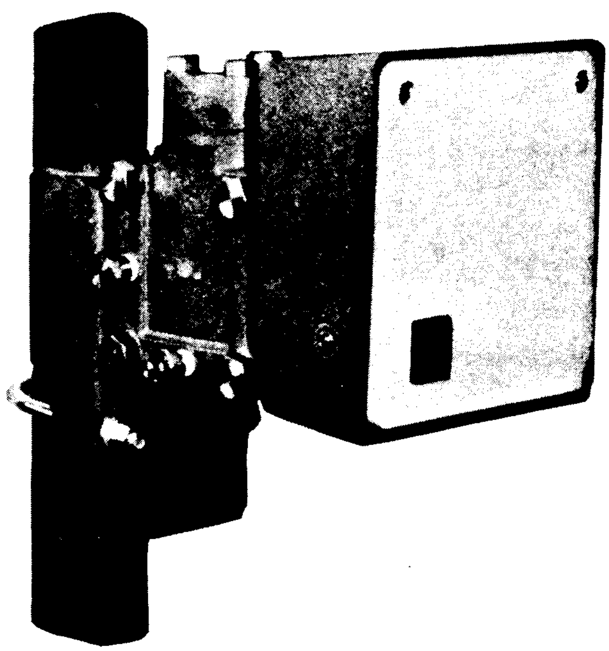
OM2-512-110

Yamatake-Honeywell OPERATOR'S MANUAL

PNEUMATIC DIFFERENTIAL PRESSURE (ΔP/P) TRANSMITTERS MODELS: NDP11, 22



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Tokyo, Japan

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PNEUMATIC
DIFFERENTIAL PRESSURE
(ΔP/P) TRANSMITTER
MODEL: NDP11,22

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DESCRIPTION

1. GENERAL

The pneumatic differential pressure ($\Delta P/P$) transmitters (NDP 11,22) consist of a low-volumetric-displacement meter body and a pneumatic transmitter with higher responsibility. The meter body senses differential pressure ranging from 0-5,000 mm H_2O to 0-50,000 mm H_2O (NDP 11) or from 0-500 mm H_2O to 0-6,500 mm H_2O (NDP 22) which is converted into a proportional pneumatic signal of 0.2-1.0 kg/cm^2. The output can be transmitted to any suitable pneumatic receiver having a range of 0.2 to 1.0 kg/cm^2 for recording. Intended primarily for measuring flow, the system can also measure specific gravity or liquid level in open or closed vessels by simply adding suppression or elevation spring and measure process pressure with one side of pressure chamber vented to atmosphere. Compact construction realizes easy installation and maintenace and high accuracy.

2. FEATURES

(1) For process connections, either one of top, bottom or rear connection can easily be selected at site by changing the end cover of the meter body. The meter body is mounted on horizontal or vertical 2-inch piping, using the U-bolt and universal mounting bracket supplied.

(2) Since corrosion-resistant seal diaphragms are employed in the differential pressure detector section (meter body) to insulate the operational mechanism from process fluid, the instrument can also be used in safety for corrosive fluid.

(3) Very low-volumetric-displacement of the meter body results even in flow or liquid level measurement without condenser pots or seal pots.

(4) Because of materials, such as tantalum, monel and the like, of process interface, measurements in almost all corrosive fluids induding chlorine, hydrochloric acid or sulfric acid are available.

(5) Providing the center section of the meter body wide over load seals for both high and low pressure sides, the instrument assures safety against malfunction.

(6) Extremely wide range of damping adjustment can easily be obtained. The damping adjustment knob is housed in the center section of the meter body and changes from maximum to minimum damping by 1/2 turn, which is visually confirmed on the scale. This results the indication, recording and control in optimum condition by eliminating the process fluctuation. The damping adjustment restriction is so constructed that it cannot be closed completely for safety in operation.

(7) For maintenance work, simply cleaning up the surface of seal diaphragms are required, and cleaning up the center section of the body and transmitter unit are performed with them mounted. After these works, the instrument can immediatly be placed in operation without readjustment.

(8) Span and zero adjustments, suppression and elevation can be performed with ease over a wide range. Zero adjustment is available externally without removing the cover.

DESCRIPTION

(9) The transmitter casing and meter body cover are mounted on the center section of the body independently of the center section of the body and force-balance mechanism, therefore, the measuring accuracy is not affected due to stress on the connection piping.

3. SPECIFICATIONS

Measuring range:	NDP 11 ; 0-5,000 mm H_2O to 0-50,000 mm H_2O NDP 22 ; 0-500 mm H_2O to 0-6,500 mm H_2O (Adjustable within ranges for each model)	
Supply air pressure:	1.4 $\pm$ 0.1 kg/cm^2	
Output:	0.2 to 1.0 kg/cm^2	
Air connection:	PT 1/4 (ISO R7 1/4") or NPT 1/4 tap thread	
Process connection:	PT 1/2 (ISO R7 1/2") or NPT 1/2 tap thread for cover materials of carbon steel, SUS 316 st. st. and Titanium. PF 1/2-A (ISO R228 1/2") tap thread for cover materials of Monel lining and Tantalum lining.	
Process connection position:	Top, bottom or rear of meter body	
Pressure limit:	-0.5 to + 100 kg/cm^{2}G	
Overload protection:	Up to 100 kg/cm^2 in either side (HP or LP)	
Temperature limit:	Meter body (process fluid); -40 to + 120 °C Transmitter (ambient); -30 to + 80 °C	
Humidity limit:	10 to 95% RH	
Suppression or elevation: By addition of suppression or elevation spring	Suppression;	NDP11 ... Up to 50,000 mm H_2O NDP22 ... Up to 6,500 mm H_2O
	Elevation;	NDP11 ... Up to 45,000 mm H_2O NDP22 ... Up to 6,000 mm H_2O
	(Span plus elevation: Up to maximum range) indicated above	
Damping adjustment:	Continuously adjustable (Time constant is 30 sec. or more at maximum damping)	
Materials of process interface section:	Meter body cover;	Carbon steel (SF 45) or SUS 316 st. st. Monellining (base SUS 316, pressure limit 70 kg/cm^{2}G), Tantalum living (base SUS 316, pressure limit 70 kg/cm^{2}G), Titanium (pressure limit 50 kg/cm^{2}G) and PVC (pressure limit-0.1 to + 15 kg/cm^{2}G and temperature limit 0 to 55 °C)
	Seal diaphragm;	SUS 316 st. st., Monel, Tantalum and Titanium
	Wet part gasket;	Teflon
	Transmitter case;	Aluminum die-cast

