) (0) 25mm(1in.) (1) 40mm(1.5 in.) (2) 50mm(2in.) (3) 80mm(3in.) (4) 100mm(4in.) (5) 150mm(6in.) (6) 200mm(8in.) (7) 250mm(10in.) (8) 300mm(12in.) (9)			Selection of meter tube		L	25mm
B04	FLUID	W	STEAM M (0) STEAM H (1) STEAM Qf (2) GAS Qn (3) GAS M (4)			Selection of fluid M: Mass flow H: Calorimetric flow Qn: Volumetric flow under standard conditions		L	STEAM M

			GAS Qf (5) LIQ Qf (6) LIQ M (7)				Qf: Volumetric flow under operating conditions			
B06	K-FACTOR(KM)	W	0.0001~32000		P/l	0~5	K-factor (KM at 15°C)		L	68.6
B08	MIN DENSITY ρ_f	W	0.0001~32000		kg/m^3	0~5	Density under operating conditions		L	
B09	TEMP UNIT	W	Deg C (0) Deg F (1)				Temperature Unit under operating conditions		L	Deg C
B10	TEMP Tf	W	-500~1000		B09	0~5	Temperature under operating conditions: Tf		L	15.0
(When Steam M: Steam GAS M and LIQ M (Mass flow) are selected in B04)										
B14	DENSITY ρ f	W	0.0001~32000		kg/m^3	0~5	Density under operating conditions: ρ f		L	1.00
B15	FLOW UNIT	W	kg (0) ton (1)				Selection of Flow unit		L	kg
When STEAM H: Steam (calorimetric flow) is selected in B04										
B19	DENSITY ρ f	W	0.0001~32000		kg/m^3	0~5	Density under operating conditions: pf		L	1.00
B20	ENTHAL UNIT	W	kcal/kg (0) kJ/kg (1)				Selection of specific enthalphy unit: h		L	kcal/kg
B21	SPE ENTHALPY	W	0.0001~32000		B20	0~5	Specific enthalphy: hf		L	1.00
B22	FLOW UNIT	W W W W	kcal (0) Mcal (1) kJ (2) MJ (3)				Selection of Flow unit		L	kcal
When GAS Qn: Gas (volumetric flow under standard conditions) is selected in B04										
B25	TEMP Tn	W	-500~1000		B09	0~5	Temperature under standard conditions: Tn		L	15.0
B26	PRESSURE Pf	W	0.00001~32000		absolute	0~5	Pressure under operating conditions: Pf		L	1.0332
B27	PRESSURE Pn	W	0.00001~32000		absolute	0~5	Pressure under standard conditions: Pn		L	1.0332
B28	DEVIATION	W	0.0001~10.000			0~5	Deviation factor: K=Zf/Zn		L	1.000
B29	FLOW UNIT	W	Nm^3 (0) Nl (1)				Selection of flow unit		L	Nm^3
When Steam Qf, Gas Qf, LIQ Qf, are selected in B04										
B35	FLOW UNIT	W	m^3 (0) l (1)				Selection of Flow unit		L	m^3
B50	TIME UNIT	W	/s (0) /m (1) /h (2) /d (3)				Selection of Time unit flowrate		L	/m
B51	SPAN FACTOR	W	E0 (0) E+1 (1) E+2 (2) E+3 (3) E+4 (4) E+5 (5) E-5 (6) E-4 (7) E-3 (8) E-2 (9) E-1 (10)				Selection of Span factor E+1=10 E+2=100 E-2=0.01		L	E0(=1)
B52	FLOW SPAN	W	0.00001~32000		FLOW UNIT m^3/m	0~5	Flow span		L	0.8746
B53	DAMPING	W	2 (0) 4 (1) 8 (2) 16 (3) 32 (4) 64 (5) 0 (6)		sec		Selection of Damping time		L	4 秒(1)
B60	SELF CHECK	R	GOOD, ERROR				Self-diagnostic message			
C00	SET2						Menu C (setting 2)		L	
C01	TOTAL RATE	W	E0 (0) E+1 (1) E+2 (2) E+3 (3) E+4 (4) E+5 (5) E-5 (6) E-4 (7) E-3 (8) E-2 (9) E-1 (10) UNSC*1 (11) UNSC*10 (12) UNSC*100 (13)				E0=1 E+1=10 E+2=100 UNSC: Unscaled pulse		L	E+5
C02	PULSE RATE	W	E0 (0) E+1 (1) E+2 (2) E+3 (3) E+4 (4) E+5 (5) E-5 (6) E-4 (7) E-3 (8) E-2 (9) E-1 (10)				Scaled pulse factor, E0=1 E+1=10 E+2=100		L	UNSC*1

			UNSC*1 (11) UNSC*10 (12) UNSC*100 (13)			UNSC: Unscaled pulse			
C09	UNIT CONV FA	W	0～32000			User's unit conversion factor		L	0.0
C10	USERS UNIT	W	alphanumeric			User's unit		L	Space
C60	SELF CHECK	R	GOOD, ERROR			Self-diagnostic message		L	

- Calculation method of minimum density for Gas (Items B08)

$$\rho_f = \rho_n \times \frac{P_f}{P_n} \times \frac{T_n}{T_f} \times \frac{1}{K}$$

'f : Minimum density under operating conditions (kg/m3)
n : Density under standard conditions (kg/m3)
P'f : Minimum pressure under operating conditions (kg/cm2G)
Pn : Pressure under standard conditions (kg/cm2abs)
Tn : Temperature under standard conditions (273 °K)
T'f : Temperature under operating conditions (°C)
K : Deviation factor (=1) (dimensionless) [K = Zf/Zn]

- Metric units

$$\rho_f = \rho_n \times \frac{P_f + 1.0332}{1.0332} \times \frac{273}{T_f + 273} \times \frac{1}{K}$$

- In case of steam service, check the steam table to find minimum density.

D00	ADJUST	R				Menu (adjustment)			
D01	REYNOLDS ADJ	W	NOT ACTIVE (0) ACTIVE (1)			Selection of Reynolds adjustment			NOTACTIVE

Reynolds Correction Factor

Reynolds	A
$5.5\times10^3 \leqq Re < 8.0\times10^3$	0.886
$8.0\times10^3 \leqq Re < 1.2\times10^4$	0.935
$1.2\times10^4 \leqq Re < 2.0\times10^4$	0.964
$2.0\times10^4 \leqq Re < 4.0\times10^4$	0.990
$4.0\times10^4 \leqq Re$	1.000

KM'=A×KM
KM':Corrected K-factor
A : Correction factor
KM : K-factor of the detector at 15°C

