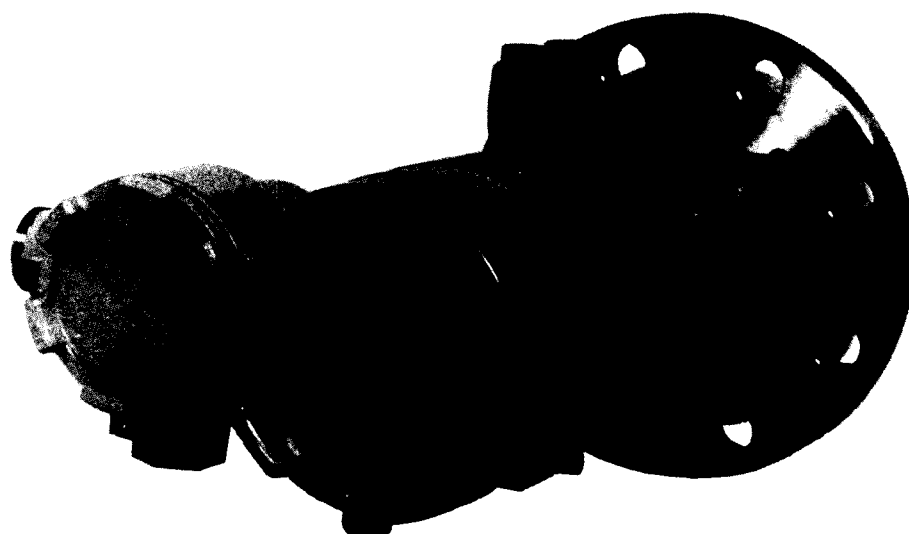


Yamatake-Honeywell**OPERATOR'S MANUAL**

**DIFFUSED SILICON TRANSMITTER (DSTJ 8000)
ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTER
MODEL KDI51/52/53/61/62/63 (FLANGE TYPE)**



DIFFUSED SILICON TRANSMITTER (DSTJ 8000)
ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTER
MODEL: KDI51/52/53/61/62/63

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DESCRIPTION**1. GENERAL**

The DSTJ 8000 Electronic Differential Pressure Transmitter (Model KDI) measures a differential pressure and is applicable for measurement of flow rate, specific gravity, liquid level, pressure, and other process variables. This transmitter employs a new type of pressure sensor a diffused silicon sensor which directly measures a differential pressure without requiring any mechanically moving parts. The measured differential pressure is converted into and transmitted in the form of a standard 4 to 20 mA DC signal.

Models KDI51, 52 and 53 are capable of "high elevation" operation. They are used to measure a liquid level of an open or a closed tank, with gas sealing by their pressure connection pipe. The high pressure side (HP side) of the differential pressure detector has a flange for direct connection to the process to be measured.

Models KDI61, 62 and 63 are capable of "high suppression" operation. They are used to measure a liquid level of a closed tank, with liquid sealing by their pressure connection pipe. The low pressure side (LP side) of the differential pressure detector has a flange for direct mounting to the process to be measured.

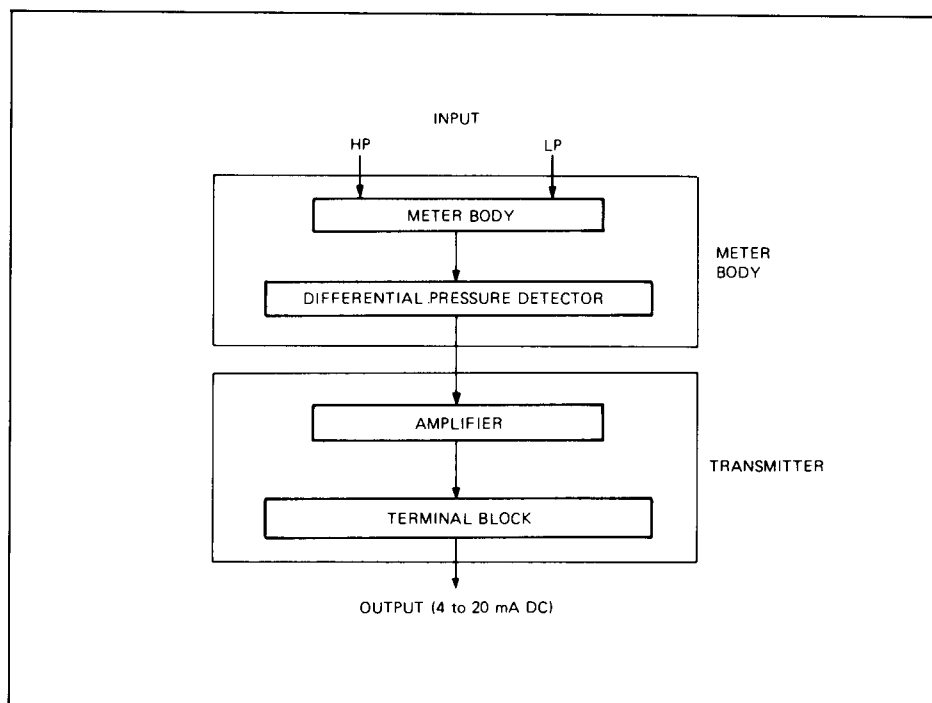


Figure 1. Construction

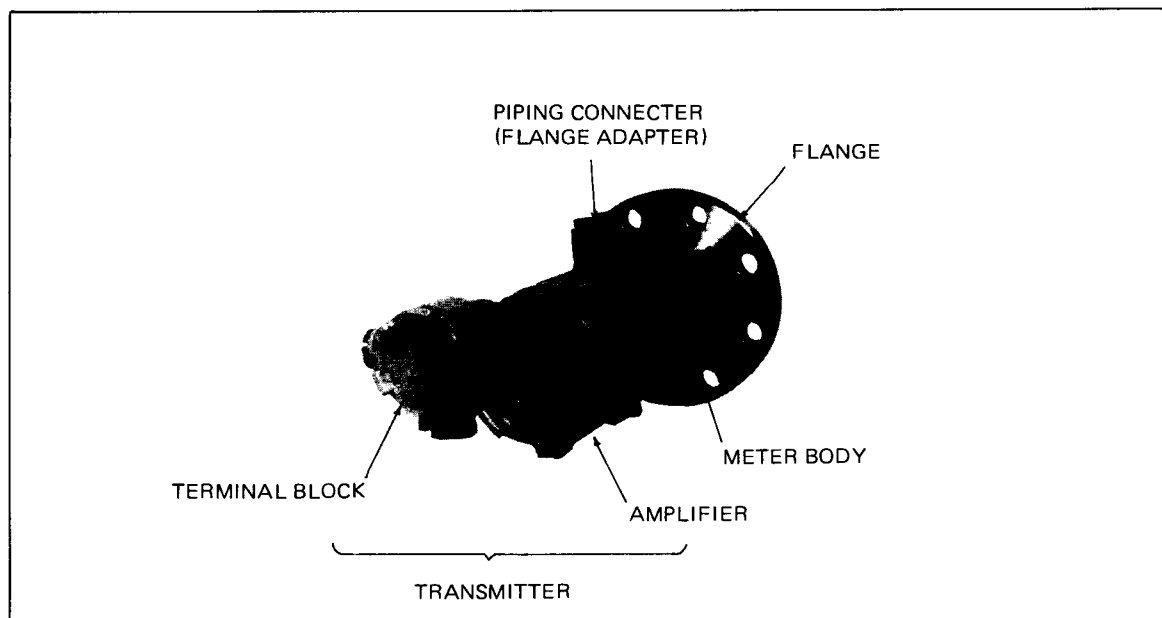


Figure 2. Nomenclature

1.1 Construction

1.1.1 Meter Body Section

The meter body section consists of a cover section for one process pressure connection and a main body section which connects the other process pressure via a flange (which has a diaphragm) to the seal diaphragm.

Models KDI51, 52 and 53 are used when one of the process pressures for differential pressure measurement may be open to atmosphere.

1.1.2 Differential Pressure Detector Section

The differential pressure detector section has a silicon sensor. The process differential pressure is applied to the silicon sensor via the seal diaphragm and liquid fill. The silicon sensor detects the mechanical differential pressure into an electrical voltage signal. A protective provision is incorporated to guard against overpressure either in the high or the low pressure side, thereby making the instrument fail-safe against erroneous handling.

1.2 Transmitter Section

1.2.1 Amplifier Section

The amplifier amplifies the low level output signal of the detector into a standard current signal of 4 to 20 mA DC. Zero adjustment and span adjustment also are done with this amplifier.

1.2.2 Terminal Block

The 4 to 20 mA DC output signal of the amplifier is fed to the terminal block, through which the signal is sent to an external instrument. Model KDI Differential Pressure Transmitter employs a 2-wire system and both supply voltage and output current flow in the same two wires. The only electrical

DESCRIPTION

connections required for the transmitter is to connect the two wires to this terminal box. Connections for an external indicating milliammeter also can be done with this terminal box.

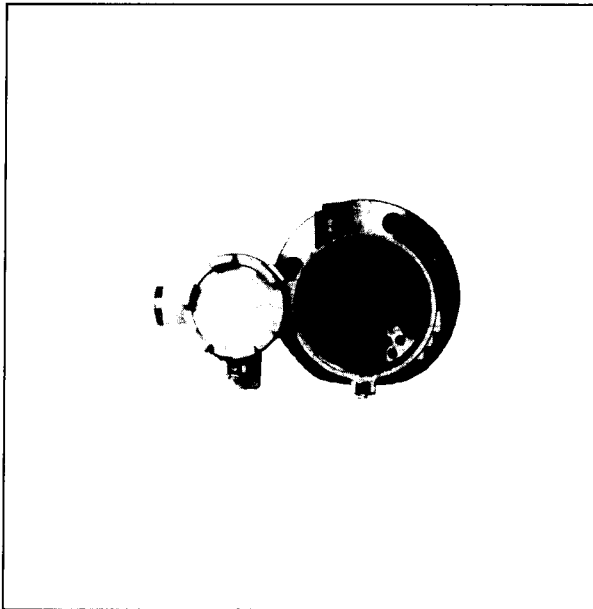


Figure 3. Transmitter
(with cover open)

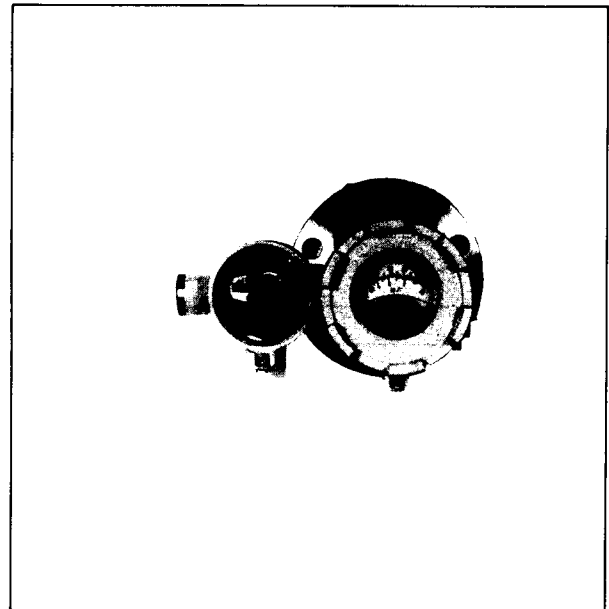


Figure 4. Terminal box
(with cover open)

2. SPECIFICATIONS

Standard Specifications

Measuring range:
(Continuously adjustable)

KDI51/61: 0-2,500 to 0-25,000 mmH₂O

KDI52/62: 0-650 to 0-6,500 mmH₂O

KDI53/63: 0-500 to 0-2,600 mmH₂O

Process connection:

Measuring side (Liquid level); Flange connection

Flush diaphragm type

80 mm JIS 10K, 30K (RF) equivalent flange

3"-ANSI 150, 300 (RF) equivalent flange

Extended diaphragm type

100 mm JIS 10K, 30K (RF) equivalent flange

4" ANSI 150, 300 (RF) equivalent flange

Reference side: Rc, 1/2 (ISO R7 1/2") or 1/2 NPT tap thread

Electrical conduit connection:	G1/2 (ISO R228 1/2") tap thread	
Power supply:	21.6-44V DC	
Output:	4-20 mA DC (External load; 575 ohms at 24V, 1475 ohms at 42V)	
Accuracy:	±0.5% FS	
Dead band:	Within 0.01% FS	
Temperature effect:	±0.5% FS/55 °C (Value of zero shift at maximum span.)	
Operating pressure range:	-1 kgf/cm ² G to maximum flange rated pressure	
Operating temperature conditions:	Amplifier;	-30 to + 80 °C
	Meter body;	-40 to +120 °C
	(Process fluid)	
Operating temperature limits:	Amplifier;	-40 to + 93 °C
	Meter body;	-40 to +120 °C
	(Process fluid)	
Transportation and storage conditions:	-50 to +120 °C	
Operating humidity conditions:	10-90 % RH	
Overload protection:	Up to maximum flange rated pressure in either direction	
Damping adjustment: (Electrically continuously adjustable)	KDI51/61:	} Time constant at maximum span
	Approx. 0.05-2.9 sec	
	KDI52/62:	
	Approx. 0.06-3.9 sec	
	KDI53/63:	}
	Approx. 0.1-6.8 sec	
Electronics housing:	Flame-proof type explosion-proof construction*: Class d2G4 of JIS C 0903 code approved. (JIS F 8001 Class 3 splash-proof included.) Also suitable for NEMA 4 and NEC Class 1, Group C, D, Division 1. (*Max. operating temperature: +70 °C)	
	Intrinsic safety construction*: Class i3nG4 of JIS C 0903 code approved. (Also suitable for above explosion and splash-proof construction.) (*Power supply: 23-27.5V DC, Operating temperature: -10 to +60 °C)	