Accuracy:	± 0.5% FS
Hysteresis:	Within 0.5% FS
Dead band:	Within 0.1% FS
Zero shift due to change in static pressure:	± 0.5% FS (at static pressure 35 kg/cm^2 and minimum measuring range) ± 2.5% FS (at static pressure 100 kg/cm^2 and measuring range) These changes can be eliminated by zero adjustment
Meter body volumetric displacement:	NDP 11 ; within 0.2 cc (at max. measuring range) NDP 22 ; within 1.6 cc (at max. measuring range)
Air consumption:	Within 4 l/min (at balanced 100% output)
Weight	Approx. 10 kg (Add 1.8 kg for air-set and 2 kg for integral orifice assembly)

4. TRANSMITTER SECTION

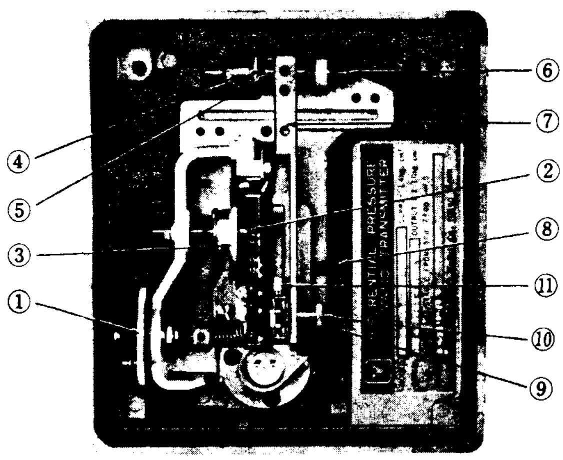
4.1 FUNCTION

a. In this transmitter, a pneumatic-balance beam system and pilot relay convert differential pressure into proportional penumatic signals in the range of 0.2 to 1.0 kg/cm^2.

b. The output of the transmitter can be connected to any pneumatic receiver for recording, indicating, integrating, or controlling the measured variable.

4.2 COMPONENTS

a. Case. The weatherproof die-cast aluminum case is suitable for either indoor or unsheltered outdoor locations. The cover, of scratch-resistant glass-reinforced polyester, is easily removed by releasing two captive screws. A bleed hole in the back of the case makes the transmitter completely selfpurging.



LEGEND

1. Zero adjustment
2. Secondary beam
3. Rebalancing capsule
4. Nozzle
5. Baffle
6. Reverse overload stop
7. Primary beam
8. Capsule tubing
9. Nozzle tubing
10. Coarse span adjustment
11. Fine span adjustment

Figure 1. ΔP/P Transmitter, interior view.

b. Internal Components

(1) The transmitting unit and the meter body (described in the following section) are connected at a single fitting through which the torque rod and seal tube pass. Transmitter components are mounted on a die-cast aluminum base plate fastened to this fitting. The transmitter case is fastened to the meter body, independently from the components, so stresses in the connecting piping do not affect the components and accuracy of measurement.

(2) Major internal components are shown in Figure 2. These are: primary and secondary beam assemblies; baffle and nozzle rebalancing capsule. The transmitter is factory-set for the specified differential range. This range can easily be changed in the field by repositioning the span rider on the beam assembly. A scale on the secondary beam indicates various range positions from 0 to 5,000 mm to from 0 to 50,000 mm of water. An additional hex head screw adjustment is provided for fine span trimming. There is also a downscale limit stop; the nozzle acts as an upscale stop. All tubing connections have gas-type fittings. Standard tubing is of neoprene.

(3) The rebalancing capsule, the zero spring, and (when supplied) the suppression-elevation spring are of the same temperature stable nickle alloy as the torque tube.

(4) Zero can be adjusted up to 75% of span either externally or internally. The external screwdriver adjustment is conveniently located on the side of the case.

(5) For liquid level or specific gravity measurement, if no purge is used, a suppression-elevation spring (supplied when specified) can be used to compensate for differences between the pressures of the reference head and the measured liquid head. Spring tension is internally adjusted with a screw. A spring can easily be removed or added in the field.

c. Manifold and Pilot Relay

(1) These parts are located in a recess on the side of the case. The manifold houses a filter and a restriction screw for the pilot relay and has two 1/4" PT female taps, identified as "S" and "O" on the case, to which supply and output pressure connections are made.

(2) The pilot relay is the standard unit used in other Yamatake-Honeywell pneumatic transmitters (J237 flow, N637 temperature, N737 pressure). It contains a double diaphragm and connecting block assembly which acts as a 3.7:1 (approximately) pneumatic amplifier.

d. Accessaries

An air set accessory consisting of a regulator-filter and a gage, a manifold valve and an integral orifice assembly are available as an option. The gage is calibrated from 0 to 2.0 kg/cm^2. The air set assembly mounts on the rear of the transmitter case and extends to the right. It provides a convenient means for regulating the supply to individual transmitters located some distance from the main air supply.

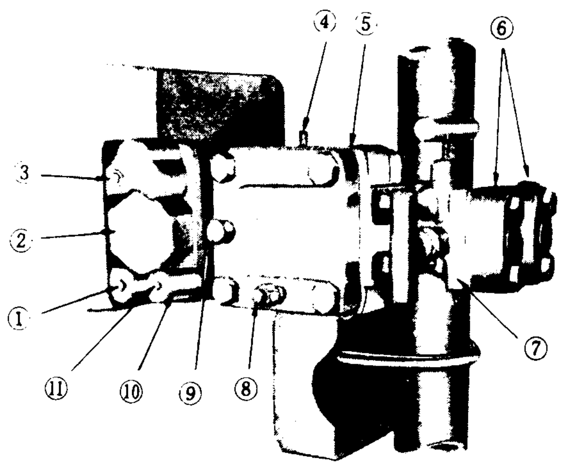


Figure 3 ΔP/P Transmitter, side view

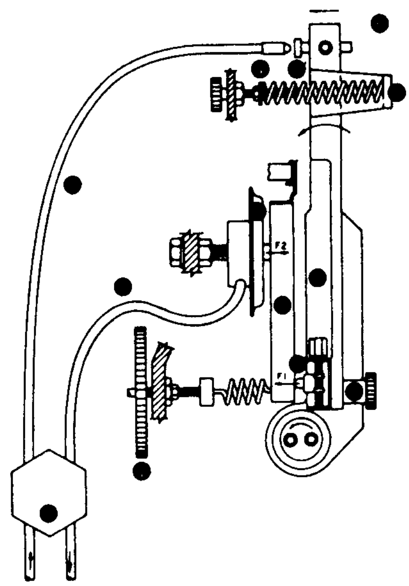
LEGEND

1. Supply air connection
2. Pilot relay
3. Output air connection
4. Damping adjustment
5. Meter body
6. Connecting flanges
7. Manifold valve
8. Vent-drain plug
9. Purge connection
10. Manifold
11. Filter and restriction screw

4.3 OPERATION (See Figure 4)

a. The torque rod from the meter body is connected to the beam system of the transmitter. When the differential pressure increases, deflection of the primary beam (7) carries baffle (5) toward nozzle (4). The resulting increase in nozzle back-pressure, amplified by the pilot relay (12), increases the output pressure. Simultaneously, this increased output is applied to the rebalancing capsule (3) which acts on the secondary beam (2). The force exerted by the secondary beam on the primary beam through span rider (11) rebalances the system. Output is changed by a net amount proportional to the change in differential pressure.

b. When a suppression or elevation spring (13) is supplied, it is adjusted to apply the required equalizing force on the primary beam.