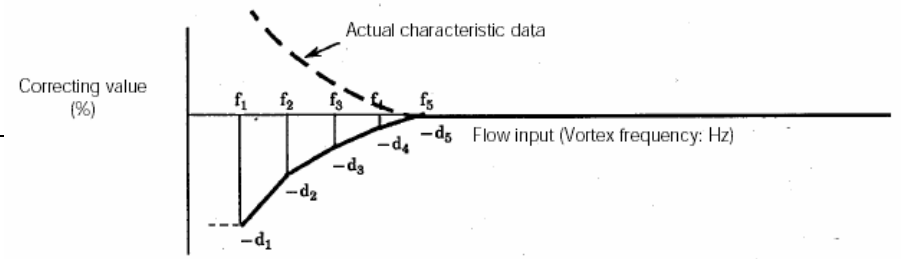
D02	VISCOSITY	W	0.00001~32000	cP	0~5	Viscosity			1.0
D03	DENSITY ρf	W	0.00001~32000	kg/m³	0~5	Density under operating conditions: f			1.0
D05	PIPE EFFECT	W	NOT ACTIVE (0) Wafer Sch 10 (1) Wafer Sch 40 (2) Wafer Sch 80 (3) Wafer Sch 10 (4) Wafer Sch 40 (5) Wafer Sch 80 (6)			Selection of Adjacent pipe			NOTACTIVE
D06	EXPANSION FA	W	NOT ACTIVE (0) ACTIVE (1)			Gas expansion correction for			NOTACTIVE

Correction factor d

	Wafer			Flange			
	Sch10	Sch40	Sch80	Sch10	Sch40	Sch80	
15mm(1/2in.)	0	st'd	-0.8	0	st'd	+0.1	ε p=1+d/100 ε p: adjacent pipe error correction d: correction factor
25mm(1in.)	0		-0.7	0		+0.1	
40mm(1.5in.)	-0.2		-0.3	0		+0.1	
50mm(2in.)	+0.1		-0.9	0		+0.1	
80mm(3in.)	+0.2		+0.2	+0.1		0	
100mm(4in.)	+0.2		-0.1	+0.1		0	
150mm(6in.)	N/A	N/A	N/A	+0.3		-0.1	
200mm(8in.)	N/A	N/A	N/A	+0.3		-0.1	
250mm(10in.)				0		0	
300mm(12in.)				0		0	

D20	FLOW ADJUST	W	NOT ACTIVE (0) ACTIVE (1)			Selection of correcting instrumental error			NOTACTIVE
D21	FREQ1	W	0.0~32000	Hz	0~5	First break-point frequency (f1)			0.0
D22	DATA1	W	-50~50	%	0~5	First correcting value (d1)			0.0
D23	FREQ2	W	0.0~32000	Hz	0~5	Second break-point freq. (f2)			0.0
D24	DATA2	W	-50~50	%	0~5	Second correcting value (d2)			0.0
D25	FREQ3	W	0.0~32000	Hz	0~5	Third break-point freq. (f3)			0.0
D26	DATA3	W	-50~50	%	0~5	Third correcting value (d3)			0.0
D27	FREQ4	W	0.0~32000	Hz	0~5	Fourth break-point freq. (f4)			0.0
D28	DATA4	W	-50~50	%	0~5	Fourth correcting value (d4)			0.0
D29	FREQ5	W	0.0~32000	Hz	0~5	Fifth break-point freq. (f5)			0.0
D30	DATA5	W	-50~50	%	0~5	Fifth correcting value (d5)			0.0

- Instrumental Error Correction



• Flow frequency input at line segments needs to be f1 P f2 P f3 P f4 P f5.
• When four correction factors are available, line segments needs to be f4 = f5 and d4 = d5.
• When three correction factors are available, line segments needs to be f3 = f4 = f5 and d3 = d4 = d5.
• When a flow input of f1 or less is present, correct the instrumental error as the correcting value = d1.
• When a flow input of f5 or more is present, correct the instrumental error as the correcting value = d5.
• Abscissa (f1 to f5): Set the break-point frequencies as parameters.

E00	CONTROL	R				Menu E (Control signal)			
E01	TOTAL RESET	W	NOT EXCUTE (0) EXCUTE (1)			Resetting Totalized value			NOTACTIVE
E02	DISP SELECT	W	RATE (%) (0) RATE (1) TOTAL (2) RATE (%), TOTAL (3) RATE, TOTAL (4) RATE, RATE (%) (5)			Selection of Display			RATE(%)
E60	SELF CHECK	R	GOOD， ERROR			Self-diagnostic message			
H00	MAINTENANCE	R				Menu H (Maintenance)			
H01	N.BALANCE	W	-5~10		0	Noise Balance			0
H02	TLA	W	-1~2		0	Trigger Level Adjustment			0
H03	GAIN	W	16 Steps		0	Setting of MAIN GAIN			0
H04	H.F. FILTER	W	4 Steps		0	Switching High-Cut Filter by density and span velocity			0
H06	NOISE JUDGE	W	NOT EXCUTE (0) EXCUTE (1)		0	Noise elimination function			ACTIVE
H07	L.C. FLOWRATE	W	0~B52	B52	0~5	Low cut flowrate			0.06122
H08	TRIM 4mA	W	-1~10	%	0~5	Trim 4mA			0.0
H09	TRIM 20mA	W	-10~10	%	0~5	Trim 20mA			0.0
H30	REVISION	R				Revision number of software			
H60	SELF CHECK	R	GOOD，ERROR			Self-diagnostic message			

〖H08，H09：TRIM 4mA，TRIM 20mA〗

- Fine tuning of 4 mA output

Set value equals the value measured

For example: the value measured is 3.879mA, then the setting value is 3.879 in item H08, until the value measured equals 4.000.

- Fine tuning of 20 mA output

Set value equals the value measured

For example: the value measured is 20.01mA, then the setting value is 20.01 in item H09, until the value measured equals 20.00.

5-2. Error code list

When an ERROR is displayed by SELF CHECK in item A60, B60, C60, D60, or E60, the error contents are displayed. The error contents are listed below:

Table5.2 Error code list

No.	Diagnostic message	Error name	Probale cause	Current output	Pulse output	% output	Enginee-ring unit output	Totalizing output	How to recover
1	OVER OUTPUT	Over range output singnal	Output signal is 110% or more.	Fixed at 110 %	Normal operation	Fixed at 110 %	Normal operation	Normal operation	Change parameters, or over ranged flow input
2	SPAN SET ERROR	Span setting error	Span setting parameters are 10 m/sec or more for liquids and 80 m/sec or more for gases and steam	Retain operation	Retain operation	Retain operation	Normal operation	Normal operation	Change parameters, span factor is outside the acceptable limits
3	N.J. CIRCUIT ERROR	Noise discriminator circuit error	Noise discriminator circuit is not functioning properly	Retain operation	Retain operation	Retain operation	Retain operation	Retain operation	Contact HUGE service
4	PULSE OUT ERROR	Pulse output setting error	Pulse output frequency is more than 6 KHz	Normal operation	Fixed at 6kHz	Normal operation	Normal operation	Normal operation	Change parameters
5	EEPROM ERROR	EEPROM is not functioning correctly		Fixed at -1.25%	Hold	Fixed at -1.25%	Fixed at 0	Hold	Contact HUGE service
—	CPU FAULT	CPU is failure	All operation is dead. Display and	Fixed at -1.25%	Hold	Hold	Hold	Hold	Contact HUGE service

			self-diagnostic function are also dead.						

5-3. Zero adjustment

In normal operation the Vortex flowmeter zero does not shift. Hence, no zero adjustment is needed.