DESCRIPTION

Zero adjustment ranges: (Use within the ranges; Elevation + Span \leq Max. Span, and Suppression \geq Span)	KDI51/61: Elevation side; Up to 2,000 mmH ₂ O, Suppression side; Up to 4,500 mmH ₂ O KDI52/62: Elevation side; Up to 600 mmH ₂ O, Suppression side; Up to 1,500 mmH ₂ O KDI53/63: Elevation side; Up to 400 mmH ₂ O, Suppression side; Up to 1,400 mmH ₂ O
Material:	Process connecting flange: Carbon steel (SF 45A), 304SS (Wet-part; 316SS, 316L SS, Monel lining, Tantalum lining) Reference chamber cover: Carbon steel (SF 45A), 316SS, Rigid PVC (with reinforced plate, pressure range; -1 to +15 kgf/cm ² G and temperature range; 0-55 °C) Seal diaphragm: 316SS, 316L SS, Monel, Tantalum Wet-part gasket: Teflon Transmitter case: Aluminium alloy
Finish:	Acryl baking finish Color: Light beige (Munsell 4Y 7.2/1.3)
Mounting:	Directly flange mounted to process flange.
Net weight:	Approx. 12 kg with 80 mm JIS 10K flange

Optional Specifications

- (1) High elevation and high suppression (Use within the ranges;
Elevation + Span \leq Max. Span, and Suppression \geq Span)

Zero adjustment range (mmH ₂ O)					
Model No.	High elevation		Model No.	High suppression	
	Elevation side	Suppression side		Elevation side	Suppression side
KDI51:	Up to 20,000	Up to 4,500	KDI61	Up to 2,000	Up to 25,000
KDI52:	Up to 5,850	Up to 1,500	KDI62	Up to 600	Up to 6,500
KDI53:	Up to 2,100	Up to 1,400	KDI63	Up to 400	Up to 2,600

- (2) Flame-proof packing type cable connecting adapter: For low voltage cable work in the division 1 location (JIS d2G4)
- (3) Induction lightning arrester: Built-in semi-conductor lightning arrester
- (4) Ammeter: Built-in wide-angle, easy-to-observe indicator

3. MODEL NUMBER TABLE

Basic Model No.	Flange & Cover Mat'l		Diaphragm Mat'l		Flange Rating	Housing	Length of Extended Part of Flange	Option	Description
	Measuring Side	Reference Side	Measuring Side	Reference Side					
KDI 51/61									Measuring range 0 – 2,500 to 0 – 25,000 mmH ₂ O
KDI 52/62									Measuring range 0 – 650 to 0 – 6,500 mmH ₂ O
KDI 53/63									Measuring range 0 – 500 to 0 – 2,600 mmH ₂ O
	-1								Carbon steel (SF 45A)
	-2								304 SS
		1							Carbon steel (SF 45A)
		2							316 SS
		5							Rigid PVC
			2						316 SS
			3						Monel (Excluding extended diaphragm type)
			4						Tantalum (")
			8						316L SS
				2					316 SS
				3					Monel (Excluding extended diaphragm type)
				4					Tantalum (")
				8					316L SS
					1				Flush diaphragm type 80 mm-JIS 10K (RF) equiv. flange
					2				" 80 mm-JIS 30K (RF) equiv. flange
					3				" 3"-ANSI 150 (RF) equiv. flange
					4				" 3"-ANSI 300 (RF) equiv. flange
					5				Extended diaphragm type 100 mm-JIS 10K (RF) equiv. flange
					6				" 100 mm-JIS 30K (RF) equiv. flange
					7				" 4"-ANSI 150 (RF) equiv. flange
					8				" 4"-ANSI 300 (RF) equiv. flange
						E			Explosion-proof type
						H			Intrinsic safety type
							10		100 mm
							15		150 mm
								-5	High elevation
								-6	High suppression
								-A	With one flame-proof packing type cable connecting adapter
								-B	With two flame-proof packing type cable connecting adapters
								-L	Built-in induction lightning arrester
								-M	Built-in ammeter

4. NAMEPLATE

The major specifications of the transmitter are indicated on the nameplate. Check the indicated items referring to the model number construction chart.

KDI Pressure-tight Explosionproof

Yamatake Honeywell	MODEL	
	PROD.	
	SERIAL	
	MAX. PRESS.	kg/cm ²
	RANGE	mmH ₂ O
	SUPPLY	24/42VDC. d2G4 (JIS C 0903)
	OUTPUT	4~20mADC. MAX. AMBIENT TEMP. 70°C
	DATE	TOKYO JAPAN

KDI Intrinsic-safety Explosionproof

Yamatake Honeywell	MODEL		
	PROD.		
	SERIAL		
	MAX. PRESS.	Kg/cm ²	
	RANGE	mmH ₂ O	
	SUPPLY	24VDC	i3nG4 (JIS C 0903)
	OUTPUT	4~20mADC	MAX. AMBIENT TEMP. 60°C
	DATE	TOKYO JAPAN	

注：本システムの構成条件については取扱説明書に準じて下さい。
 NOTE: THE INTRINSICALLY-SAFE LOOP CONFIGURATION SHALL BE COMPLIED WITH INSTRUCTION MANUAL

MODEL: Model number
PROD.: Product number
SERIAL: Serial number
MAX. PRESS.: Maximum pressure rating
RANGE: Measuring range
SUPPLY: Supply voltage
OUTPUT: Output current
DATE: Date of manufacture

RIGHT-HAND BOX OF SUPPLY AND OUTPUT:
 Type of explosionproof feature and maximum ambient temperature

OPERATING PRINCIPLE

1. GENERAL

The process pressure (or differential pressure) to be measured is applied to the silicon sensor of the DSTJ transmitter. The resistance of the silicon sensor varies in response to the process pressure applied. Since a constant current is supplied to the silicon sensor which makes up a bridge circuit, the pressure is detected as a millivoltage signal. This millivoltage signal is amplified to a required level and then converted into a current signal.

To perform the above functions, this instrument consists of a measuring circuit, a constant-current circuit (including a constant-voltage circuit to provide the constant current), a differential amplifier, and a voltage-to-current converter. For details, see the schematic diagram at a later part of this manual.

2. OPERATING PRINCIPLES OF INDIVIDUAL CIRCUITS

2.1 Measuring Circuit

The measuring circuit (silicon sensor) is a bridge circuit consisting of four pressure sensitive resistors and two temperature compensating resistors (not shown in the illustrations.) The constant current is fed to the bridge which produces an output voltage proportional to the pressure (differential pressure) applied to the silicon sensor.

Refer to Figures 1 and 2. First, assume that no process pressure is applied to the sensor. The four pressure-sensitive resistors (R_{1s} , R_{3s} , R_{4s} , R_{6s}) are at the same values, the potentials of points B and C are the same with that of point A, the input voltage (ε) of the differential amplifier (U_2) is zero, and the bridge circuit is in a balanced state. When in this state, the output signal is 0% (4 mA).

Next, assume that a process pressure is applied to the sensor. The resistances of the pressure-sensitive resistors vary (by ΔR), the potentials of points B and C varies with respect to point A, and a differential voltage (E_0) is produced between points B and C. Denoting resistance variation as $\Delta R_1 = \Delta R_3 = \Delta R_4 = \Delta R_6 = \Delta R$ and denoting the constant-current by I_E , the voltage variation (E_0) can be expressed as follows:

$$E_0 = I_E \cdot \Delta R \dots\dots\dots (1)$$

Differential voltage E_0 is applied as input signal (ε) to the high sensitivity differential amplifier. The output of the differential amplifier controls the output current 3 to 19 mA ($I_{o'}$) of the V/A converter (Q_5).

The output current 4 to 20 mA (I_o) for the external circuit is obtained by adding to current $I_{o'}$ the constant current (I_E)* which is obtained by the measuring circuit.

*This constant current is 1 mA. The source of this current is connected in series to the bridge circuit and connected in parallel with the output current circuit.

The output current obtained as indicated by equation (1) is fed via the load to the feedback resistor R_{12} , producing a voltage drop (E_f) across the resistor. The value of E_f is given as follows:

$$E_f = I_o \cdot R_{12} \dots\dots\dots (2)$$

Therefore, the feedback voltage E_f between points B and C is expressed as follows:

$$E_f \cdot \frac{(R_{3S} + \Delta R_3) + (R_{6S} - \Delta R_6)}{(R_{1S} - \Delta R_1) + (R_{3S} + \Delta R_3) + (R_{4S} + \Delta R_4) + (R_{6S} - \Delta R_6)} = \frac{1}{2} E_f \dots\dots\dots (3)$$

The system balances when the following condition is satisfied:

$$\frac{1}{2} E_f = E_o \dots\dots\dots (4)$$

Assigning equation (4) into equations (1) and (2), the following equations can be written:

$$\frac{1}{2} \cdot I_o \cdot R_{12} = I_E \cdot \Delta R$$

$$I_o = (2 \cdot \frac{I_E}{R_{12}}) \cdot \Delta R \dots\dots\dots (5)$$

This equation indicates that the output current varies in response to variation of the resistance of the silicon sensor.

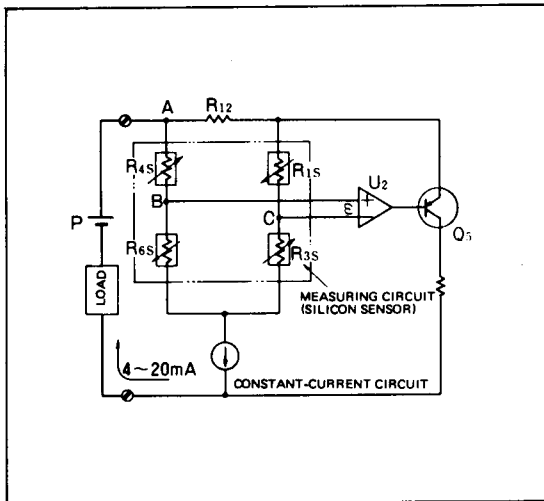


Figure 1.

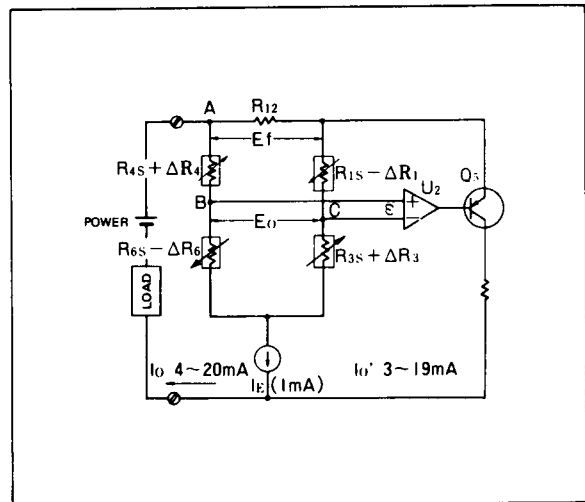


Figure 2.

OPERATING PRINCIPLE

2.2 Constant-current Circuit and Constant-voltage Circuit

These circuits provide a constant current (1 mA DC) for the measuring circuit, in order to detect the measured process variable in the form of voltage change of a resistance bridge. (See Figure 3.) The functions of these circuits are as explained in the following.

As transistor Q3 is self-biased with resistor R20 and a constant current is fed to temperature-compensated zener diode ZD1, a constant voltage ($6.4\text{V} \pm 5\%$) is developed. The value of the constant current depends on resistor R20. For this instrument, the value is set at 1 mA which provides the most stabilized voltage operation of zener diode ZD1.

The constant voltage (6.4 V) developed across zener diode ZD1 is divided with a critical resistance array (R10) and the divided voltages are applied to the inputs of differential amplifier U1, thereby accurately and stably controlling the emitter current I_E of transistor Q1 at 1 mA.

Since Q1 is a high gain transistor, its collector current I_C is almost equal to its emitter current I_E and a very stable current of 1 mA flows in the measuring circuit.