LEGEND

1. Zero adjustment
2. Secondary beam
3. Rebalancing capsule
4. Nozzle
5. Baffle
6. Reverse overload stop
7. Primary beam
8. Capsule tubing
9. Nozzle tubing
10. Coarse span adjustment
11. Fine span adjustment
12. Pilot relay
13. Suppression or elevation spring (Suppression spring is shown on the Figure.)

Figure 4 Schematic of pneumatic transmitting unit.

5. METER BODY SECTION

5.1 PURPOSE

a. The low displacement meter body described in this section can be combined with either an integrally mounted ΔP/P (pneumatic) or ΔP/I (electric) transmitting unit. The selected transmitter is described in a separate section of this instruction.

b. The meter body senses differential pressures from 0 to 50,000 mm of water for NDP 11 and from 0-6,500 mm of water for NDP 22. These are converted by the transmitter into a proportional pneumatic (0.2-1.0 kg/cm^2) output. The range of differential measurement can be adjusted at the transmitter to any value between 0 to 5,000 mm and 0 to 50,000 mm of water for NDP 11 and between 0 to 5,000 mm and 0 to 6,500 mm of water. A receiver capable of translating the output of the transmitter in terms of the measured variable completes the system.

5.2 USE

a. Variations in this system can be used to measured flow, specific gravity, liquid level in open or closed vessels, process pressure.

1) The operating parts of this meter body are never touched by the process fluid. This eliminates the need for seal pots in many applications.

2) The volumetric displacement of the meter body is very small. As a result, there is so little liquid displacement in the connecting piping, that steam flow installations can often be made without condensers, and liquid level installations without level pots.

3) The liquid in the meter body is relatively motionless and, even when the differential changes rapidly, no pumping action occurs to allow suspended matter like coke or tar to enter the connecting piping and pressure chambers. Sediment chambers are seldom needed, lines need be blown less frequently.

b. The same meter body is used with both the ΔP/P pneumatic and the ΔP/I electric transmitting unit. A system can be converted from one type to the other by replacing only the transmitting unit.

5.3 METER BODY COMPONENTS

a. General. The meter body has only three major components; a center section, and two end covers which form the high and low pressure chambers.

b. Pressure Chambers

1) These can be bolted to the center section in any of three positions to make process connections from the top, bottom, or rear. Process

connections are located on 54 mm centers for direct connections to standard flange taps or to a suitable manifold. With the universal mounting bracket, the meter body can be attached to either vertical or horizontal two-inch pipe in any position for the desired location of connections.

2) A combination fitting which can serve either as a vent or drain is provided in each pressure chamber. In addition, there is a 1/4" PT tap in each pressure chamber for connecting a purge when measuring fluids containing suspended matter.

c. Center Section

1) A corrosion-resistant type 316 stainless steel diaphragm separates each of the pressure chambers from the center section. Here, sensing element, torque rod, and seal tube are immersed in an inert non-corrosive silicone fluid (Figure 2).

2) An adjustable damping restriction is located in the fill fluid of the center section, where it cannot become clogged by process fluid. This restriction cannot be completely closed, so there is no danger of the adjustment accidentally causing a "dead" meter.

3) Overload seals, also located in the center section, protect the sensing element from overloads in either direction up to the maximum 100 kg/cm^2G rating of the meter body. If the differential pressure builds up beyond normal on either side of the meter body, the appropriate seal closes. The fill behind the closed seal then increases to the overload pressure, preventing a damaging differential across either the measuring element or the diaphragms. Seals are designed to open quickly when the overload subsides.

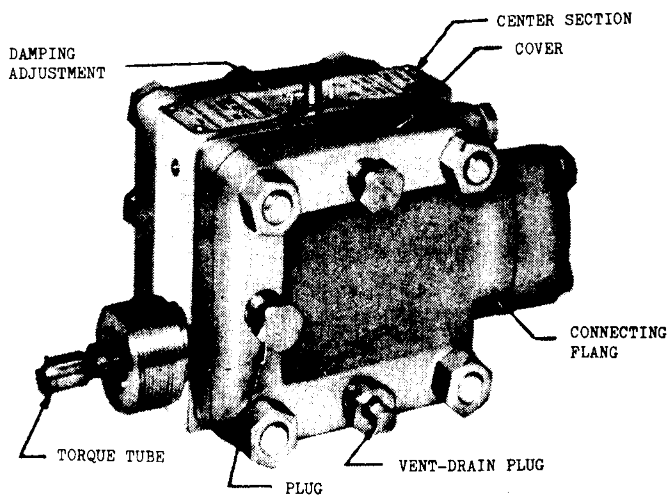


Figure 1. Meter Body

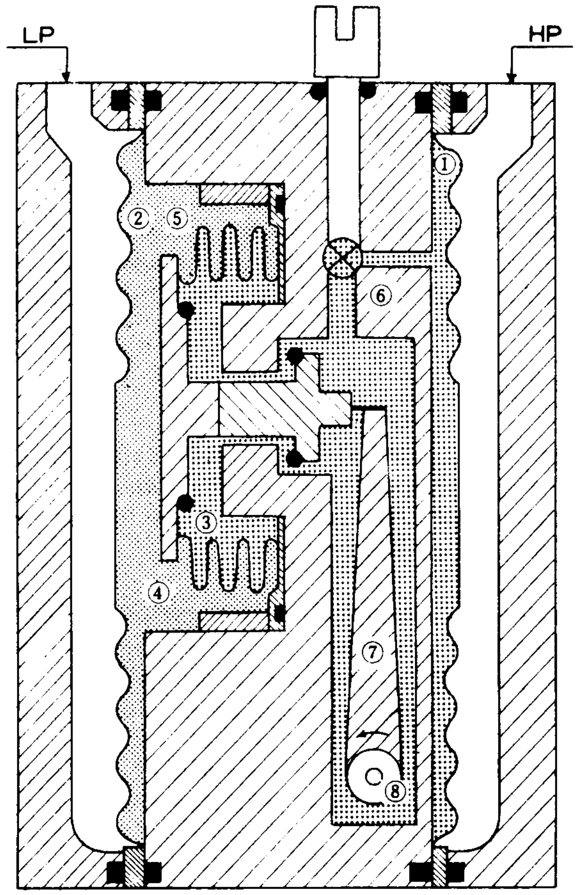


Figure 2. Schematic cross section of meter body.