5-4. Data determination and parameter setting

The flow converter has many parameters, but not all of them are always required for setting. In addition to the mandatory parameter items to be set for flow measurement, set the data which are necessary for process conditions.

Fundamental items necessary for flow-measurement setting

To accurately measure flow, correctly enter menu items B02 to B53 as shown bellow:

(1) Selection of output (B02)

- Select 4 to 20 mA with HART communitions or pulse output.
- Besides parameter setting, need to change amplifier selector pins.

  Refer to item 5.8 “Selection of output”

(2) Selection of size (B03)

(3) Selection of fluid to be measured (B04)

- Select a fluid to be measured (steam, gas, or liquid) in item B04. Select from the following six types in considering the flow unit to be set:

Notation	Fluid to be measured	Flow unit
Steam Qf	Steam	Volumetric flow under operating conditions (m^3, l)
Steam M	Steam	Mass flow (kg, ton)
Steam H	Steam	Calorimetric flow (Kcal, Mcal)
Gas Qf	Gas	Volumetric flow in actual state (m^3, l)
Gas Qn	Gas	Volumetric flow in standard state (Nm^3, Nl)
Gas M	Gas	Mass flow (kg, ton)
Liquid Qf	Liquid	Volumetric flow in actual state (m^3, l)
Liquid M	Liquid	Mass flow (kg, ton)

(4) K-factor setting (B05 and 06)

- The K-factor (KM) at 15℃ for combination with the flowmeter is marked on the data plate of VORFLO. Set this unit and value in item B05 and B06.

(5) Setting of minimum density (B07 and B08)

- Set unit and minimum value of the density at operating conditions.
- The minimum density can be calculated by ideal gas law. Refer to item 5.2 “Parameter lists” parameter item B08.

(6) Setting of density at normal operating conditions (B14, B19, D03)

- Set value of the density at normal conditions. The unit of the density is the same as item B07.
- Item B14 or B19will be determined by measuring fluid setting.

(7) Temperature setting in an operating condition (B09 and B10)

- Set the temperature of the fluid to be measured at operating condition temperature unit and

temperature in item B09 and B10.

(8) Setting of several conditions for a fluid to be measured (B15 to B35)

- Corresponding to the type of fluid to be measured (set in B04), the conditions of the fluid must be entered in item B15 and B35 and subsequent items. Depending on the flow setting in subsection 5.2, enter each condition.

(9) Flowrate span setting (B52)

- Set the required span with a numerical value and unit. Select the flowrate unit in items FLOW UNIT（example B15） and set the flowrate span in item B52. Since the data setting range of FLOW SPAN in B52 is 0.0001 to 32000, determine the setting by combining B52 with B51 SPAN FACTOR.

Example of setting (Set the flowrate span at 200000kg/h):

B15: kg

B50: /h

B51: E+1

B52: 20000

(10) Totalizing rate setting (C01) (with indicator/totalizer option)

- If a totalized flow value is necessary, set the factor per totalized-value count.

Example of setting: When the flow per totalized-value count display is to be set at 100 kg, set as shown below:

C01：E＋2（10^2）

（The flow unit such as a kilogram ot ton is already set in item B15 for example.）

- By entering item (1) to (8) above, an output of a 4 to 20 mA signal which is proportional to the flowrate and the proper flow display can be obtained. Flow of the setting is shown in table 6.2. For detail on the contents of each item and set unit, see the parameter list in section 5.2. Since set parameters are written in EEPROM, the contents are retained even during a power failure.

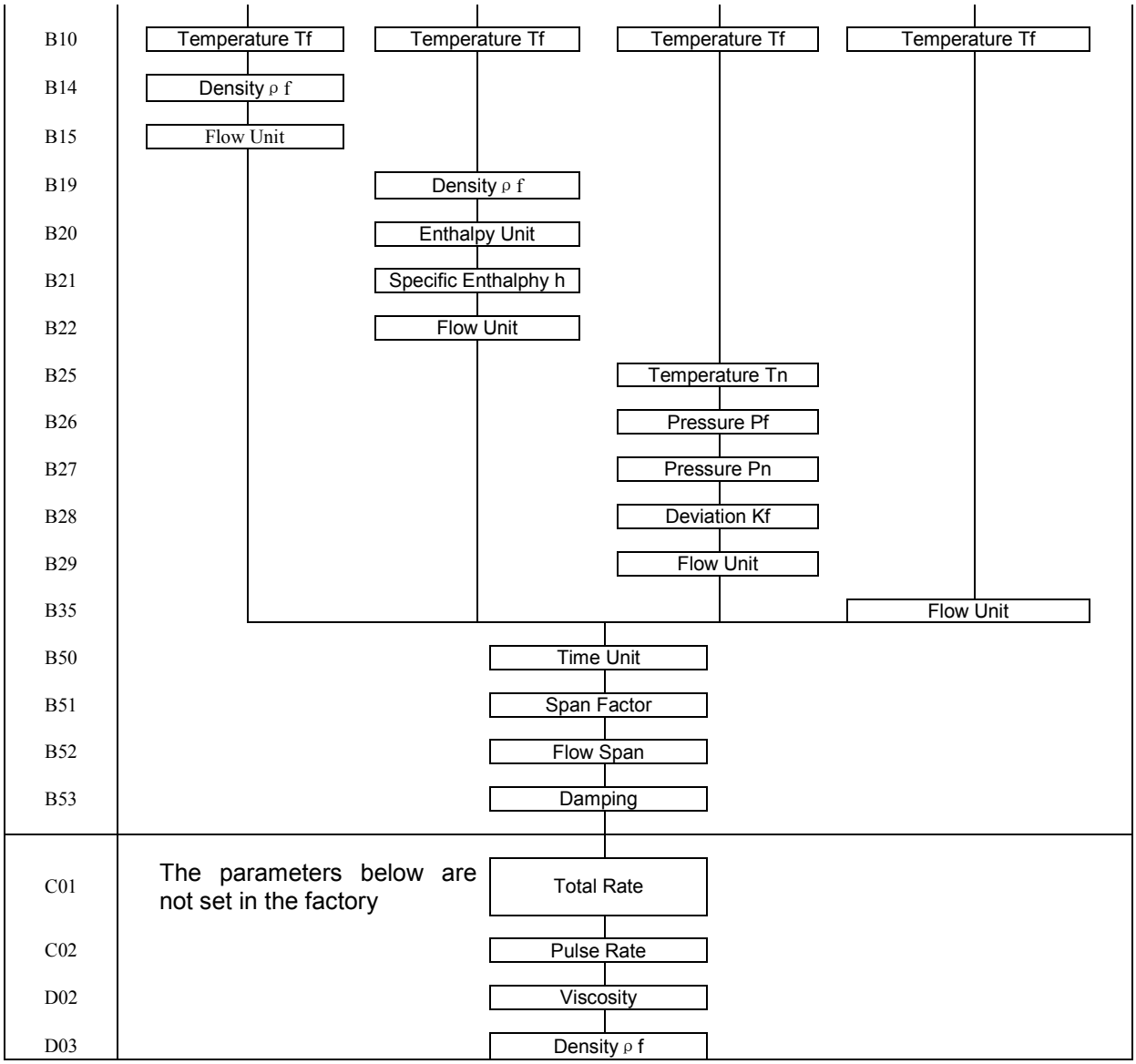
(11) Pulse rate setting (C02) (Pulse output)

Set to change the output rate of pulse output. Refer to section 5.9 “Unscaled pulse output”.