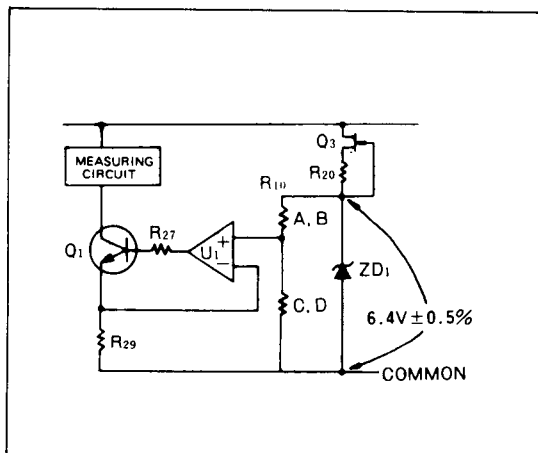


Figure 3.

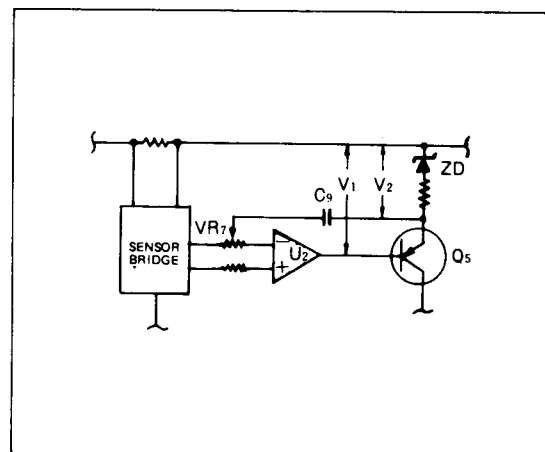


Figure 4.

2.3 Damping Circuit

Damping is done purely electrically. When the input has rapidly changed, the output signal is fed back to the differential amplifier via a "lead network" feedback circuit.

Referring to Figure 4, when a stepwise input is applied to the sensor, the output voltages V_1 and V_2 also change stepwise. The stepwise voltage change of V_2 is fed back to the input of differential amplifier U_2 via damping capacitor C_9 so that the change follows the output voltage V_1 of U_2 . At the same time the damping capacitor is charged and discharged with a new signal level, thereby attaining a damping effect.

Even when the damping constant is rapidly changed (the value of VR7 is sharply changed), it does not effect the output signal because voltage V_1 of the emitter side which affects transistor Q5 remains unchanged.

INSTALLATION

1. INSTALLATION DIMENSIONS

For installation dimensions, see the external dimension drawings at a later part of this manual.

2. ACCESSORIES

The following accessory is supplied accompanying this instrument.

L-shape bar wrench (for anti-rotation M4 bolts, for explosion-proof model)

3. PLACE OF INSTALLATION

When selecting a place of installation for the instrument, take into consideration the matters related to instrument inspection, maintenance service, life expectancy, and operation safety as follows:

3.1 Select a place where temperature change is small (within the limits of -30°C to $+80^{\circ}\text{C}$). Avoid a place where the instrument is exposed to high temperature by radiation from a source of heat.

When water is measured, pay attention to freezing which may damage the instrument. Provide appropriate means to guard against freezing.

3.2 Select a place where is reasonably free from humidity and vibration.

3.3 When an explosionproof feature is required, select a Class II Explosionproof place whenever available. Although the explosionproof type instrument can be used in a Class I Explosionproof place, it is deal to use the instrument in a Class II Explosionproof place from the viewpoint of safety.

3.4 Be sure to provide spaces for ZERO adjustment and DAMPING adjustment (for inserting a screwdriver).

4. INSTALLATION METHOD

Install the transmitter flange on the process flange. Tighten uniformly the flange bolts. The center of the flange becomes the zero liquid level position. By raising the zero position, a head pressure of a corresponding amount can be obtained.

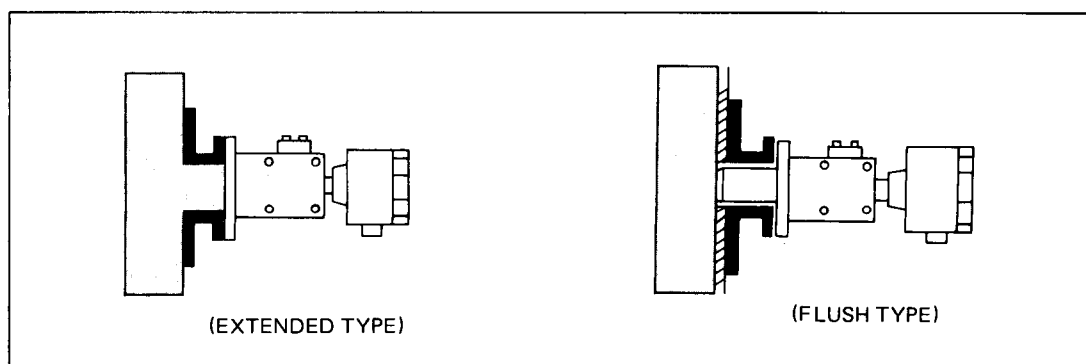
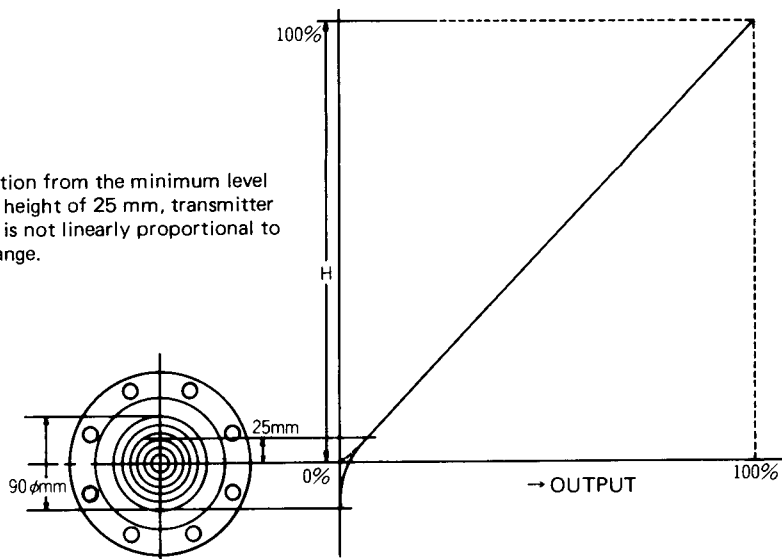


Figure 1. Mounting to a tank

Note: Within the portion from the minimum level (0% level) to a height of 25 mm, transmitter output change is not linearly proportional to liquid level change.



5. MOUNTING ATTITUDE

The differential pressure transmitter may be installed in any attitude, so far as vent can be done as needed. Note that measuring errors may be caused if drain or other foreign substance is entrapped in the instrument. It is ideal to install the instrument in such attitude that its diaphragm (flange) is positioned plumb. After installing the instrument, be sure to perform fine ZERO adjustment*.

*See Section "CALIBRATION."

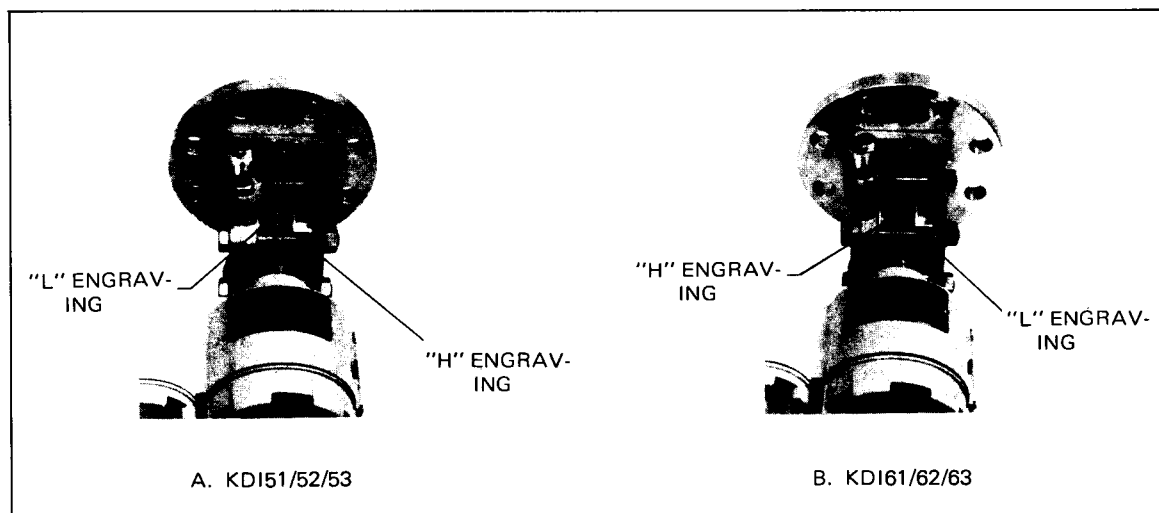


Figure 2. Identification of HP side and LP side of flange section

6. CONNECTION TO PROCESS

The process pressure connections for Models KDI51, 52 and 53 Differential Pressure Transmitters are such that the high pressure (HP) side (flange side) is at the right hand side of the instrument as viewed from the front of the instrument (transmitter section) with the terminal section located in the left hand side. The low pressure (LP) side is at the left hand side.

INSTALLATION

Of Models KDI61, 62 and 63 instruments, the locations of the HP and LP pressure connections are in the reverse of the above.

The above facts mean that the differential pressure must be applied to the silicon sensor in such manner that the higher one of the two process pressures should be applied to the "H" side of the silicon sensor, although the instrument is so designed that it is not damaged even when the higher one of the two pressures is inadvertently connected to the "L" side.

6.1 Terminology

The terms "elevation" and "suppression" as used in this publication are defined as follows:

"Elevation": Synonymous with "suppressed zero range."
 A range where the zero value of the measured variable is less than the lower range-value. Zero does not appear on the scale.
 For example, a range of 20 to 100.

"Suppression": Synonymous with "elevated zero range."
 A range where the zero value of the measured variable is greater than the lower range-value.
 For example, a range of -20 to 60.

Table 1.

Model	Zero adjustment ranges of standard printed circuit board (mmH ₂ O)	
	Elevation	Suppression
KDI51, KDI61	2,500	4,500
KDI52, KDI62	750	1,500
KDI53, KDI63	400	1,400

6.2 Level Measurement of Open Tank (Models KDI51, 52, 53)

Install the transmitter as shown in Figure 3.

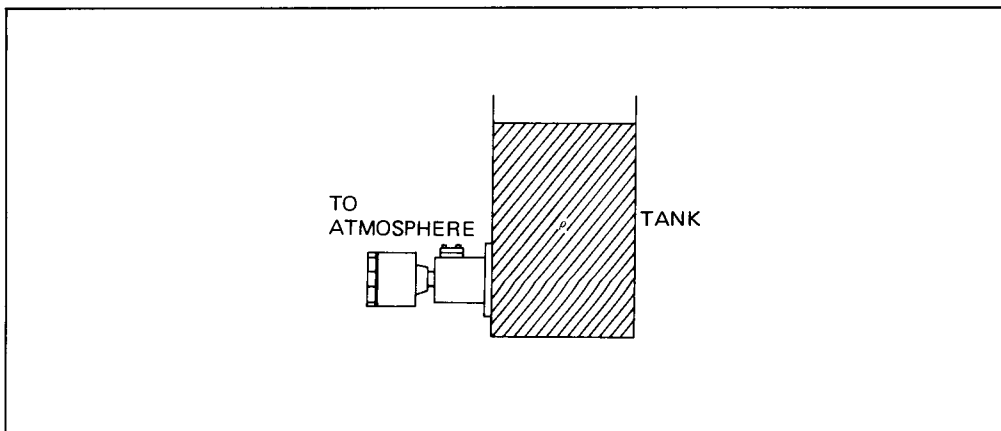


Figure 3

When the product $h \cdot \rho$ of multiplication of head (h) of the transmitter from the zero level position by the specific gravity (ρ) of the measured liquid for the maximum measuring range is larger than the corresponding value shown in Table 1, a high elevation PCB (optional). The PCB is used in common for high suppression also. In the case of the standard type of transmitter, so install the transmitter that the value of (h) is within the limit values shown in Table 1.

6.3 Level Measurement of Closed Tank (when no head is caused by the pipe from the upper section of the tank) (Models KDI51, 52, 53)

Install the transmitter and make pressure connections as shown in Figure 4.