5.4 OPERATION (Figure 2)

a. High and low process pressures (HP and LP) are transferred by barrier diaphragms ① and ② to the silicone fill in the center section of the meter body. HP fill acts on the inside ③ and LP fill acts on the outside ④ of the measuring element. At balance (during periods of no flow) the pressure on both sides of the bellows ⑤ are equal.

b. With flow, the force applied by the LP fill decreases, the element moves to the left, and HP fill flows through damping restriction ⑥ . As the measuring element moves, it exerts a proportional torque through a torque arm ⑦ on the torque rod and seal tube assembly ⑧, which actuates the transmitting unit.

1. GENERAL RECOMMENDATIONS

a. Location. Select a location which is reasonably free from vibration and where ambient temperature is within -30° to+80°C (limits specified by transmitter unit). Since some servicing will be required, the instrument should be accessible from ground level.

b. Low Temperature Applications. If the meter body will be subjected to temperatures lower than -40°C, fill it with a mixture of ethylene glycol or other antifreeze solution. Insulating the meter body and connecting piping up to and including the primary element connection is also recommended. If the meter still operates unsatisfactorily due to extreme cold, use steam tracing with 1/4-inch copper tubing (in addition to insulation) on the meter body and piping.

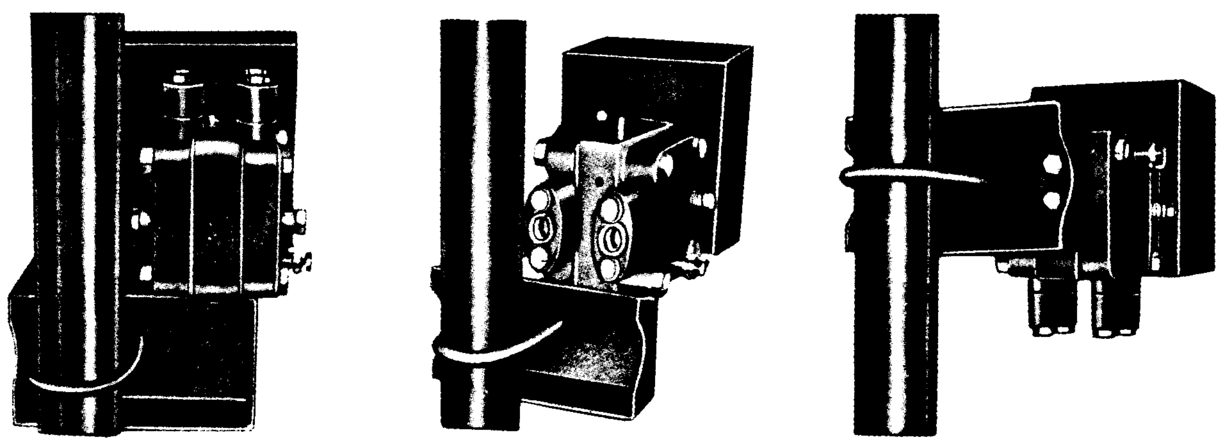
Note: Do not cover meter body damping adjustment with insulation. Leave it exposed so you can get at the adjustment.

c. High Temperature Applications. If the temperature of the measured fluid exceeds +120°C, use long lengths of piping between the meter body and the primary element connection to reduce the fluid temperature at the meter body.

2. MOUNTING

a. The transmitter is usually mounted on horizontal or vertical 2-inch piping, using the U-bolt and universal mounting bracket supplied. It can be mounted in any position in which the diaphragm assemblies of the meter body are vertical. Mounting dimensions are given in a diagram attached to this manual.

b. As shipped, the end covers of the meter body are positioned for top connections. To make connections from the bottom or rear of the meter body, remove the four mounting nuts and bolts and rotate the end covers to the desired position. Figure 1 shows mounting arrangements with the end covers in each of the three positions.



A. Top connection B. Rear connection C. Bottom connection

Figure 7 End covers positioned for top, rear, and bottom connections.

3. AIR PRESSURE CONNECTIONS

Use 6 mm O.D. x 4 mm I.D. copper or polyethlene tubing with brass fittings for input and output air connections.

a. Supply Air Connection.

(1) The input air supply must be clean, dry, and regulated at 1.4 $\pm$ 0.1 kg/cm^2. Install a filter in the supply line to remove all contaminants from the air. Install a pressure regulator in the supply line between the filter and the inlet to the transmitter. When several transmitters are used, install an individual filter and pressure regulator for each transmitter.

(2) Connect the air supply to the tap marked "S" in the manifold.

Caution: Seal paint (pipe dope) may foul up the air lines. Apply just a little on male threads or use seal tape if available.

b. Output Air Connection. (Figure 2). Connect the receiving device to the tap marked "O" in the manifold.

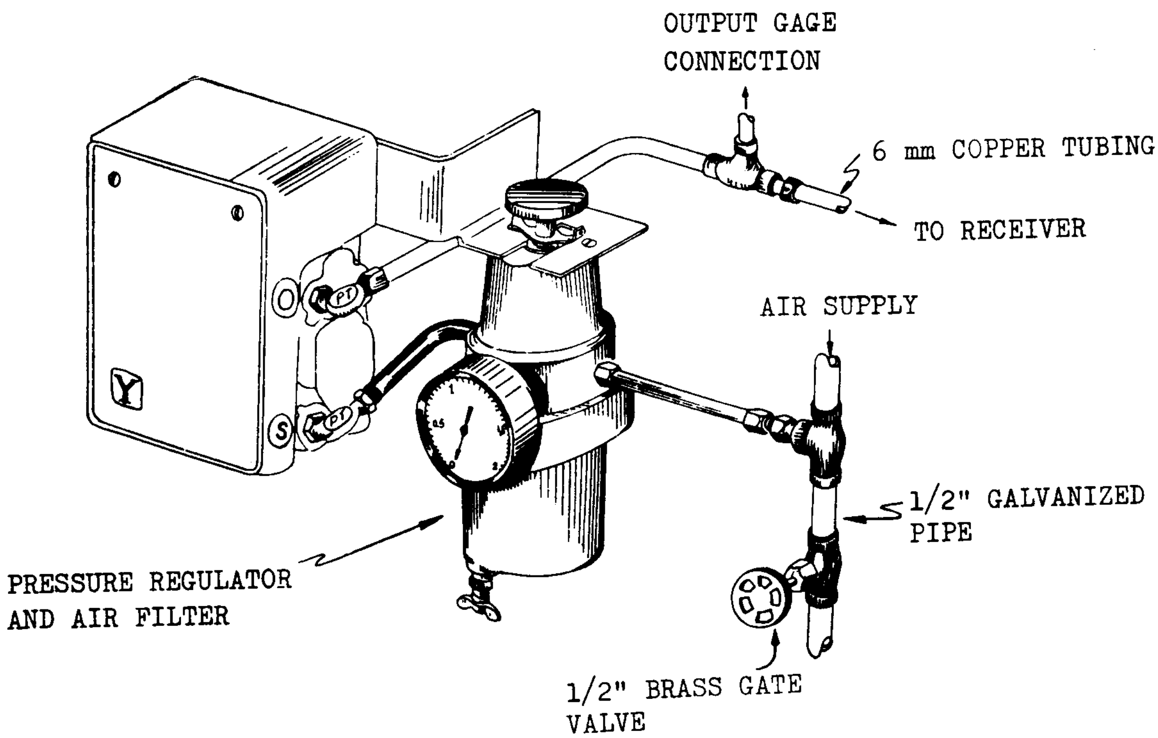


Figure 2 Input and output air connections.