Example of setting: UNSC*1

Table 5-3. Flowchart of parameter settings for flow measurement

Item No.	Name			
	FLUID			
B04	STEAM M GAS M LIQUID M	STEAM H	GAS Qn	STEAM Qf GAS Qf LIQUID Qf
B02	OUTPUT	OUTPUT	OUTPUT	OUTPUT
B03	SIZE	SIZE	SIZE	SIZE
B06	K-factor KM	K-factor KM	K-factor KM	K-factor KM
B08	Min. Density ρ'f	Min. Density ρ'f	Min. Density ρ'f	Min. Density ρ'f
B09	Temperature Unit	Temperature Unit	Temperature Unit	Temperature Unit



5-5. Unscaled pulse outputs (B02 and C02)

When the Vortex flowmeter output needs to be set as ”unscaled pulse”, follow the procedure below:

1. Turn power OFF.
2. Change 3 pins to PULSE.
3. Turn power ON.
4. Select B02 ”Pulse”.
5. Select C02 ”UNSC*1”, ”UNSC*10”, or ”UNSC*100”.
6. Set the other necessary parameters.

NOTE:

If ”UNSC*1” is selected, the output is the same as unscaled pulses (1 pulse in = 1 pulse out).

If ”UNSC*10” is selected, the output becomes ten (10) times as many as unscaled pulses (1 pulse in = 10 pulses out).

If ”UNSC*100” is selected, the output becomes hundred (100) times as many as unscaled pulses (1 pulse in = 100 pulses out).

The unscaled pulse output is computed with compensation computation (instrumental error correction,

expansion correction for compressible fluid, Reynolds number correction and adjacent pipe error correction) based on the N number of generated voices (refer to equation below).

Pulse output = ε f. ε e. ε r. ε p.N.... (equation for UNSC*1)

N = Number of input pulses (pulse)

ε f = Instrumental error correction factor

ε e = Expansion correction factor for compressible fluid

ε r = Reynolds number correction factor

ε p = Adjacent pipe error correction factor.

6-3. Zero adjustment

In normal operation the Vortex flowmeter zero does not shift. Hence, no zero adjustment is needed.

6-4. Totalizer reset

By pressing [SET], [SHIFT] and [INC] switches, change item E1 [00] to [01].

6-5. Power failure

When a power failure occurs, the totalized value will be protected by EEPROM (Electrically Erasable Programmable ROM). But during a power failure, the vortex flowmeter stops and also the totalizing will stop. After a power failure recovered, the vortex flowmeter and the totalizing start to work automatically.

6-6. Notice prior to operation

1. When steam first flows in a pipeline in a cooled state during the initial stage of steam measurement, drainage may be generated and a two-phase flow may result. Be careful, because an accurate measurement cannot be made in a two-phase flow state.
2. If the pipeline is subject to vibration, the vortex flowmeter may indicate an output of more than 0% even if the flow is 0%. In such a case, carry out an NB adjustment according to subsection 8-2-3.

7. DISPLAY AND OPERATION USING INTEGRAL INDICATOR/TOTALIZER

This chapter describes display contents using an integral indicator/totalizer (option) and the parameter setting procedure. For mounting and removal of the integral indicator/totalizer, see subsection 8-3-1 ”Removal of Integral indicator/totalizer.”

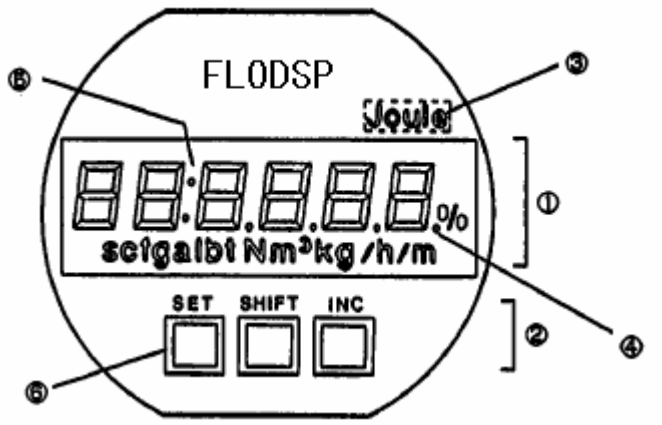


Fig. 7-1. Integral indicator/totalizer

7-1. Integral indicator/totalizer configuration and functions

The integral indicator/totalizer displays a numerical value, a percentage, and an engineering unit in its LCD display.

If a unit other than those that appear in the display is to be set, attach an unit symbol label to the right shoulder of the display window. Parameters can be set using [SET], [SHIFT], and [INC] keys in the setting section.

Table 7-1. Types of unit display

Unit	Description
%	Percent
l	Litre
t	Ton
Nm^3	Normal cubic meter
m3	Cubic meter
kg	Kilogram
/h	Per hour
/m	Per minute

Table 7-2. Description of display

Item	Description
1	Display section: Displays data, units, parameter setting item numbers and parameters.
2	Setting section: Sets parameter item numbers and parameter data using SET, SHIFT, and INC parameter setting keys.
3	Attach unit labels if those other than displayed units are to be used.
4	Decimal point
5	A symbol for delimiting a parameter setting item number and a parameter data
6	Setting key

Caution: The setting operation is canceled if flowmeter power supply voltage is cut off within 30 sec.

7-2. Display contents in display section

The display content items are classified in the following three items:

Table 7-3. Mode name list

Nr.	Mode (status) name	Key operation	Display contents
1	Normal mode	—	A mode in which instantaneous flow rates or totalized values are displayed. Display content is usually selected either in display content selection mode or by setting parameters via Brain communication.
2	Setting mode	SET □	In this mode, parameter contents are confirmed or data is updated using the setting section. The mode is changed to this mode when [SET] key is pressed in normal mode.
3	Alarm number display mode	—	This mode is overlapped when an alarm is occuring in normal mode. The alarm number presentation to indicate alarm contents (about 2 sec) and the normal data display (about 4 sec) are repeated

Note: Mode represents that the system is in a state where the relevant setting or display is possible.

7-2-1. Normal mode

1. The normal mode (status) is a mode in which instantaneous flowrates or totalized flowrates are displayed. In normal mode there are six display modes as shown in table 7-4.

2. Display modes can be changed using the integral indicator/totalizer setting section.

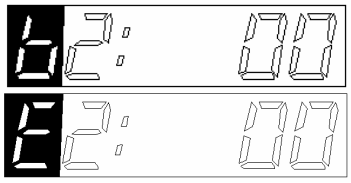
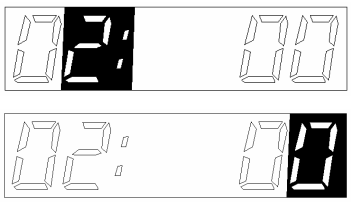
3. If the display contents are to be changed using the integral indicator/totalizer setting section, change E2 parameter item number to display an appropriate display.