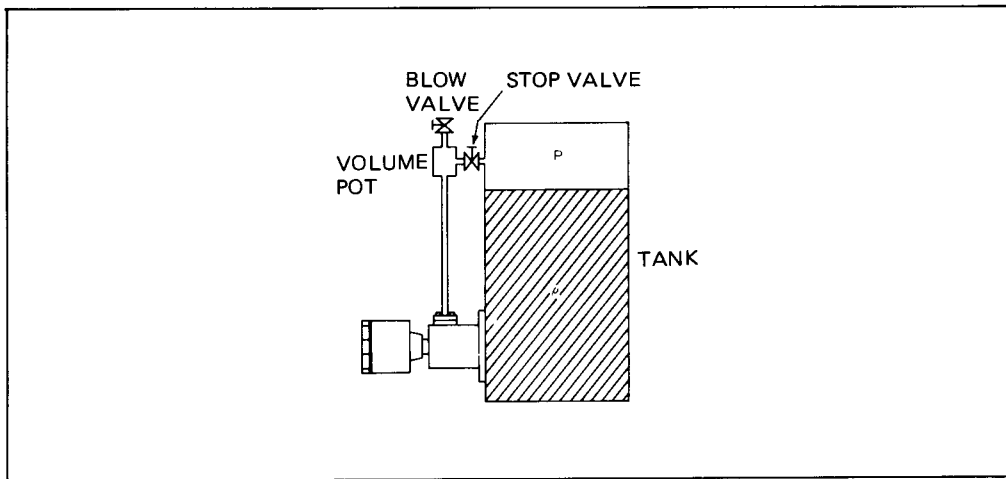


Figure 4

The effect of head (h) which is caused by the differential height between the zero liquid level position and the instrument position is the same with that of Subsection 6.1.

6.4 Level Measurement of Closed Tank (when there is a head pressure caused by the pipe from the upper section of the tank) (Models KDI61, 62 and 63)

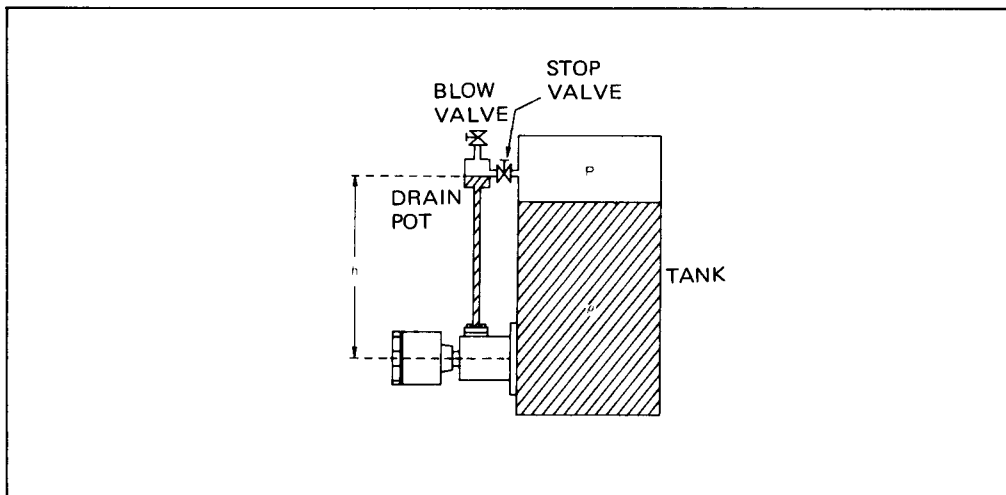


Figure 5

INSTALLATION

Install the transmitter and make pressure connections as shown in Figure 5. The value $h \cdot \rho$ shown in Figure 5 represents the value required for suppression. When the value of $h \cdot \rho$ is larger than the corresponding value shown in Table 1, the high suppression PCB (optional) should be used.

7. ELECTRICAL CONNECTIONS

7.1 Electrical Connections for Standard Instrument

As shown in Figure 5, the KDI Transmitter employs a 2-wire system, using the same pair of wires for both power and signal. Run the wires into the terminal box through the side or bottom conduit hole (G1/2 internal thread).

Two ground terminals are provided, one in the terminal box and the other outside of the terminal box. Either terminal may be used. Grounding must be JIS Class 3 (grounding resistance 100 ohms or less).

To use an external indicating meter, disconnect the jumper plate and connect the meter as indicated with the dotted lines. For this connection, undo the blind cap stopper of the conduit with the L wrench and then remove the blind cap.

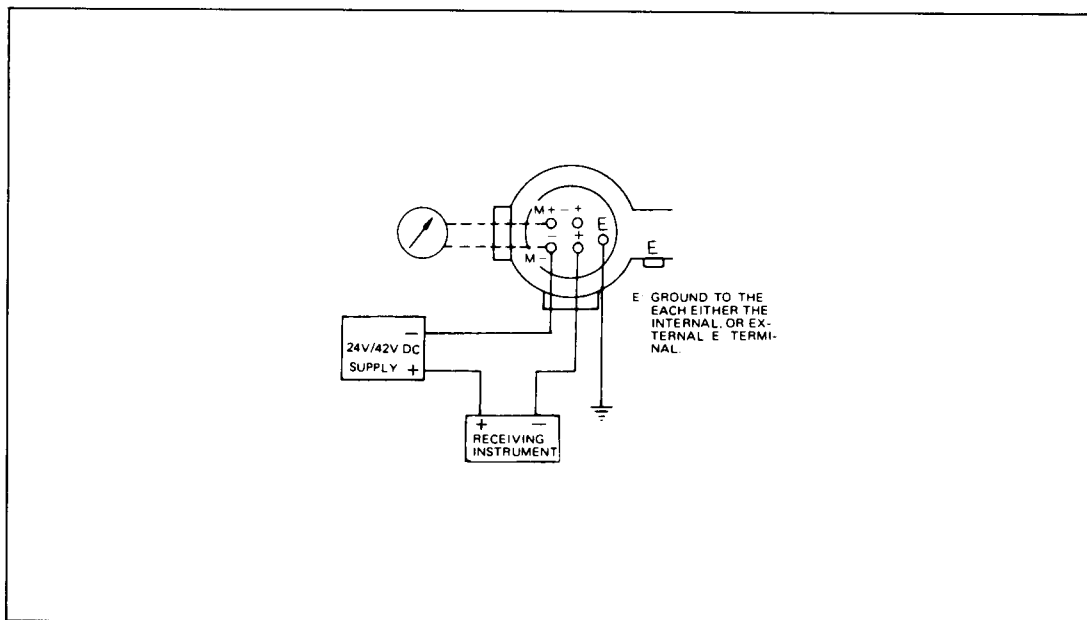


Figure 6. Electrical connections

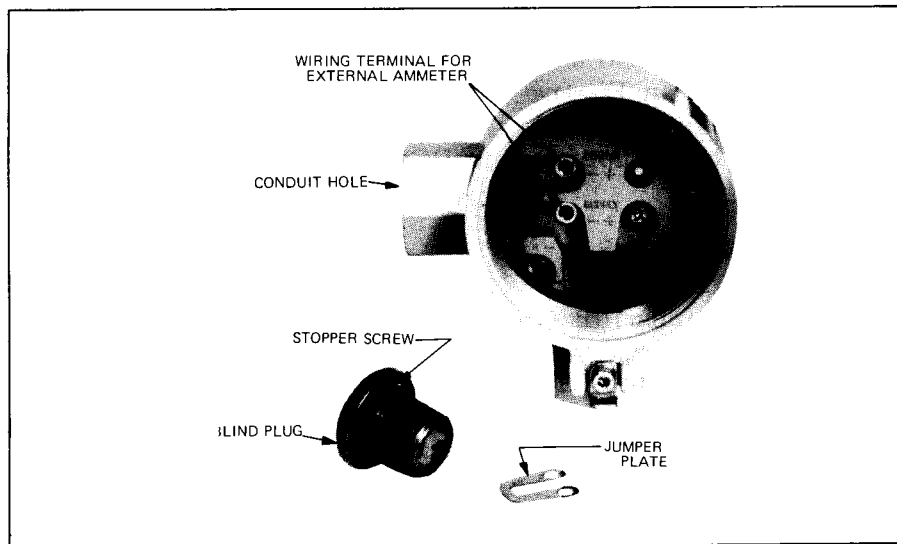


Figure 7. Connections for external indicating meter

7.2 Electrical Connections for Explosionproof Instrument

Of the explosionproof instrument, the terminal box cover is designed in an anti-rotation clamp structure. After the electrical connections are cover, tightly close the cover and securely clamp it with the anti-rotation bolts (at transmitter main unit and terminal box). The electrical wires must be led into the terminal box in the pressure-tight screw-thread coupling method or in the pressure-tight packing method. (For details, refer to Technical Guidance RIIS-TR-76-1 issued by the Ministry of Labour The Research of Industrial Safety, a Japanese Governmental Organization.)

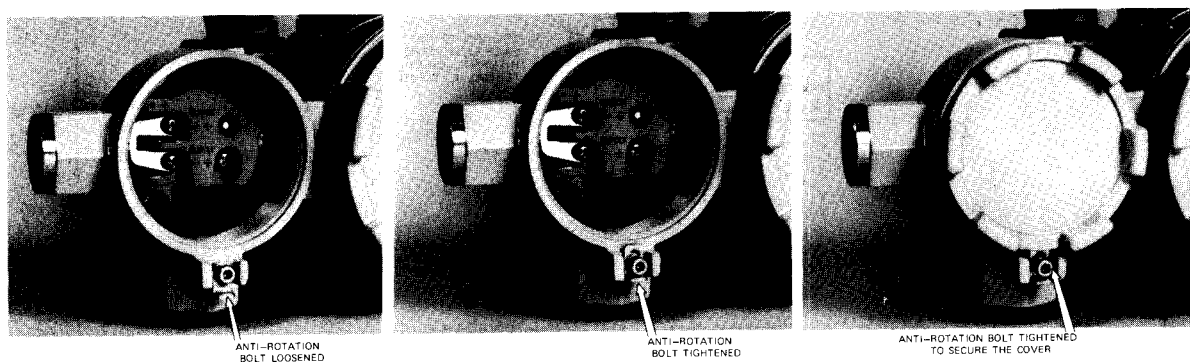


Figure 8. To secure the cover

7.3 Electrical Connections for Intrinsic-safety Instrument

An intrinsic-safety explosionproof feature can be attained by using this instrument in conjunction with the 8907 Zener Barrier safety devices. For details, refer to Technical Guidance RIIS-TR-76-1 issued by the Industrial Safety Institute. For the 8907 Zener Barriers, refer to Instruction Manual OM2-326-890.

OPERATION METHOD

To operate the transmitter, observe the following procedure:

1. Check that piping and wiring are correctly done.
2. If the transmitter is with a meter, remove the cover of the meter and adjust the meter pointer to a leftward mark point of the zero scale point by means of the meter adjustment screw. (See Figure 1.)
3. Turn on the transmitter power.
4. Zero point check and adjustment:

When the instrument has become the measuring state, check and adjust the zero point as explained in the following. (Also see Figures 2 and 3.)

Connect a precision milliammeter to the receiver or transmitter CHECK terminals. Under this state, check the zero point and, if it has been shifted, adjust it with the fine zero adjustment screw.

5. Damping adjustment:

If the output signal abnormally pulsates due to pulsation of the input pressure, make damping adjustment by means of the damping adjustment screw shown in Figure 3. The damping adjustment screw rotates for 270 degrees of angle, with its counterclockwise extreme position for the minimum damping and its clockwise extreme position for the maximum damping.

When span adjustment and zero adjustment are done, the damping adjustment screw should be set at the counterclockwise extreme position (for the minimum damping) for ease of such adjustment.

6. Never loosen any clamping-screws of the blind board and milliammeter board in the transmitter when it is in operation (power is being applied). If they are loosened, the instrument power may be turned off and the output signal may be lost.