4. FLOW APPLICATION

4.1 PROCESS CONNECTIONS

Exact connections depend on the medium (gas, liquid, or steam) being measured and on the location of the meter with respect to the pressure line. As a guide, general recommendations are given below, and typical connections are shown in Figures 1 through 8. For all other modifications, follow accepted piping standards.

Note: We have shown vent valves (F and G) in Figures 1) to 8). At your discretion, plugs can be used instead of valves.

a. The meter can be connected either directly or through manifold piping to the orifice flange taps. For manifold piping, either a piping assembly or a commercial assembly can be used. The installation diagrams show connections for both manifold assemblies.

Note: Commercial manifold does not apply for high pressure service over 100 kg/cm^2G.

b. Use 1/2-inch O.D. steel tubing or Schedule 80 steel pipe between the meter and the orifice when required by operating conditions. For water and steam service, copper tubing with brass valves is generally acceptable.

c. Slope piping a minimum of 25 mm per 300 mm toward the meter. If the meter is located above the orifice, piping should rise vertically above the meter and then slope downward toward the flow line.

d. When measuring fluids containing solids in suspension, install permanent blow-off valves in order to blow down the piping at regular intervals. On new installations, be sure to blow down all lines with compressed air or steam (where permissible) and flush them with process fluid before connecting them to the meter body.

4.2 PLACING IN OPERATION

a. Steam Flow Service (Figures 1 and 2)

(1) Close the HP and LP primary element valves.

(2) Open valves F, G, A, B, and C.

(3) Using a funnel, fill the meter and lines by pouring water in valve F and forcing air out through valve G. Crack open the meter vent plugs to release trapped air. Close the vent plugs and valves F and G after meter and piping free of air.

(4) Place the meter into service by first opening the HP valve, closing valve C, and then opening the LP valve.

(5) Check instrument zero by closing valve A and opening valve C. Adjust zero if necessary.

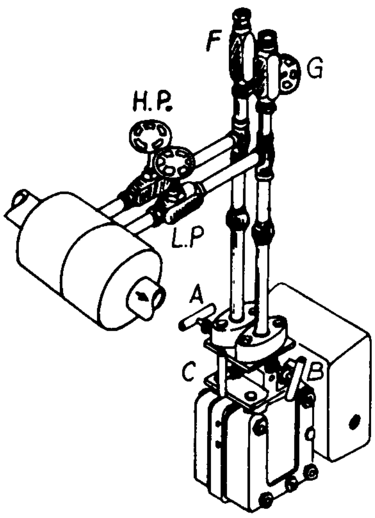


Figure 1. Piping connections for steam or corrosive liquid flow applications, using commercial manifold.

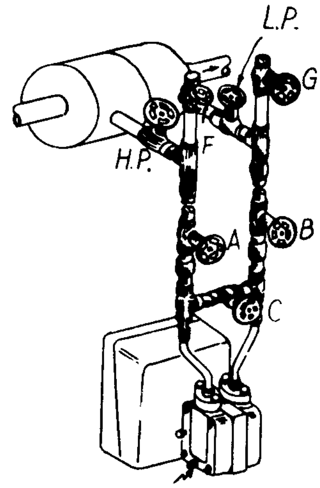


Figure 2. Piping connections for steam or corrosive liquid flow applications, using piping manifold.

b. Water Flow Service

(1) Using Commercial Manifold (Figure 3)

Note: 1 Shown connection (rear connection) dose not apply for Model: NDI(P)33, NDI(P)44, NDI(P)81, and NDI(P)82 transmitters.

(a) Close the HP and LP primary element valves.
(b) Open valves A, B, and C.
(c) Open the meter body vent plugs.
(d) Crack open the LP valve, fill piping with liquid, and bleed all air from the meter body and piping. Leave the vent plugs open, but close the LP valve and open the HP valve a small amount. Be sure all air is removed from the meter and connecting lines.
(e) Close the meter body vent plugs and open the HP valve fully.
(f) Place the meter in service by closing valve C and opening the LP valve.
(g) Check instrument zero by closing valve A and opening valve C. Adjust zero if necessary.

(2) Using Piping Manifold (Figure 4)

(a) Close the HP and LP primary element valves.
(b) Open valves A, B, C, F, and G.
(c) Open the meter body vent plugs.
(d) Crack open the HP valve.
(e) When water begins to flow freely out through valve G, close valves G, F, and C.
(f) Close the meter body vent plugs.
(g) Open fully the HP and LP valves to place the meter into service.
(h) Check zero by closing valve A and opening valve C. Adjust zero if necessary.

c. Corrosive Liquid Flow Service. The piping connections for this application are the same as that for liquid flow measurements. The difference here is the use of a sealing liquid to prevent the process fluid from entering the meter body. This is needed only if the process fluid is too corrosive for the specified meter body material.

Caution: Be sure the sealing liquid you use has a higher specific gravity than the line liquid and keep the sealer in the meter and the line liquid out.

(1) Using Commercial Manifold (Figure 1)

(a) Close the HP and LP primary element valves.

(b) Open valves A, B, C, F, and G.

(c) Open the meter body vent plugs.

(d) Fill the meter and connecting piping with the sealing liquid by using a funnel and pouring the liquid through valve F. Continue pouring until all air is released through valve G and the meter body vent plugs.

(e) Close the meter body vent plugs and valves F and G. Slowly crack open the HP valve. Crack open valve F until line fluid appears, then close valve F and the HP valve.

(f) Crack open the LP valve and valve G until line fluid appears, then close both valves.

(g) Open the HP valve slowly to the full open position.

(h) To place the meter in service, close valve C and fully open the LP valve, in that order. Check for and repair any leaks.

(i) Check zero by closing the LP valve and opening valve C. Adjust zero if necessary.

Note: By using the LP valve to check zero instead of valve A or B, you automatically equalize the quantity of sealing liquid in each leg of the meter piping.

(2) Using Piping Manifold (Figure 2)

(a) Perform steps (a) through (d) above.

(b) Close valves F, G, and C and slowly crack open the HP valve.

(c) Crack open valve F until line luid appears, then close valve F and the HP valve.

(d) Slowly crack open the LP valve and valve G until line fluid appears, then close valve G and fully open the LP valve.

(e) Open the HP valve all the way to place the meter in service.

(f) Check zero by closing the LP valve and opening valve C. Adjust zero if necessary.