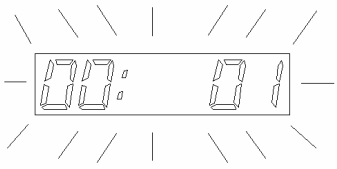
Table 7-4. Display mode number list

Display-mode nr.	Name	Description
0	% display mode	Instantaneous flowrate is displayed in 0.0 to 110.0%.
1*	Display in engineering unit mode	Instantaneous flowrate in an engineering unit is displayed using 0 to 32000.
2	Totalized flow display mode	Totalized flow is displayed using 0 to 999999 without indicating the decimal point.
3	Alternate % flow rate and totalized flow display mode	Instantaneous flowrate (%) and totalized flow (engineering unit) are alternatively displayed.
4	Alternate flow rate in engineering unit and totalized flow display mode	Instantaneous flowrate (engineering unit) and totalized flow (engineering unit) are alternatively displayed.
5	Alternate instantaneous flowrates (in engineering unit and %) display mode	Instantaneous flowrates in engineering unit and in % are alternatively displayed.

The decimal point position is determined depending on the position set for span. If the decimal point is set at the most significant digit (the left side of the numeral), since the LCD display section cannot display it, the most upper settable decimal point position will be the position to the right of the numeral of the most significant digit.

Table 7-5. Display mode change sequence

Sequence	Key operation	Display	Description
0		123456 kg	Normal mode Example of totalized value
1	[SET] □ [INC] □		Setting mode • Press [SET] key to enter setting mode. • Press [INC] key until “E” appear ※ Flashing display position is changeable.
2	[SET] □		• Press [SET] key, “E” is disappear, “02” is displayed
3	[SFT] □ [SET] □		• Press [SFT] key, flashing display position moves to “2:” • Press [SET] key to enter data section

4	[INC] □		• When [INC] key is pressed, the flashing position change to “1”
5	[SET] □ [SET] □		• Press [SET] key once display will be flashing • Press [SET] key one more time, flashing display position move to far left.
6	[SFT] □	123456 kg	Mode returns to normal mode.

7-3. Parameter setting

This section describes how to set parameters required for operating Model VF100 (style A) intelligent Vortex flowmeter using the integral indicator/totalizer (option) setting section.

7-3-1. Transfer from normal mode to setting mode

1. Pressing [SET] key allows the ”normal mode” to be transferred to the ”setting mode” that represents a status possible for setting parameters.

2. A parameter is displayed in the display section with the left two digits indicating ”parameter item number” and the right four digits indicating ”parameter data content” delimiting both using a ” : ” (colon).

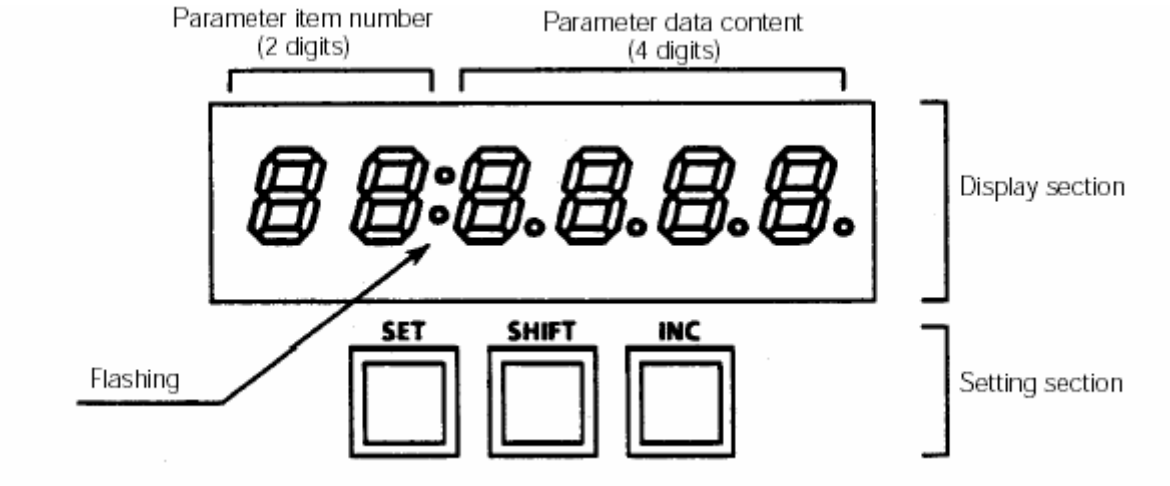
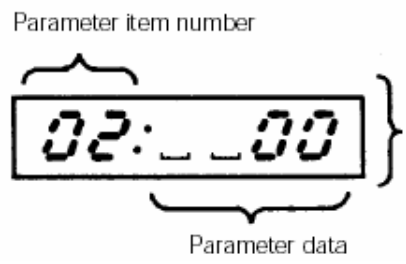


Fig. 7-2. Integral indicator/totalizer setting section and display section

7-3-2. Setting of parameter item number and parameter data

1. Press [SET] key to move the normal mode to the setting mode.

2. Change parameter item number setting (numeric values or alphabets) using [INC] key, and move the flashing part using [SHIFT] key.



Integral indicator/totalizer setting section

(This example shows B02. In case of parameter item B YY, Press [SET] key again, B will not appear.)

3. Press [SET] key to move to ”parameter data updating mode.”

4. Update parameter data numeric value and the decimal point position using [INC] key and move the flashing part using [SHIFT] key.

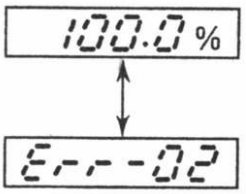
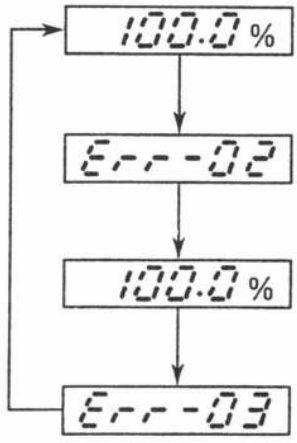
5. When completing updating, once press [SET] key. Since the entire display or the parameter data flashes, confirm the content and then press [SET] key again. Now the setting is completed.

6. When completing setting, press [SHIFT] key . The mode moves to the ”normal mode” and flow or an alarm is displayed.

7-4. Alarm number display mode

When an alarm occurs, alarm number display and normal display are alternately displayed in the LCD display to show that an alarm is occuring. But this performance is possible only in normal mode or parameter item number change mode in setting mode.

Table 7-6. Example of alarm display

Example of alarm number 2
 Normal display (for four seconds) (An example of instantaneous flow rate) Alarm number number display (for two seconds)
When two alarms or more are simultaneously occuring, it will be as below example: Example of alarm number 2 and 3 occuring simultaneously
 Normal display (for four seconds) (An example of instantaneous flow rate display) Alarm number 2 display (for two seconds) Normal display (for four seconds) Alarm number 3 display (for two seconds) NOTE: When data display is a scrolled data, normal display time is not four seconds but continues

until the end of scroll.