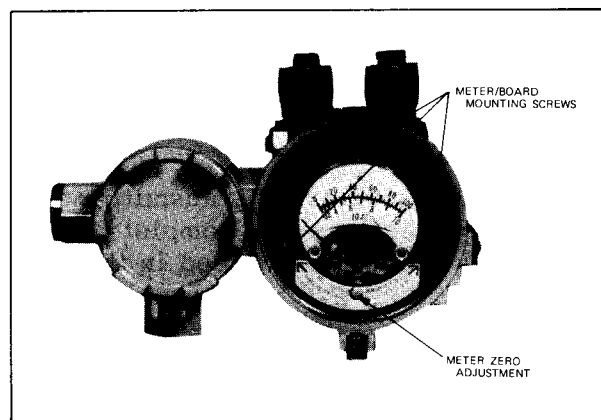


Figure 1. Zero adjustment of meter

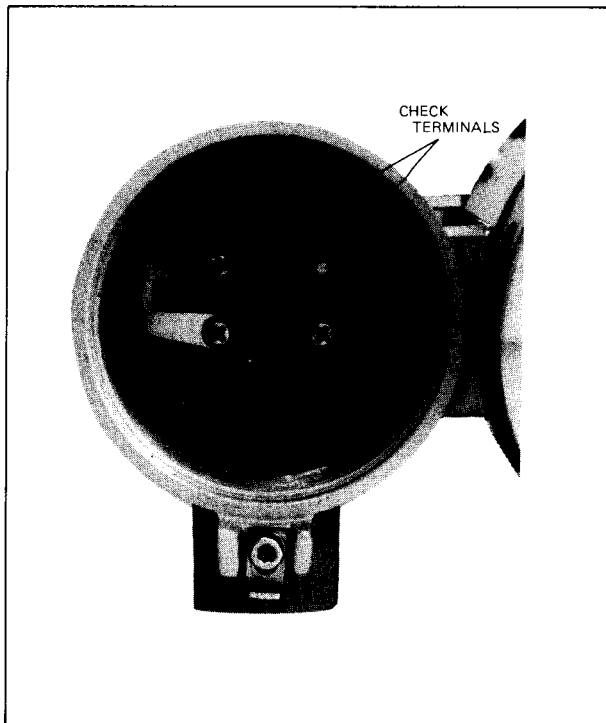


Figure 2. CHECK terminals

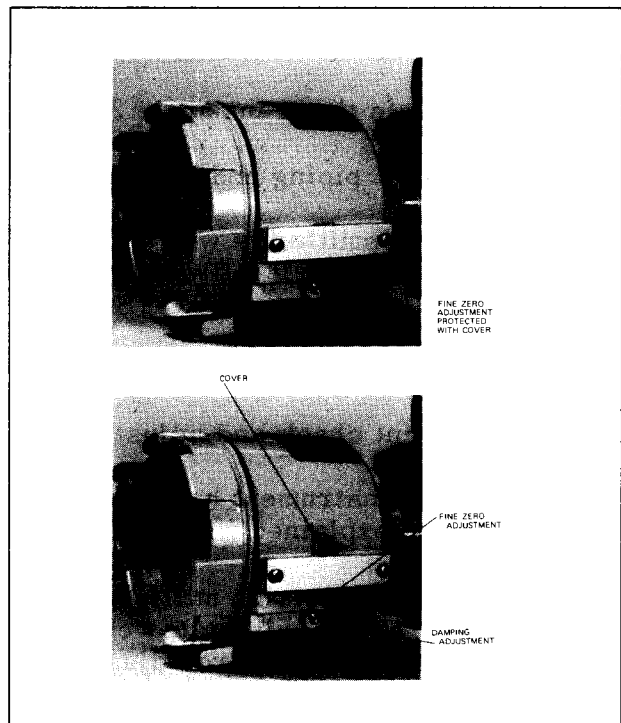


Figure 3. Fine zero adjustment and damping adjustment

7. Operation Method

7.1 When Model KDI51, 52 or 53 transmitter is installed for an open tank, the instrument is ready for operation when its installation and electrical connections are complete.

In the case of a closed tank level measurement with gas seal, proceed as follows after electrical connections for the instrument are complete:

- (1) Close the stop valve
- (2) Close the blow valve
- (3) Open the valve which is installed between the volume pot or drain pot and the tank

7.2 In the case of Model KDI61, 62 or 63 transmitter, after it has been installed and its electrical connections are complete, fill the pipe of the high pressure side with seal liquid and then proceed in the steps as shown in Subsection 7.1.

CALIBRATION AND ADJUSTMENT

1. PREPARATION FOR CALIBRATION

- 1.1 To calibrate the transmitter, prepare a device which can accurately measure the input pressure (or differential pressure such as a water column with vernier, a mercury column, or a digital pressure meter.
- 1.2 To provide a stable input pressure, prepare such device as a pressure cylinder. (Release the low pressure side to atmosphere and apply the pressure to the high pressure side.)
- 1.3 The indicating meter of the transmitter cannot measure the output very accurately. Prepare an accurate milli-ammeter externally.
- 1.4 Note that the calibration accuracy depends on the accuracies of the devices used for calibration.
- 1.5 Make electrical connections as shown in Figure 1.

2. CALIBRATION PROCEDURE

- 2.1 Position the transmitter in such attitude that its pressure receiving diaphragm is positioned vertically.
- 2.2 To perform the following calibration, turn the damping adjustment screw outside the case to the counterclockwise extreme position with a screwdriver.
- 2.3 Zero Adjustment
 - 2.3.1 Set the input pressure at zero.
 - 2.3.2 A small amount of zero shift, such as caused by the mounting height of the instrument, can be compensated for by turning the fine zero adjustment screw from outside of the case using a screwdriver. The output increases as the fine zero adjustment screw is turned clockwise.
 - 2.3.3 When zero adjustment more than that can be covered with the fine zero adjustment screw is required after disassembling and reassembling the instrument or replacing the amplifier or when the zero point is required to be largely varied for elevation or suppression, make zero adjustment with the internal coarse zero adjustment switch (see Figure 1) and the external fine zero adjustment screw in the following procedure:
 - (a) Set the fine zero adjustment screw in a midposition of its adjustment range. (This screw rotates 22 turns. Rotate it 11 turns from an extreme position.)
 - (b) Adjust the output at approximately 4 mA with the coarse zero adjustment switch.
 - (c) Adjust the output at 4 mA with the fine zero adjustment screw. The output increases as this screw is turned clockwise.
- 2.4 Span Adjustment

Span adjustment can be easily done with the following procedure.

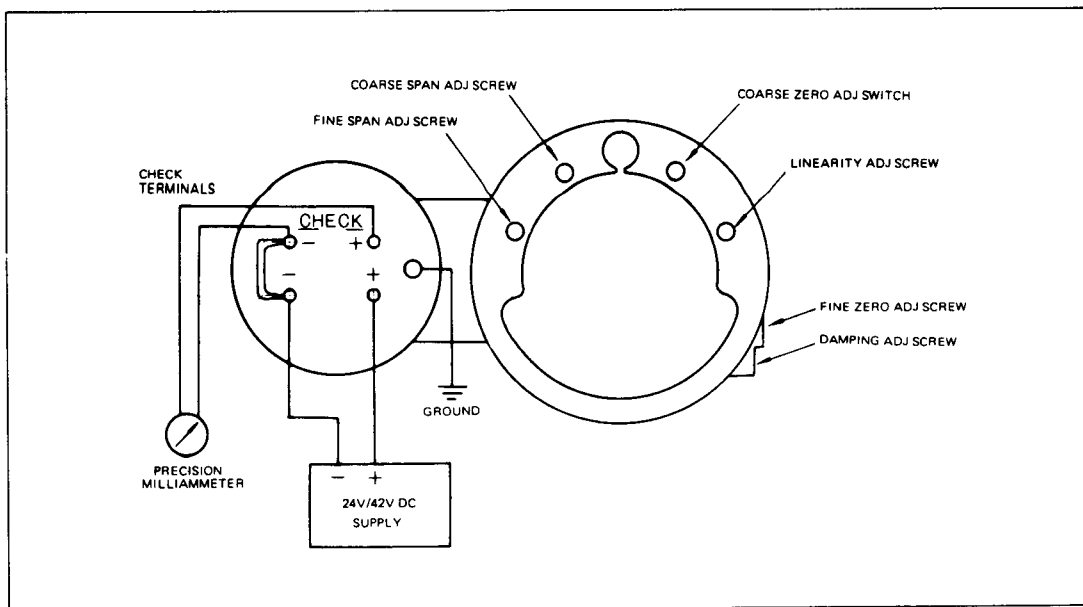


Figure 1. Calibration setup and adjustments

2.4.1 After zero adjustment is complete, apply an input for 100% of span.

2.4.2 Calculate a value of 1/4 of the difference between the above input value and 20 mA.

2.4.3 Adjust the output at 20 mA with the coarse and fine span adjustment screws in the case with a screwdriver. (See Figure 1.) Then, shift* the output by the amount calculated in Step 2.4.2.

* If the output is larger than 20 mA, reduce the output; if it is smaller than 20 mA, increase the output.

2.4.4 Set the input at zero and repeat zero adjustment.

2.4.5 If the result of span adjustment is unsatisfactory yet, repeat the procedure of Steps 2.4.1 to 2.4.4.

Calculation formula:

$$\text{Output after adjustment} = 20 \text{ (mA)} - \frac{(\text{Output before adjustment}) - 20 \text{ (mA)}}{4}$$

Example:

Assume that the output is 21.24 mA when an input of 100% of span is applied after zero adjustment is complete. First, calculate 1/4 of the difference between the output and 20 mA as follows:

$$\frac{21.24 - 20}{4} = 0.31 \text{ (mA)}$$

CALIBRATION AND ADJUSTMENT

Next, adjust the output at 20 mA with the coarse span adjustment switch and fine span adjustment screw. Then, reduce the output by 0.31 mA or set it at $20 \text{ (mA)} - 0.31 \text{ (mA)} = 19.69 \text{ (mA)}$. If no satisfactory result is obtained still, repeat the procedure once more.

2.4.6 If no satisfactory accuracy is obtained when the above adjustment is done, perform the following adjustment.

- (a) So adjust the span that the deviation between the maximum deviation points of " + " side and " - " side is made minimum.
- (b) Adjust the linearity as per Subsection 2.8.

2.5 Elevation/suppression Adjustment

The amplifier can be used in common for elevation and suppression. Change between elevation and suppression can be done by changing the insertion positions of the connector on the printed circuit board as follows:

For high elevation: Insert the 2-pin connector (jack) at position E.

For high suppression: Insert the 2-pin connector (jack) at position S.

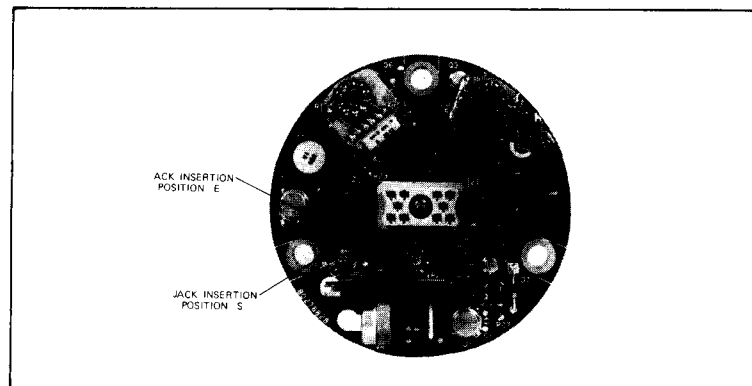


Figure 2. Change between elevation and suppression

a) Elevation adjustment

First, apply to the high pressure side of the meter body an input pressure corresponding to the amount of elevation. Under this state, perform zero adjustment as explained in Subsection 2.3. For span adjustment, apply an input pressure corresponding to the sum of the measuring span plus the amount of elevation and, under this state, perform span adjustment as explained in Subsection 2.4. Note that the sum of the measuring span plus the amount of elevation must not exceed the maximum measuring range of the instrument.

b) Suppression adjustment

For suppression application, the transmitter is so assembled that the high pressure side is located to the left and the low pressure side to the right as viewed from the transmitter front. For zero and span adjustment in this case, proceed as follows:

- o For zero adjustment, apply a 100% span input to the high pressure side and adjust the zero point as explained in Subsection 2.3.
- o For span adjustment, perform the procedure of Subsection 2.4 interchanging the figures between 0% and 100%.

Note that the amount of suppression must not exceed the maximum measuring range of the instrument.

2.7 Damping Adjustment

Damping adjustment can be done by rotating the damping adjustment screw from outside of the case with a screwdriver. Damping becomes more effective as the screw is turned clockwise. The total turning angle of the screw is 270 degrees. Do not try to turn the screw exceeding this angle.

2.8 Linearity Adjustment

Linearity adjustment can be done with the linearity adjustment screw in the case. This adjustment has been set at the optimal position for the span at the instrument manufacturer's factory before shipment. This adjustment should not be varied by customer except when unavoidable.

As the linearity adjustment screw is turned clockwise, linearity is varies in the " + " direction; as it is turned counterclockwise, linearity is varies in the " - " direction. The adjustable range is $\pm 1.2\%$ FS at 50% position of the measuring span. After linearity adjustment is done, be sure to perform span adjustment as per Subsection 2.4.

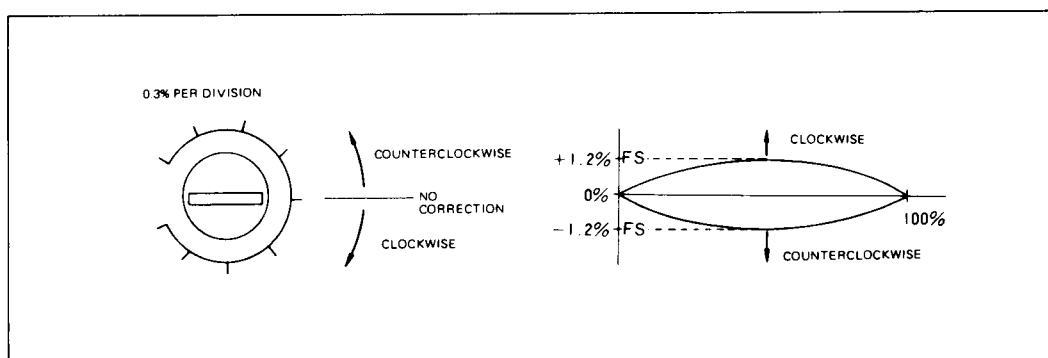


Figure 3. Linearity adjustment

DISASSEMBLY AND REASSEMBLY

1. DISASSEMBLY OF TRANSMITTER SECTION

To remove and put on the cover in a hazardous area, observe the instructions given in the Explosionproof Guidance.