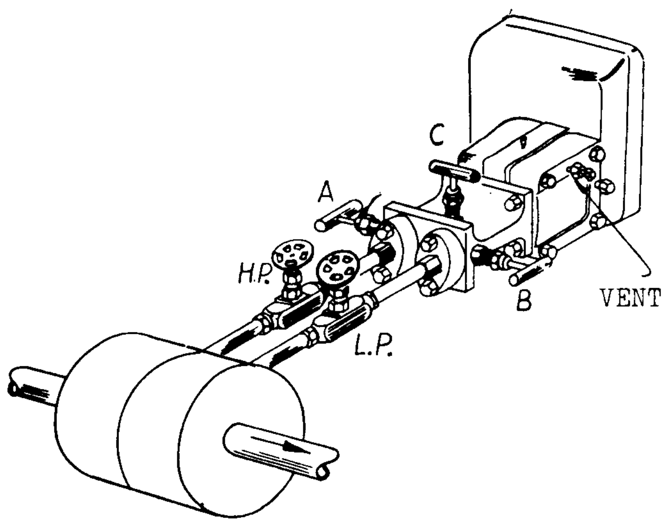


Figure 3. Piping connections for water flow service, using commercial manifold.

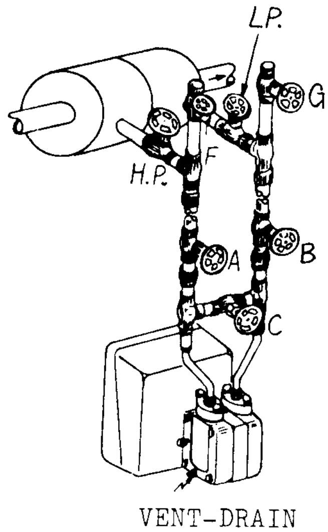


Figure 4. Piping connections for water flow service, using piping manifold.

d. Dry Gas Flow Service

(1) Using Commercial Manifold (Figure 5)
   (a) Close the HP and LP primary element valves.
   (b) Open valves A, B, and C.
   (c) Open the HP valve slowly to the full open position.
   (d) Open the LP valve slowly to the full open position.
   (e) Close valve C to place the meter in service.
   (f) Check zero by opening valve C and closing valve A. Adjust zero if necessary.

(2) Using Piping Manifold (Figure 6)
   (a) Perform steps (a) through (e) above.
   (b) Check zero by opening valve C and closing the HP valve. Adjust zero if necessary.

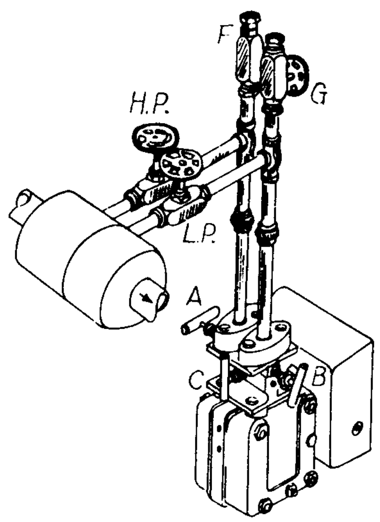


Figure 5. Piping connections for dry gas flow service, using commercial manifold.

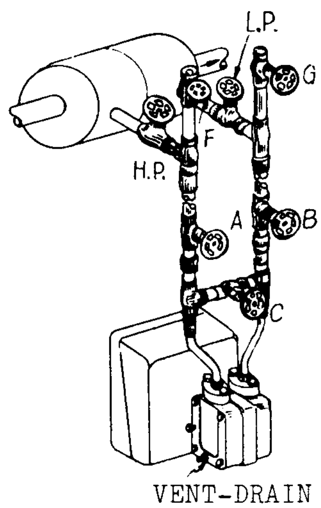


Figure 6. Piping connections for dry gas flow service, using piping manifold.

e. Wet Gas Flow Service

Caution: For wet gas service, orifice taps should be on the top of the flow line. If possible install the meter body above the orifice taps so condensation will drain back into the flow line. If you cannot, put condensing pots (about 200 mm long by 75 mm diameter) above the orifice taps as shown in Figure 8.

(1) Using Commercial Manifold (Figure 7)

(a) Close the HP and LP primary element valves.

(b) Open valves A, B, and C.

(c) Slowly crack open the HP valve.

(d) Open the meter body vent plugs if necessary to prevent contamination from air in meter piping.

(e) When the wet gas starts to flow freely from the vent plugs, close the plugs and open the LP valve.

(f) Close valve C to place the meter in service.

(g) Check zero by closing valve A and opening valve C. Adjust zero if necessary.

(2) Using Piping Manifold (Figure 8)

(a) Close the HP and LP primary element valves.

(b) Open valves A, B, C, F, and G.

(c) Slowly crack open the HP valve.

(d) If contamination is a problem, open the meter body vent plugs to release trapped air, then close plugs.

(e) Open the HP valve slowly to full open position.

(f) To place the meter in service, close valve C and then open the LP valve, in that order.

(g) Check zero by closing the HP valve and opening valve C. Adjust zero if necessary.

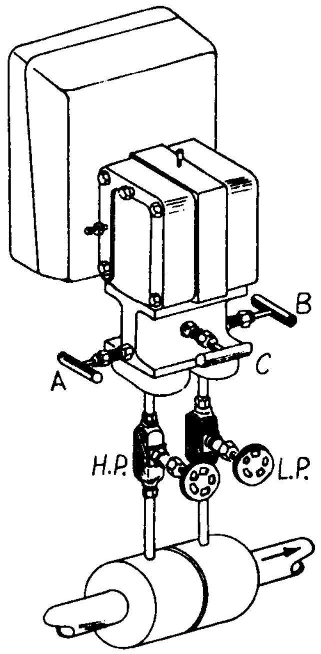


Figure 7. Piping connections for wet gas flow service, using commercial manifold.

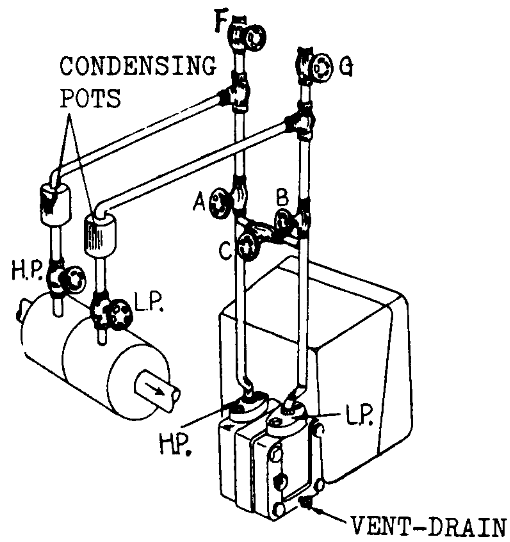


Figure 8. Piping connections for wet gas flow service, using piping manifold with water seal.