8. MAINTENANCE

This section describes adjustment procedures, parts replacement, disassembly and reassembly relating to maintenance. Properly handle the instrument by thoroughly reading the following sections.

8-1. Maintenance service instruments

The instruments required for maintenance service of this flowmeter are listed in table 8-1.

Table 8-1. Instruments for maintenance service

Item	recommended instruments	Remarks
Power supply	24VDC Power supply	Output voltage: 24 V DC ± 10 % for 4 to 20 mA and pulse output.
Load resistance	Standard resistor:(250 W ± 0,005 %)	4 to 20 mA DC version only if a distributor is used, the load resistance of it can be used.
Voltmeter	Digital multimeter (accuracy: ±0,05 %)	4 to 20 mA DC version only
Oscilloscope	—	

8-2. Adjustments

Adjustment procedures required for the converter range are described. Adjustments are usually made in a service room where calibration instruments are readily available.

8-2-1. Zero adjustment

Zero adjustment is not required.

8-2-2. Span adjustment

1. This span setting applies to the Analog output, and also ”pulse output”.
2. When re-calibrating the amplifier, check the flow range according to section 6-1 and 6-2.
3. Set ”H06: NOISE JUDGE” to ”NOT ACTIVE”. And set the parameters for flow measurement according to section 5-2.
4. Span adjustment will be achieved automatically when parameters are set.
5. Normally, the span and output relations are to be checked because the micro p rocessor takes care of calculation.
6. But when the span and output relations are to be checked, follow the procedure below:
7. a. Connect instruments as shown in Fig. 9-1. Wa rm up the instruments for at least five minutes.
   Use a 250 W or other readily availabe resistor whose resistance value is within the tolerances given in Fig. 4-1.
   b. Set the sine wave generator to 2 to 5 V (rectangular wave may be used) and set the frequency obtained from the equation on next page.
8. Set ”H06 : NOISE JUDGE” to ”ACTIVE”.

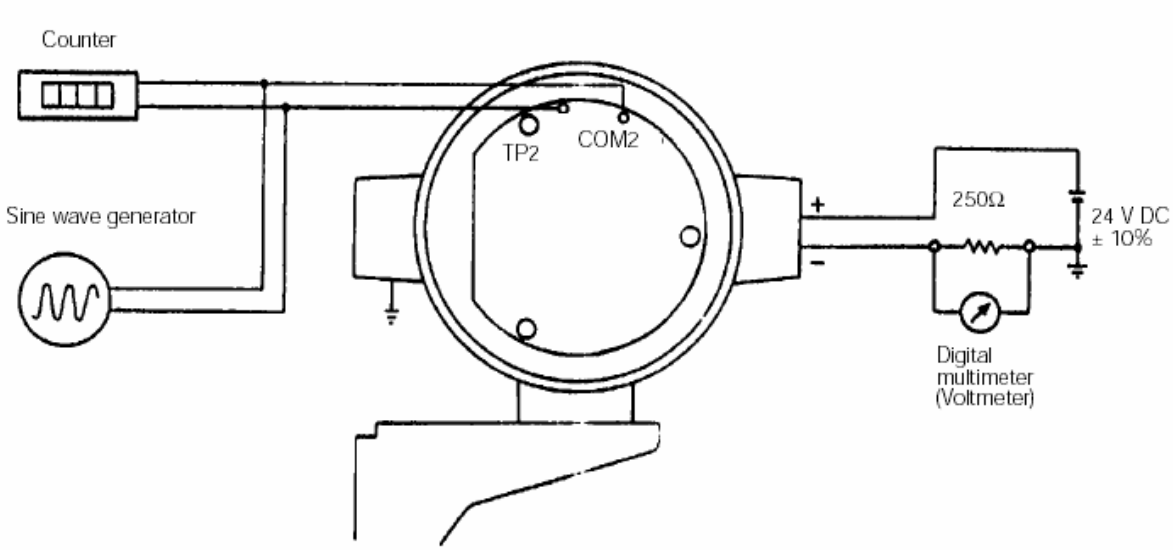


Fig. 8-1. Span adjustment setup (analog output)

f= KT . Q

Where: f : Frequency at maximum flowrate (Hz)

Q : Maximum flowrate (m_3/ h)

KT : Constants at flowing temperature (Hz / m_3/ h)

KT = KM [1- 4,81 x 10^{-5}x (t - 15)]

KM : M (pulse / litre) (Constants at 15°C), (entered on data plate)

KM' : M'(Hz/m_3/h) (Constants) (M' =M • 0,2778 Hz/m^3/h)

t : Operating temperature (°C)

The following examples show frequency calculations within maximum flowrates.

Example 1

Nominal size :	50 mm (2 inch)
Fluid :	Liquid
Maximum flowrate :	50 m_3/h
Operating temperature :	105 °C
K-factor (KM) :	8,921 pulse/liter

[Solution]

KM = 8,921 pulse/liter = 2,478 Hz/m_3/h

KT= 2,478 [1 – 4,81 x 10^{-5} (105 – 5) = 2,468 Hz/m_3/h

f = 2,468 x 50 = 123,4 Hz

Hence, frequencies between 0 and 123.4 Hz are generated for flows in the range 0 to 50 m_3/h.

Example 2

Nominal size :	100 mm (4 inch)
Fluid :	Dry air
Maximum flowrate :	2000 Nm_3/h (15 °C, 1 atm) 788 m^3/h (60 °C, 2 kg/cm_2G)
Operating temperature :	60 °C
K-factor (KM) :	1,438 pulse/liter

[Solution]

KM = 1,438 pulse/liter = 0,3995 Hz/m_3/h

KT= 0,3995 [1 – 4,81 x 10^{-5} (60 – 15)] = 0,3986 Hz/m^3/h

f = 0,3986 x 788 = 314,0 Hz

Thus, frequencies between 0 and 314.0 Hz are generated for flows in the range 0 to 2000 Nm_3/h.

Example 3

Nominal size :	100 mm (4 inch)
Fluid :	Saturated steam
Maximum flowrate :	1800 kg/h
Pressure :	2 kg/cm_2G
Saturated temperature :	133,3 °C
Specific weight :	1,638 kg/m_3
K-factor (KM) :	1,438 pulse/liter

[Solution]

KM=1.438P/l=0.3995Hz/m^3/h

KT = 0,3995 x [1 - 4,81 x 10^{-5} (133,3 - 15)] = 0,3986 Hz/m^3/h

Q = 1800 kg/h:1,638 kg/m_3 = 1098,901 m^3/h

f = KT•Q = 0,3986 x 1098,901 = 438,02 Hz

Thus, frequencies between 0 and 438.02 Hz are generated for flows in the range 0 to 2000 Nm_3/h.