1.1 Removing the Cover

The covers of main unit and terminal box are locked with anti-rotation stoppers. To undo the stoppers, loosen the M4 hex-hole bolts with the L wrench (supplied). Then remove the covers by turning them.

1.2 Removing the Meter (Board)

The meter (board) is clamped with three screws. Undo these screws and then remove the meter.

1.3 Removing the Printed Board

Remove the center screw of the board. Remove the board by raising it and disconnecting it from the connector. Do not pull the board with an excessively large force. (See also the next paragraph.)

The damping adjustment potentiometer and fine zero adjustment potentiometer are provided with a plate for adjustment from outside of the case. Before removing the printed board, set the grooves for the screwdriver horizontal (as faced to the front of the transmitter section). (See Figure 1.) When this is done, the plates also are set horizontal.

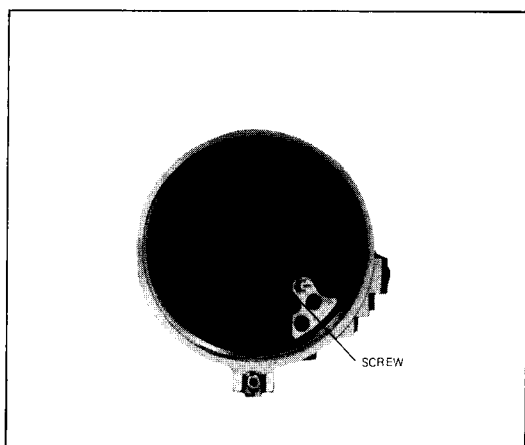


Figure 1.

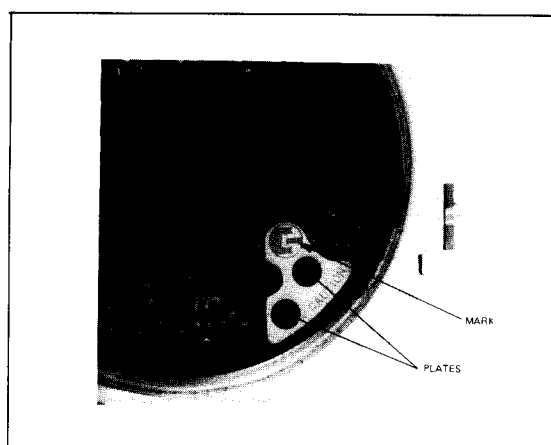


Figure 2. Alignment of potentiometer drive plates

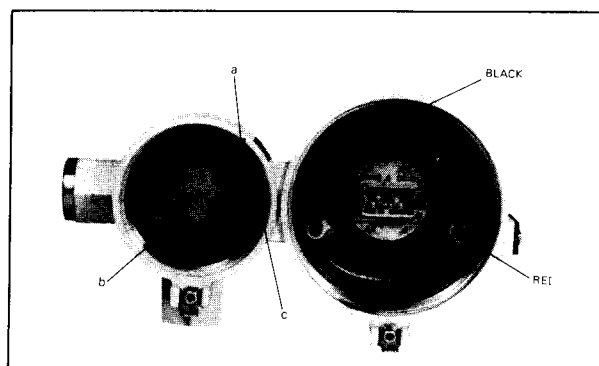


Figure 3.

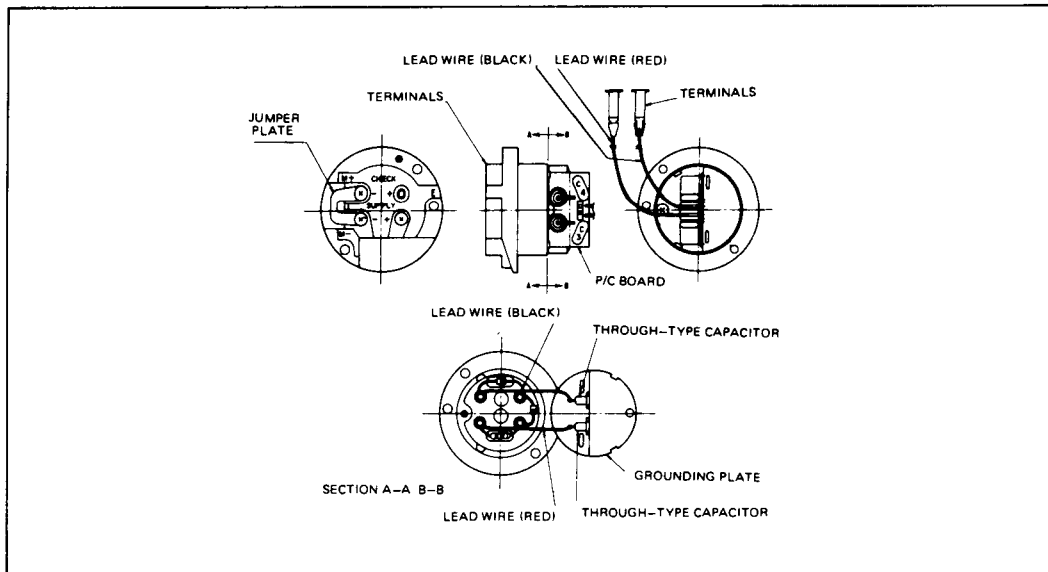


Figure 4

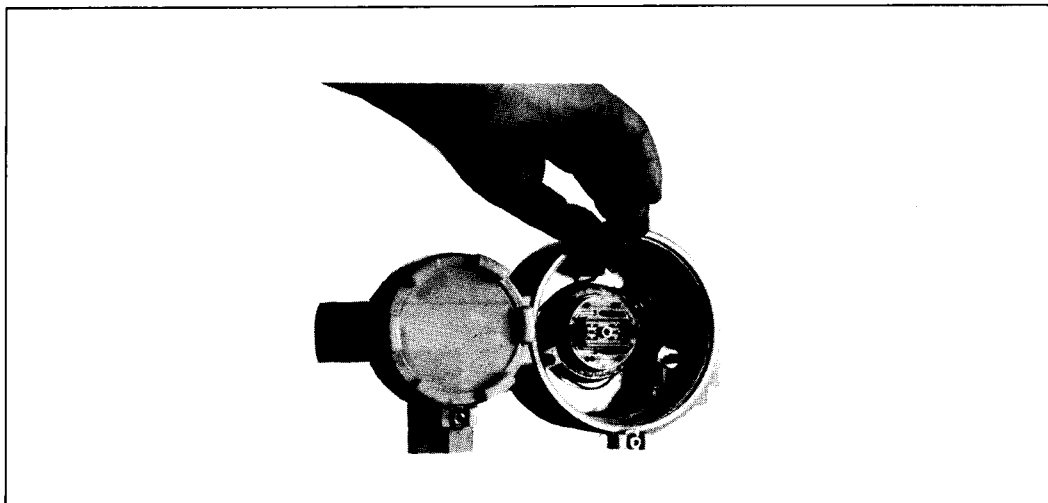


Figure 5. Loosening the bolt

1.4 Removing the Terminal Board (See Figure 3 and 4.)

To remove the terminal board, undo the three screws a, b, and c. A noise killer, a lightning surge absorber circuit board, and leadwires for connection to the amplifier main unit are installed or connected on the back side of the terminal board. When removing the terminal board, pay attention not to damage these components and leadwires on the back of the terminal board.

The metallic plate on which the through-type capacitor is mounted and which is located at the rear of the terminal block plays a role as a grounding plate. Be careful not to bend or deform this metallic plate.

DISASSEMBLY AND REASSEMBLY

1.5 Removing the Meter Body (See Figure 5.)

The meter body is fixed to the case with a single special bolt. This bolt has eight 5.2 mm holes around its head. To loosen the bolt, insert on appropriate bars in an appropriate one of the holes and turn the bolt. After removing the bolt, remove the pressure receiving section by pulling the case to the front side.

Note: Of a transmitter with suppression, the meter body may be installed in the reverse direction. Then, the H-side connection port is located in the left-hand side as viewed from the instrument front. When reassembling the instrument, make it sure that the meter body installed in the correct direction. See to "INSTALLATION" 7.1.4.

2. REASSEMBLY OF TRANSMITTER SECTION

2.1 Reassembly of Case and Meter Body

Fix the meter body to the case with the bolts. (See Section 1.5.)

2.2 Reassembly of Terminal Board

Pass the red leadwire and black leadwire from the terminal box to the main unit. Pulling lightly the leadwires, place the terminal board in the correct position and fix it with the three screws.

When the terminal board is assembled, the bent angle of the metallic plate (grounding plate) will be slightly open. The leaf-spring action of the metallic plate maintains the grounding path. Make it sure that the metallic plate is contacting with the instrument casing.

2.3 Reassembly of Printed Board

Make it sure that the red leadwire and black leadwire are positioned as shown in Figure 3. Set the slits of the damping adjustment potentiometer and zero adjustment potentiometer as shown in Figure 2. Keep the zero adjustment plate outside of the case in the removed state as explained in Subsection 1.3. Observing through the hole of the printed board that the slits of the potentiometers are aligned with the external adjustment key plates, slowly tighten the center screw so that the connector is gradually and securely connected.

2.4 Reassembly of Meter (Board)

Set the holes of the meter (board) on the bushings of the printed board reassembled in Subsection 2.3 and fix the meter with the three screws with a tightening torque of 15 kgf-cm.

2.5 Reassembly of Covers

Place the O ring to each of the main unit and terminal box, and tightly secure the covers until the O rings are flattened. Next, set the anti-rotation stoppers to the grooves of the covers and fix them with the M4 hex socket bolts using the L wrench.

3. DISASSEMBLY AND REASSEMBLY OF METER BODY

The covers of any model of instrument are fixed with bolts. To remove the covers, remove these clamping-bolts. When doing this, be careful not to press or damage the diaphragm section.

When reassembling the instrument, replace the teflon seal gasket with a new one as required. For the tightening torque of the clamping-bolts, see the following table.

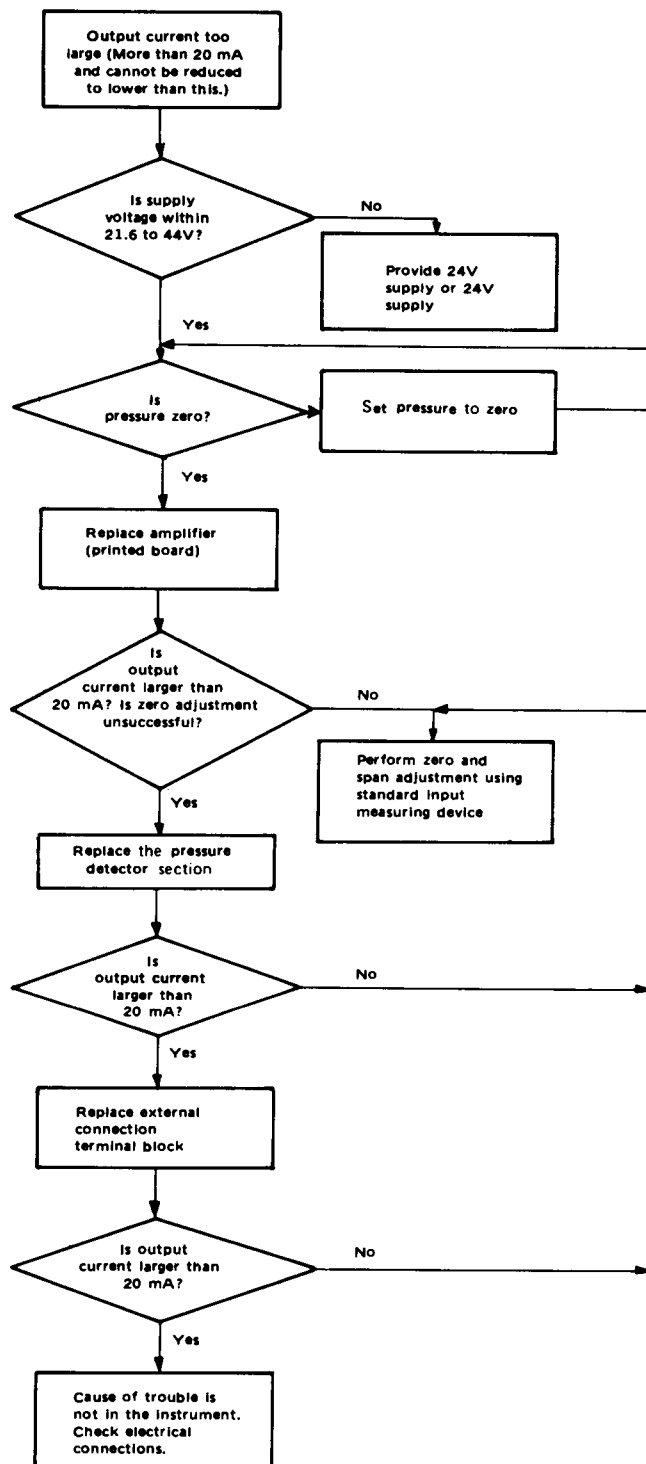
Material of bolts	Tightening torque (kgf-cm)	
	When new gasket is used	When old gasket is reused
SNB7	440 \pm 20	300 \pm 15
SUS304	440 \pm 20	200 \pm 10