1. SCOPE

a. This section covers preventive maintenance, which includes the routine inspection, tightening, and cleaning of parts.

b. For corrective maintenance including major adjustments, repairs, parts replacement, and calibration refer to the Servicing section.

2. TOOLS AND EQUIPMENT

Item	Used to
Hand syringe	Dust interior of transmitting unit
Soft bristle brush	Clean diaphragms
Solvent	Clean diaphragms and end covers (pressure chambers)

3. PROCEDURES

What to check	How to check
Dashpot (transmitting unit)	Check for excessive oil leakage. Thin film of oil in damping area is permissible and does not affect operation
All piping connections between meter and primary element	Inspect for leakage. Tighten all loose connections
Interior of transmitting unit	Clean out the interior of the instrument case with dry air
Connecting piping	Clean as described in par. 4
Meter body	Clean as described in par. 5
Vent drain fittings	Clean out any accumulated dirt

4. CLEANING CONNECTING PIPING

a. General. To assure continued accuracy and satisfactory performance the meter body and connecting piping must be kept clean. Sediment or other foreign particles may cause faulty measurement if allowed to collect in the pressure chambers of the meter body. The small volumetric displacement of this meter body reduces the need for cleaning and blowing down connecting piping to a minimum. The time intervals between these operations can only be determined after the meter is in operation. On some applications, where the fluid being measured carries materials such as coke in suspension, it is advisable to install blow down facilities. In some applications it may be necessary to use purges. The following procedures can be considered standard for most applications.

b. Installations Using Direct Connections and Standard Manifold (Figure 1)

(1) Close the HP meter body shut-off valve on the piping manifold.

(2) Open the equalizing valve on the piping manifold and close the LP meter body shut-off valve in that order.

(3) Slowly crack open one of the meter body vent-drain screws to relieve pressure, then retighten.

(4) Disconnect the unions (or flanges) to the meter body.

(5) Position the connecting piping so that discharge of the flowing medium will not come in contact with the meter body.

(6) Slowly open the HP and LP meter body shut-off valves permitting the flowing medium to discharge through the piping until it is clear of sediment.

(7) Close the HP and LP meter body shut-off valves on the piping manifold.

c. Installations Using Blow-Down Piping (Figure 2)

(1) Close the HP meter body shut-off valve on the piping manifold.

(2) Open the equalizing valve on the piping manifold and close the LP meter body shut-off valve in that order.

(3) Slowly open the HP and LP blow-down valves, permitting both lines to discharge flowing medium until it is clear of sediment.

(4) Close the HP and LP blow-down valves, pressure-tight.

Caution: When you are measuring an acid, gasoline, or other dangerous liquid. Connect your blow-down lines to a sewer or drain.

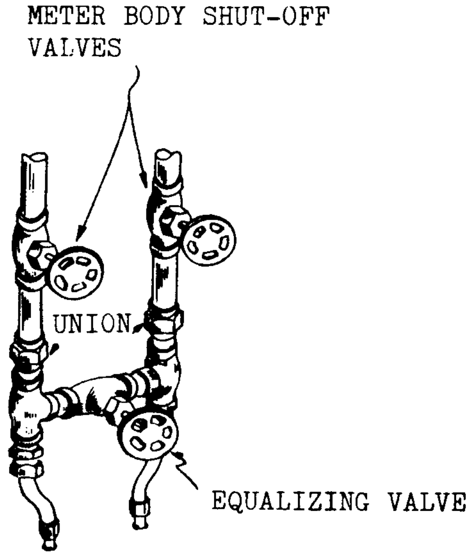


Figure 1. Installation using direct connections and standard manifold.

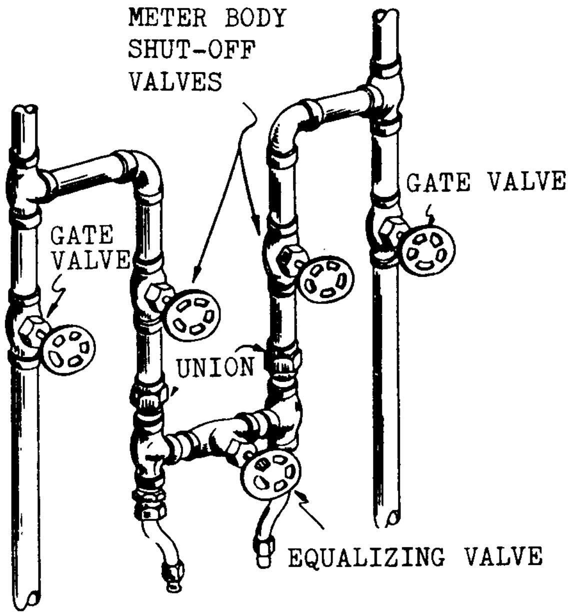


Figure 2. Typical blow down piping installation.

5. CLEANING METER BODY

a. Close the primary element shut-off valves.

b. Close the HP meter body shut-off valve on the piping manifold.

c. Open the equalizing valve on the piping manifold and close the LP meter body shut-off valve in that order.

d. Slowly crack open one of the meter body vent-drain plugs to relieve excessive pressure and drain the meter body. Retighten the vent-drain screws.

e. Disconnect the unions (or flanges) to the meter body.

f. Detatch the covers by removing the bolts of the meter body.

Caution: Do not take apart the center section of the meter body.

g. Clean the diaphragms and interior of the covers with a soft bristle brush and suitable solvent.

h. Reassemble both covers to the meter body using new flange gaskets when required.

i. Reconnect the unions or flanges to the meter body.

SERVICE

1. TOOLS AND EQUIPMENT REQUIRED

a. The following tools and equipment are required for troubleshooting and servicing the ΔP/P Transmitter.

Item	Used to
1.4 kg/cm2 air supply	Supply air to the ΔP/P Transmitter
Mercury column	Indicate ΔP/P Transmitter output
Regulated pressure source	Set measurable differential pressure input
Water or mercury column	To measure differential pressure input

2. TROUBLESHOOTING

a. The tests listed below will aid in isolating a fault. Use them in conjunction with the troubleshooting chart (Table 1) and proceed in the order listed.

(1) Visual inspection. Inspect the components visually for dirt, corrosion, mechanical looseness, or faulty connections.

(2) Operational test. Check input versus output readings.

(3) Substitution check. Substitute replacement parts or components for suspected ones. This will often determine the exact location of the trouble.

3. DISASSEMBLY AND REASSEMBLY OF MAJOR COMPONENTS

a. Preliminary Instructions. Disassembly should be performed only as far as necessary to repair or replace the defective assembly or component. After any component has been replaced or repaired or after the equipment has been dismantled to any extent, realign and recalibrate as described in paragraphs 4 and 5.

b. Rebalancing Capsule

(1) To remove rebalancing capsule:

(a) Note zero reading, then shut off supply air and disconnect air line.