Table 8-2. Selected saturated steam density

Pressure kgf/cm^2G	Temperature °C	Density kg/m^3	Pressure kgf/cm^2G	Temperature °C	Density kg/m^3
0	100.0	0.5976	9	179.2	5.064
0.5	111.4	0.8653	10	183.3	5.553
1	120.1	1.126	15	200.5	7.934
1.5	127.2	1.383	20	213.9	10.35
2	133.3	1.638	25	225.1	12.77
3	143.2	2.140	30	234.6	15.21
4	151.4	2.635	35	250.7	17.69
5	158.3	3.127	40	257.6	20.21
6	164.4	3.615	45	264.0	22.78
7	170.3	4.147	50	275.4	25.38
8	174.7	4.581	60		30.75

NOTE

Steam measurements are influenced by the moisture in the steam...
V = X • Vg + (1-X) Vf
V : Wet steam specific volume
X : Dryness fraction
Vg : Saturated steam specific volume
Vf : Water specific volume
(1-X) : Wetness fraction

CAUTION

It is prohibited by law for the user to modify flameproof instruments. It is not permitted to add or remove indicators. If modification is required, contact HUGE.

8-3-1. Indicator totalizer removal

If necessary for servicing of amplifier, remove the indicator/totalizer (option) as follows (see Fig. 8-5).

1. Turn off the power.
2. Remove the cover.
3. For the indicator/totalizer, disconnect the cable connector from the amplifier unit (see Fig. 8-6).
4. Loosen the four indicator/totalizer mounting screws using a Philips screwdriver.

5. Pull out the i

6. Reinstall the ıe) and secure the mounting screws.

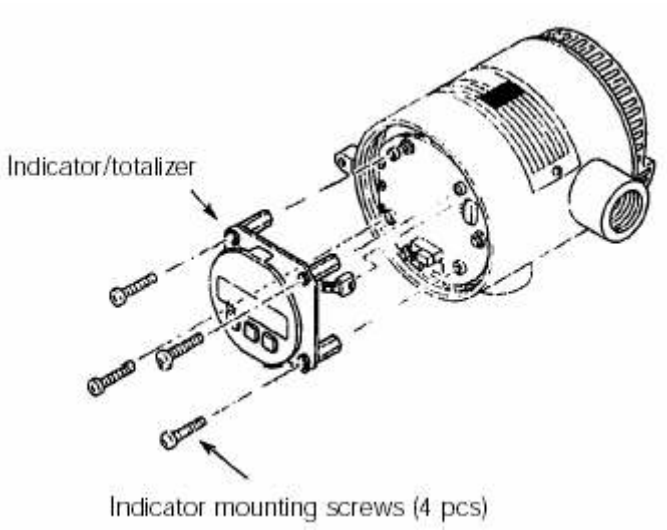


Fig. 8-5. Removing and reinstalling the indicator

8-3-2. Amplifier unit replacement

Replace the amplifier unit as follows (see Fig. 8-7).

1. Turn the power OFF.
2. Remove the converter cover
3. Remove the indicator/totalizer according to the procedures described in paragraph 8-3-1.
4. Loosen the terminal screws and remove leadwires. An analog output amplifier and a pulse output amplifier uses three leadwires.).
5. Loosen the three amplifier unit mounting screws and remove the amplifier unit as shown in Fig. 8-6.
6. When reinstalling the amplifier unit in the converter, match the connector pin positions with the socket. Push the amplifier unit back in position.
7. Tighten the amplifier mounting screws.
8. Reconnect the leadwires to the amplifier unit. The leadwires must be connected to the proper terminals. See Fig. 8-6 for the correct leadwire connections.
9. Adjust span as per paragraph 8-2-2.

CAUTION
Do not turn the amplifier unit. The connector pins may be damaged.

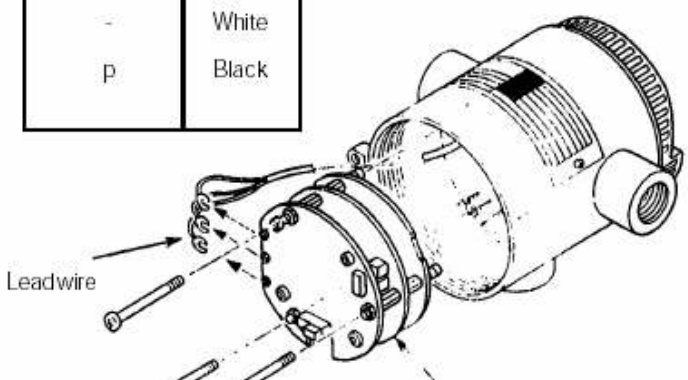
8-3-3. Vortex shedder assembly removal

Disassemble the Vortex flowmeter only when abnormality occurs in the instrument.

8-3-3-1. Removal of shedder from remote converter type

1. Remove the terminal box cover. Loosen the two terminal screws and disconnect the leadwires.

Terminal	Wire
+	Red
-	White
p	Black



2. Loosen the bracket mounting bolts and remove the terminal box together with the bracket. Be careful not to damage the leadwires connected to the Vortex shedder assembly when removing the terminal box.
3. Loosen the Vortex shedder assembly mounting bolts or nuts and remove the Vortex shedder assembly.