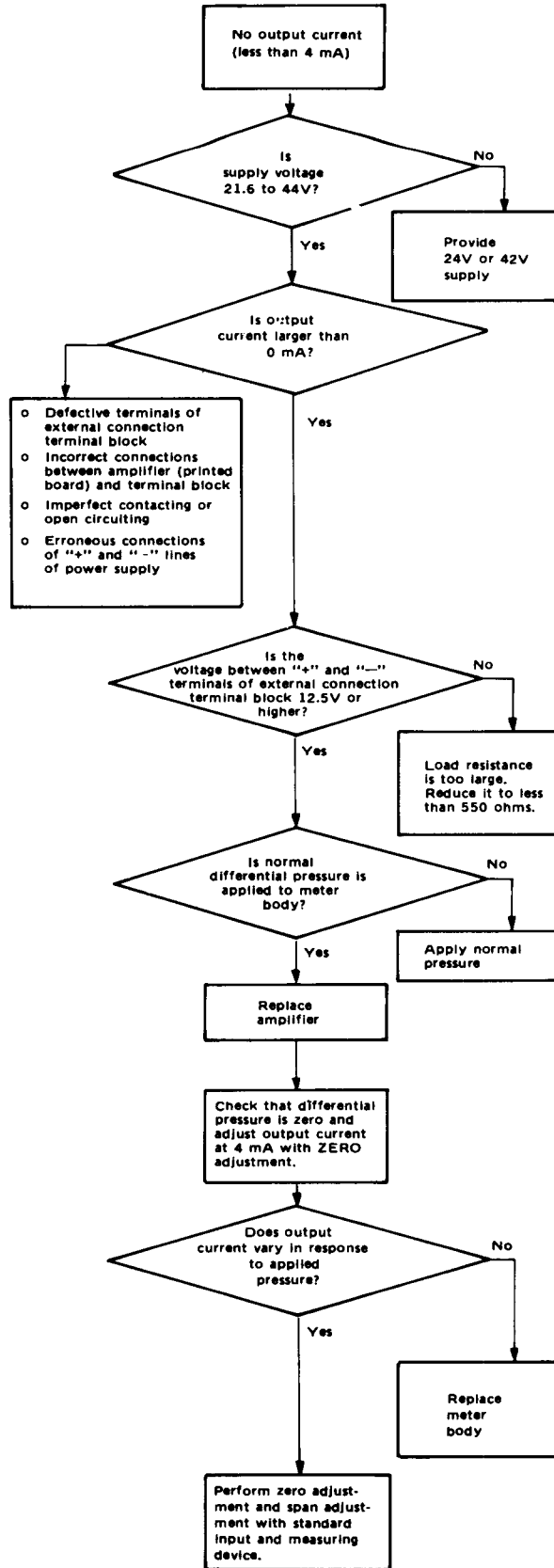
TROUBLE SHOOTING

Typical symptoms of troubles are as mentioned in the following. Localize the causes of troubles referring to the troubleshooting flowchart.

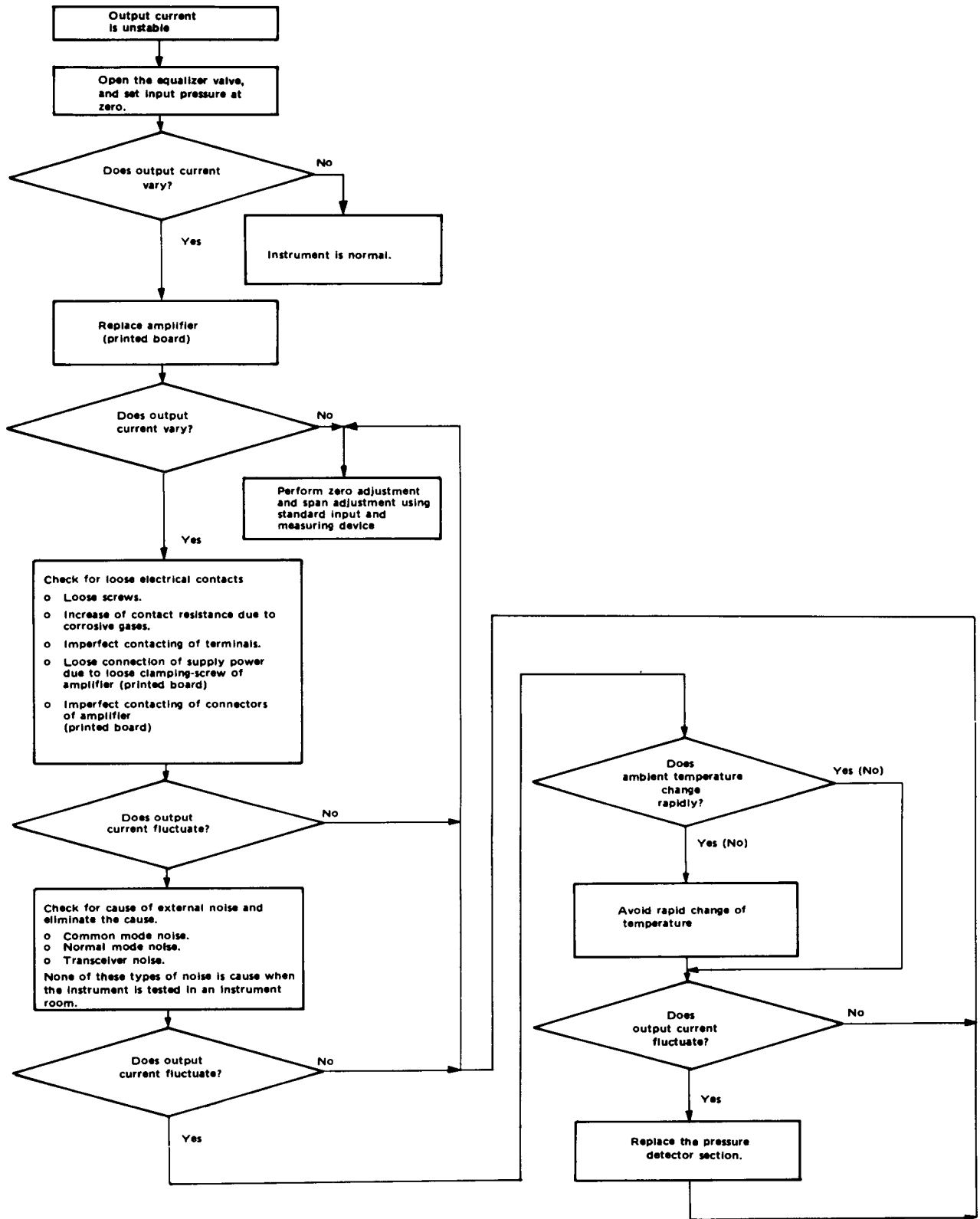
1. Output current too large
2. Output current too small
3. Output current unstable

Note: For replacement spare components and parts, please contact your Yamatake dealer.





TROUBLE SHOOTING



INSPECTION AND MAINTENANCE

For routine inspection and maintenance, pay attention to the following:

1. CHECK FOR LEAK FROM PIPING

Check that there is no leak in the piping from the pressure tap points to the transmitter. If any loose connections are found, tighten them securely.

2. BLOW AND CLEANING OF TRANSMITTER AND PIPING

To maintain constantly the instrument at its best performances meeting its specification accuracy, keep clean the transmitter and its piping. If sediment or other foreign matters are entrapped in the pressure chambers of the transmitter, measuring errors may be caused. To blow and clean the instrument and piping, proceed as mentioned in the following.

2.1 Blow and Drain

To blow and drain the instrument, proceed as follows:

- (1) In the case of an open tank level measurement, drain the instrument by loosening the drain plug underneath the low pressure side cover at appropriate intervals.
- (2) In the case of a closed tank level measurement with gas seal, close at first the stop valve of the pipe of the low pressure side and then drain the instrument as explained in Item (1) above.
- (3) In the case of a closed tank level measurement with liquid seal, check the seal liquid level and replace seal liquid at appropriate intervals.

First, close the stop valve of the high pressure side, open the blow valve, loosen the drain plug, and drain out the seal liquid. Next, close the drain plug, pour seal liquid from the blow valve until it overflows, and then close the blow valve. Finally, close the stop valve.

2.2 Cleaning of Meter Body

Proceed as described in the following.

- (1) Remove the cover of the meter body by removing its clamping-bolts.
- (2) Clean the diaphragm and the inside of the cover using soft brush and detergent. When doing this, be extremely careful not to deform or damage the diaphragm.
- (3) When reassembling the cover, replace gasket with new one as required.
- (4) Fix the clamping-bolts of the cover with the specified tightening torques. (For details, see Section 3 of Part "DISASSEMBLY AND REASSEMBLY.")

2.3 Notes for Use in Freezing Season

When the transmitter used for measurement of water or other freezable liquid is paused in a freezing season or area, loosen the drain plugs and drain out liquid from the pressure chambers to prevent freezing.

3. INSULATION RESISTANCE TEST AND WITHSTANDING VOLTAGE TEST (Only for instrument without lightning arrester)

As general rule, do not perform any insulation resistance test or withstanding voltage test in order to avoid damage to the surge voltage suppression varistors. If such test is unavoidable, test the instrument observing the following instructions:

- (1) Disconnect the external electrical connections from the transmitter.
- (2) Short together the transmission line connection terminals "+" and "-", and external ammeter connection terminal "+".
- (3) Test the instrument by apply the test voltage between the shorted line of (2) and the ground.
- (4) Voltage application and the standard for judgement must be as mentioned below. In order to avoid damage to the instrument, do not apply voltages higher than that mentioned below.

Insulation resistance test: $2 \times 10^7 \Omega$, 25V DC

Withstanding voltage test: 50V AC, 1 minute, current setting 5 mA

If a voltage higher than the above is required to be applied (500V DC for insulation resistance test; and 500V AC, 1 minute, or 600V AC, 1 minute), isolate the terminal block and eliminate contacting of metallic parts.

4. CHECK OF SURGE VOLTAGE SUPPRESSION VARISTORS

To protect the internal circuits of the instrument against external surge voltage, zinc oxide varistors are used. Check these varistors as required.

For the standard instrument (without lightning arrester), one varistor is connected between the output terminals. For the instrument with lightning arrester, one varistor is connected between output terminals and two varistors are connected between the two output lines and the ground line.

To check the varistors, remove the printed circuit board (amplifier) as explained in Subsection 1.3 of Part "DIASSEMBLY AND REASSEMBLY." and then proceed as explained in the following.

INSPECTION AND MAINTENANCE

4.1 For Regular Type (without lightning arrester)

Check varistor RV1 as follows: Connect a current test setup between SUPPLY " + " terminal and SUPPLY " - " terminal (or M " - " terminal) as shown in Figure 1 and feed a current of 1 mA. Determine the voltage between SUPPLY " + " terminal and M " + " terminal. Varistor RV1 is normal if the voltage is 74 to 90 V.

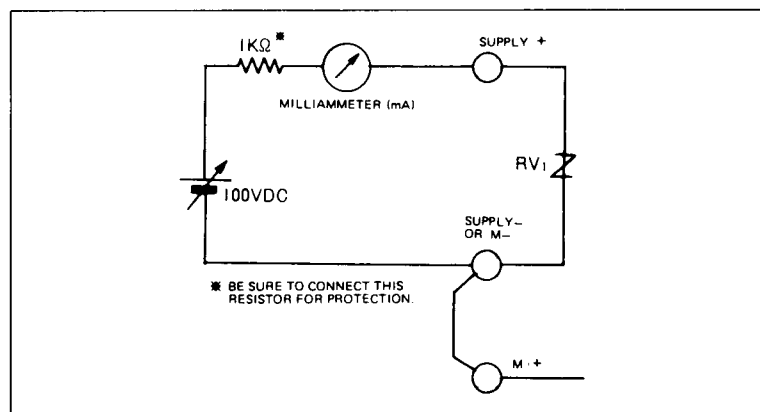


Figure 1.