Fig. 8-6. Removing amplifier unit

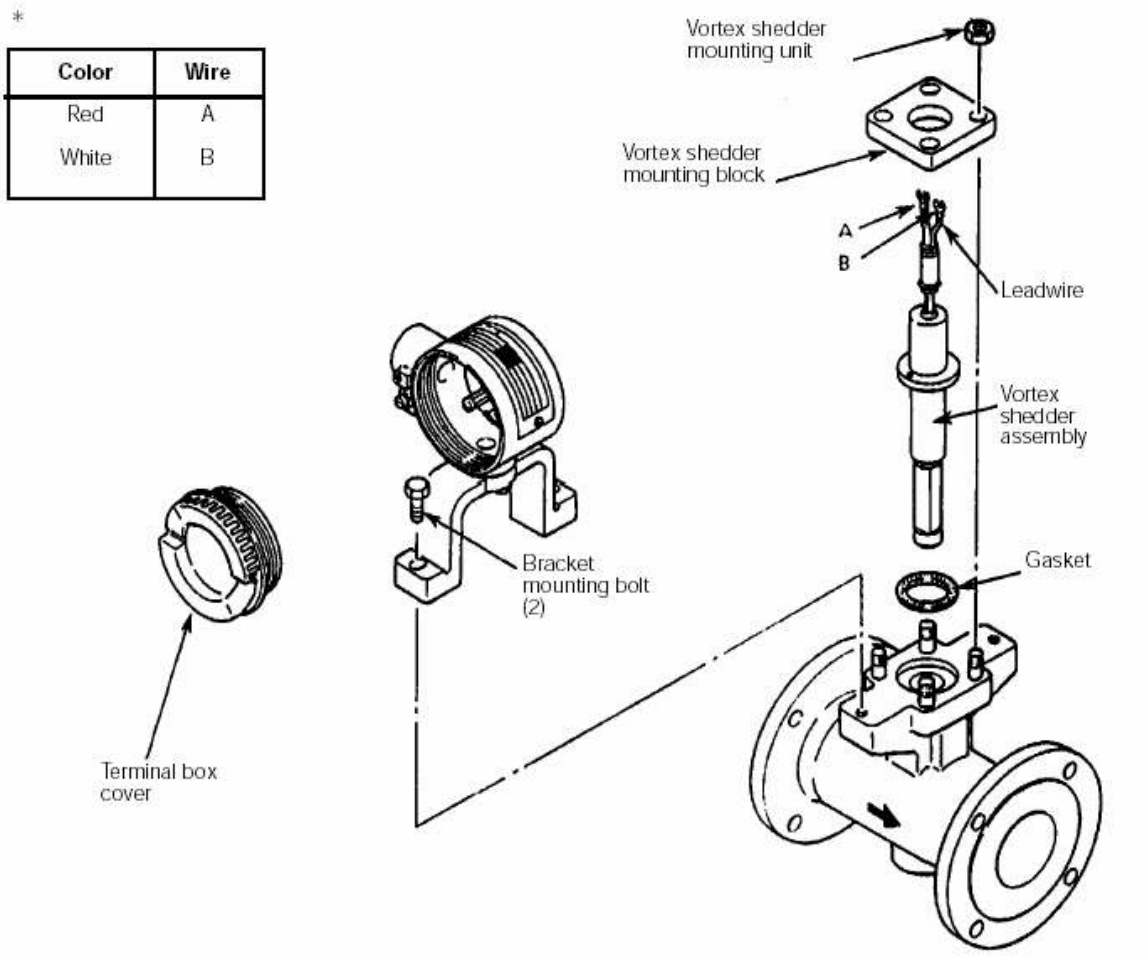


Fig. 8-7. Disassembling and reassembling the Vortex shedder assembly

CAUTION
When the shedder assembly is disassembled, the gasket must be replaced with a new gasket.

8-3-3-2. Removal of shedder from integral type

1. Remove the converter cover
2. Loosen the three terminal screws and disconnect leadwires on the amplifier and loosen 3 screws to disassemble the amplifier.
3. Loosen the bracket mounting bolts and remove the amplifier housing together with the bracket. Be

careful not to damage the leadwires connected to the Vortex shedder assembly when removing the terminal box.

4. Loosen the Vortex shedder assembly mounting bolts or nuts and remove the Vortex shedder assembly.

5. When reassembling the Vortex shedder assembly, reverse above procedure. Confirm the following:

a. In principle, a new gasket should be used.

b. The guide pin on the Vortex shedder mounting block meets the guide pin hole. See Fig. 8-10. The guide pin applies to the 1 to 4 inch flowmeters.

c. The Vortex shedder assembly is installed as illustrated in Fig. 8-9.

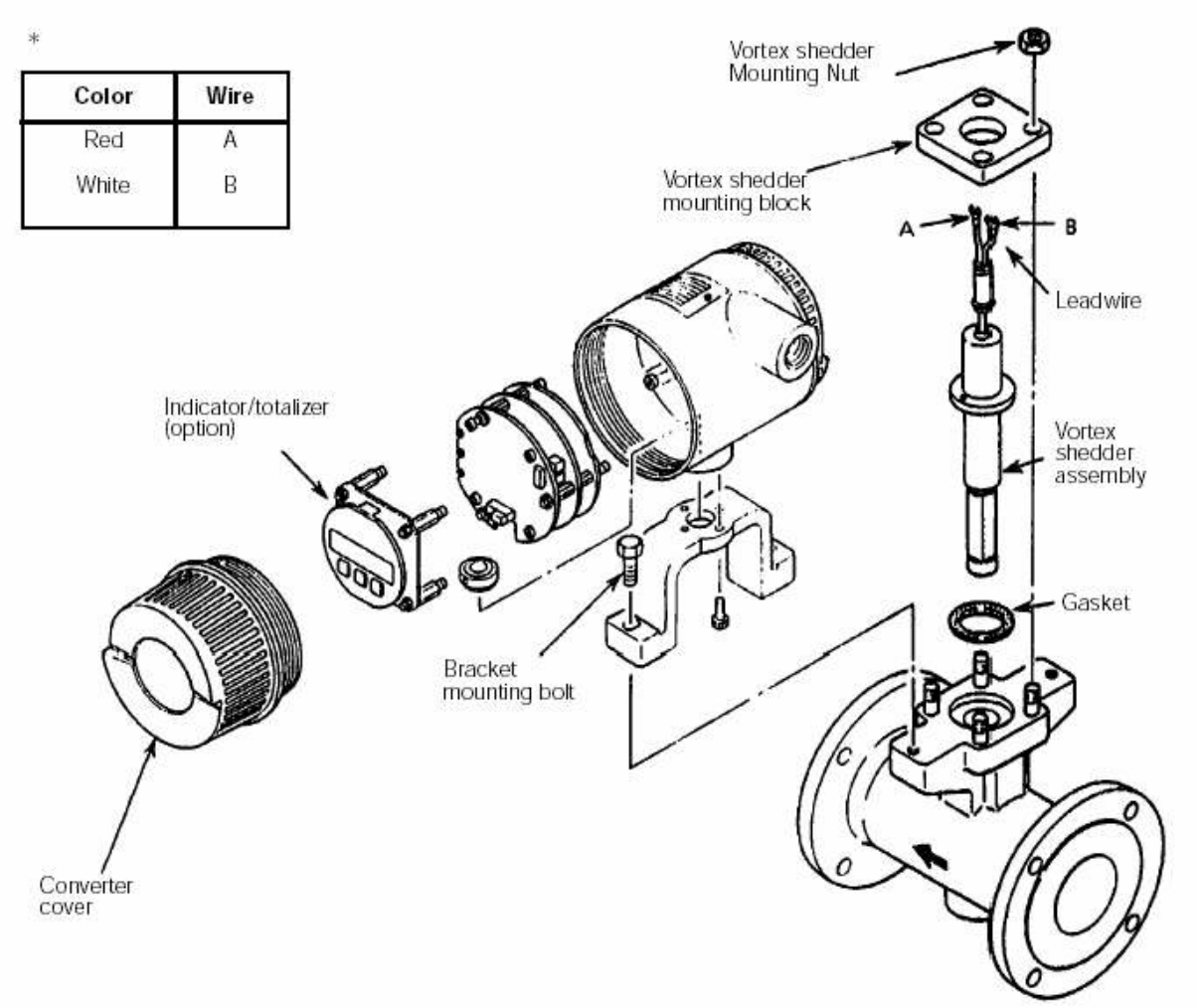


Fig. 8-8. Disassembling and reassembling the Vortex shedder assembly

8-3-4. Caution at reassembly

When reassembling the Vortex shedder assembly, reverse above procedure. Confirm the following.

1. In principle, a new gasket should be used.

2. The guide pin on the Vortex shedder mounting block meets the guide pin hole. See Fig. 8-10. The guide pin applies to the 1 to 4 inch flowmeters.

3. The Vortex shedder assembly is installed as illustrated in Fig. 8-9.

4. Tighten the sensor mounting bolts or nuts with a torque wrench, applying the torque specified below.

Table 8-8. Torque value

Unit: kg.m

Nominal size Standard mm (inch)	Torque value
15	1.6
25	1.2
40	1.2
50	2
80	3
100	4
150	5
200	7
250	16
300	16

5. Insert the leadwires (Vortex shedder) through the terminal box bottom hole and lower the terminal box slowly until the bracket touches the flowmeter shoulder. Be sure to keep the leadwires vertical while lowering the terminal box.

6. After assembling, confirm that there is no leakage from the Vortex flowmeter.