4.2 For Instrument with Lightning Arrester

First, check Varistor RV1. In the same procedure as is the case of Subsection 4.1, feed a 1 mA current and determine the voltage between the ends of the leadwires (red wire and black wire) with the printed circuit board removed. Varistor RV1 is normal if the voltage between red wire (" + ") and black wire (" - ") is 74 to 90 V.

Next, check varistors RV2 and RV3 as follows: Feed a 1 mA current with the same test setup as is the case of Subsection 4.1 to between SUPPLY " + " terminal and ground terminal and between SUPPLY " - " terminal and ground terminal, with the ground terminal as the negative polarity in either case. Varistors RV2 and RV3 are normal if the voltages measured between the terminals through which the 1 mA current is fed are 74 to 90 V. (See Figure 2.)

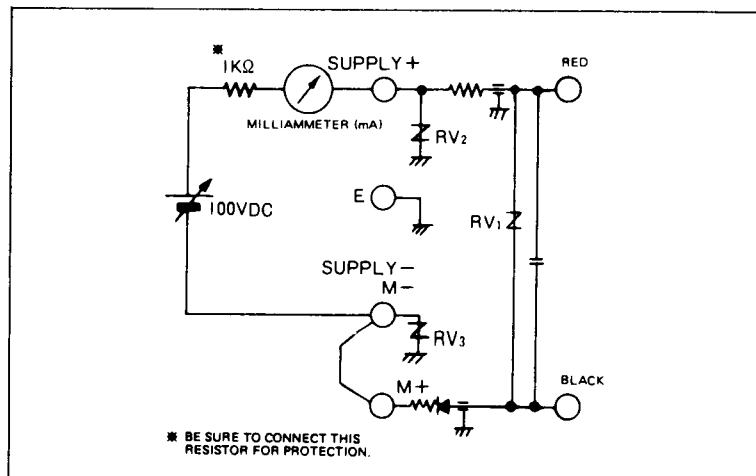
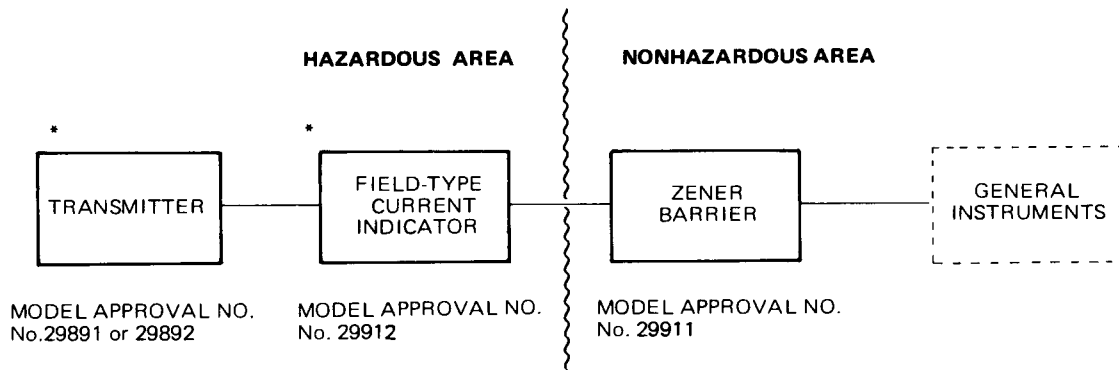


Figure 2.

INTRINSIC SAFETY FEATURE

The structure and conditions of installation of the intrinsic-safety explosion-proof system with transmitter (KDI or KKI), field-type current indicator (NW35-□H-□), and Zener barrier (8907/51-24/25) are as follows:

1. System Structure



* Combination of either transmitter or field-type current indicator with Zener barrier.

2. Of the external electrical circuits connected to the intrinsic-safety explosionproof circuit, inductance must not be greater than 4 mA and capacitance must not be greater than 24 nF.
3. Pay attention so that other electrical devices and connections which relate to the explosionproof circuit do not impair its intrinsic-safety explosionproof feature.
4. Of the general instruments, the voltages and currents fed to them or induced in them must not be greater than 500V, 30A, respectively.
5. The Zener barriers must be installed in a non-hazardous area and they must be provided with an independent grounding work or an equivalent one.

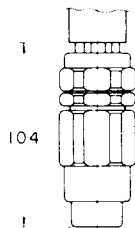
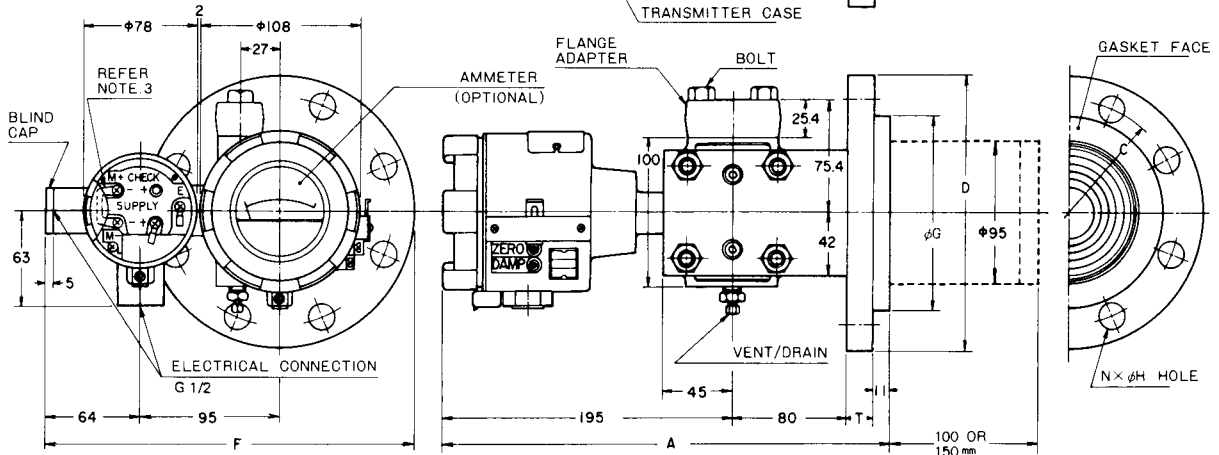
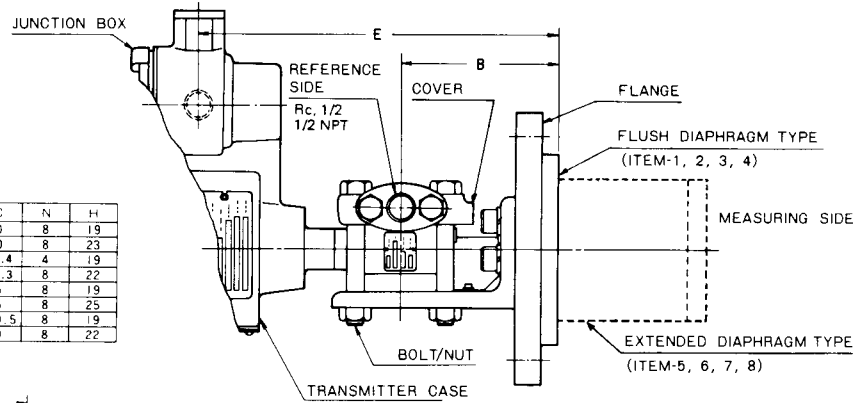
EXTERNAL DIMENSIONS

OVERALL DIMENSION

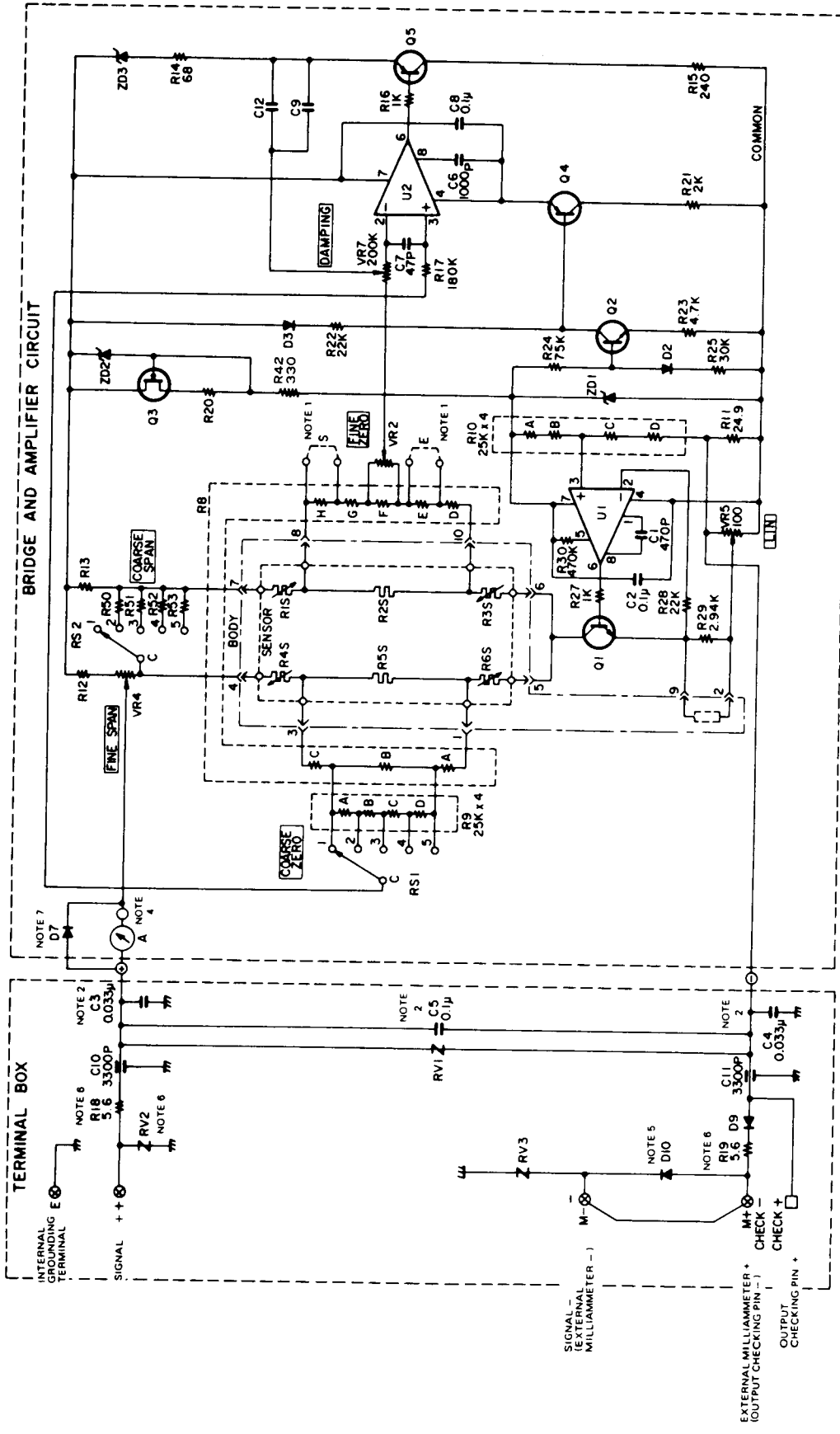
ITEM	A	B	E	F
1	304	109	246.5	251.5
2	314	119	256.5	264
3	309.9	114.9	252.4	254
4	314.6	119.6	257.1	264
5	304	109	246.5	264
6	318	123	260.5	279
7	309.9	114.9	252.4	273.5
8	317.8	122.8	260.3	286

FLANGE DIMENSION

ITEM	FLANGE RATING	φD	φG	T	C	N	H
1	80mm-JIS 10K	185	130	18	150	8	19
2	80mm-JIS 30K	210	130	28	170	8	23
3	ANSI 150	191	130	24	152.4	4	19
4	ANSI 300	210	130	29	168.3	8	22
5	100mm-JIS 10K	210	157	18	175	8	19
6	100mm-JIS 30K	240	157	32	195	8	25
7	ANSI 150	229	157	24	190.5	8	19
8	ANSI 300	254	157	32	200	8	22



FLAME-PROOF
PACKING TYPE
CABLE CONNECTING
ADAPTER



- Notes:
1. For high elevation specification instrument, short between pins E.
 2. For high suppression specification instrument, short between pins S.
 3. C3, C4 and C5 are eliminated for the intrinsic-safety explosionproof specification instrument.
 4. C12 is provided only for the high damping specification instrument.
 5. D10 is provided only for the instrument which has the interlock switch.
 6. R18, R19 and RV2 are provided only for the instrument with lightning arrester.
 7. D7 is for protection in case of open circuit of meter A section. It is not for switching the circuit when the meter is disconnected.
 8. All potentiometers are of the CW characteristics.

Schematic diagram of DSTJ 8000 Transmitter