(b) Remove the two secondary beam assembly mounting screws and loosen zero spring setscrew.

(c) Loosen rebalancing capsule and back off adjusting nut.

(d) Remove secondary beam assembly (including zero spring) and capsule assembly locknut and washer; detach capsule from base.

TABLE 1
TROUBLESHOOTING CHART

Symptom	Probable Cause	Remedy
Excessive hysteresis	a. Parts rubbing b. Parts loose c. Damaged rebalancing capsule d. Dirt on force contact points	a. Remove source of rubbing, such as air tubing on primary or secondary beams. If suppression spring is used, align so that it does not rub the primary beam or its adjusting screw b. Tighten screws c. Replace capsule per par. 3b. d. Clean with clean air areas where span rider and rebalancing capsule contact secondary beam.
Excessive error	a. Not calibrated properly b. Nozzle misaligned c. Damaged rebalancing capsule	a. Calibrate per par. 5 b. Realign nozzle c. Replace capsule per par. 3b.
Excessive change in zero with range change	Beams not parallel	Realign per par. 4 and recalibrate per par. 5
No output signal	a. Supply filter clogged b. Restriction in pilot manifold clogged c. No air supply d. Transmitter misaligned so that baffle does not approach nozzle close enough	a. Replace filter b. Clean restriction c. Adjust regulator to supply 1.4 ± 0.1 kg/cm^2 d. Realign transmitter per par. 4
Cannot obtain 1 kg/cm^2 output	a. Supply air pressure not high enough b. Dirty supply filter	a. Adjust regulator to supply 1.4 ± 0.1 kg/cm^2 b. Replace filter
Unstable or pulsating output	a. Air leak b. Nozzle or baffle dirty c. Nozzle misaligned d. Dirt in pilot relay	a. Tighten all tubing connections and gaskets b. Clean nozzle & baffle c. Realign nozzle d. Remove pilot and clean per par. 3c. Replace pilot if necessary
Unable to adjust zero	a. Transmitter preload insufficient	a. Realign transmitter per par. 4

(2) To replace rebalancing capsule.

(a) Mount loosely. Use nuts and washers from old assembly.

(b) Replace secondary beam assembly, being sure to insert zero spring end completely in bushing before locking the setscrew.

(c) Tighten the secondary beam mounting screws.

(d) Connect tubing to capsule. Turn on the supply air and position the feedback capsule to obtain the same zero reading as noted in step (1)(a). Tighten capsule nuts securely.

c. Pilot Relay (Refer to Illustration of Parts List Section)

(1) To detach the pilot relay from the manifold, remove the three mounting screws and lockwashers and the gasket which rests against the manifold.

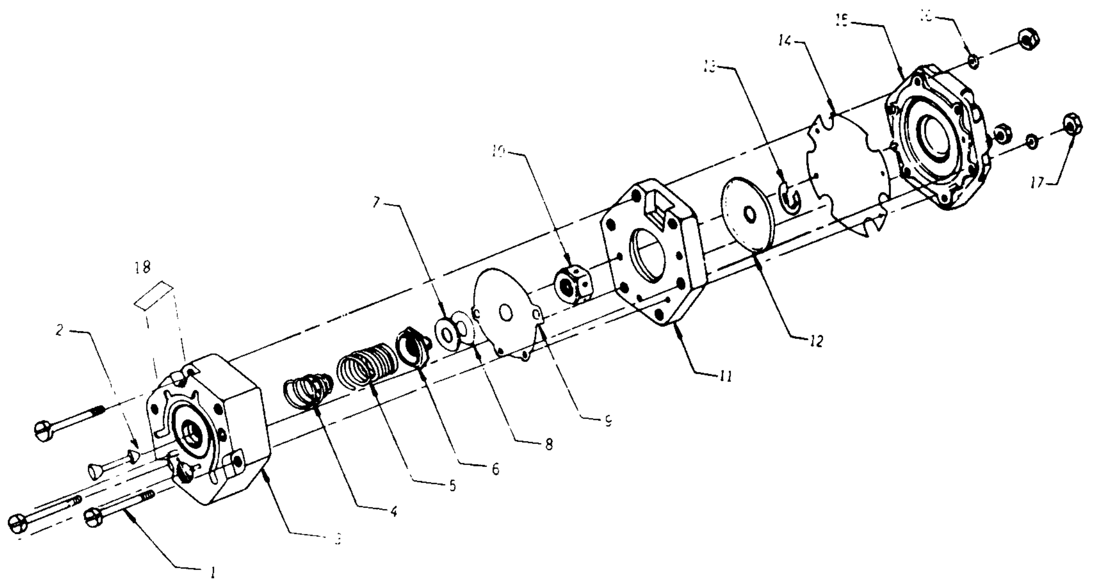


Figure 1. Pilot relay assembly.

(2) To service the pilot relay.

(a) Remove the three assembly screws (1) washers (16) and nuts (17). (See Fig. 1 exploded view of pilot relay)

(b) Parts (3) to (15) will separate in order. It is not necessary to separate parts (2) to (4) unless they are to be replaced.

(c) Clean metal parts with approved solvent such as petroleum naphtha or Clorothene.* Keep the solvent away from the diaphragms. Depress the valve stem (2) against the conical spring (4) to allow the solvent to penetrate through the seat.

(d) Examine the inner exhaust ring (10). If dirty, clean it with a pipe cleaner dipped in solvent.

(e) Clean the bleed hole (0.4 mm in diameter) with a fine wire.

(f) Dry all parts thoroughly with clean compressed air.

(g) Replace diaphragms (14) and (9) if worn or damaged.

(h) Reassemble the pilot relay by rejoining all parts in order with assembly screws (1), washers (16) and nuts (17). Tighten the screws evenly.

(3) To replace pilot relay:

(a) Stick a new gasket in position on the pilot relay.

(b) Attach the pilot relay to the manifold with the mounting screws and lockwashers. Tighten the screws evenly.

d. Meter Body (Refer to Illustration of Parts List Section)

(1) To remove the meter body from the transmitter

(a) Take the meter out of service by closing off and equalizing the meter as described in par. 5 a) to 5 d) of maintenance section.

Note: If the meter body is flange mount type. The transmitter can be removed only when the process is shutted down.
Decrease the lequid level of the vessel below to the center of meter body flange or release the pressure in vessel equal to atmospher. Then remove the transmitter.

(b) Remove the oval connector(s) from the meter body. Be careful not to loose filter-screen.

(c) Disconnect the air lines to the transmitter.

(d) Separate primary beam from end of force shaft by removing the two beam mounting screws.

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* Tradename, Dow Chemical Co.

(e) Disconnect air lines (inside case) to manifold.

(f) Detach bearing housing and transmitter base from meter body neck by removing the three mounting screws. Remove transmitter. When removing the base, rotate the knob so that the mesh between the pin of zero adjusting knob and groove of adjustment arm is properly positioned.

(g) Detach transmitter case as follows:

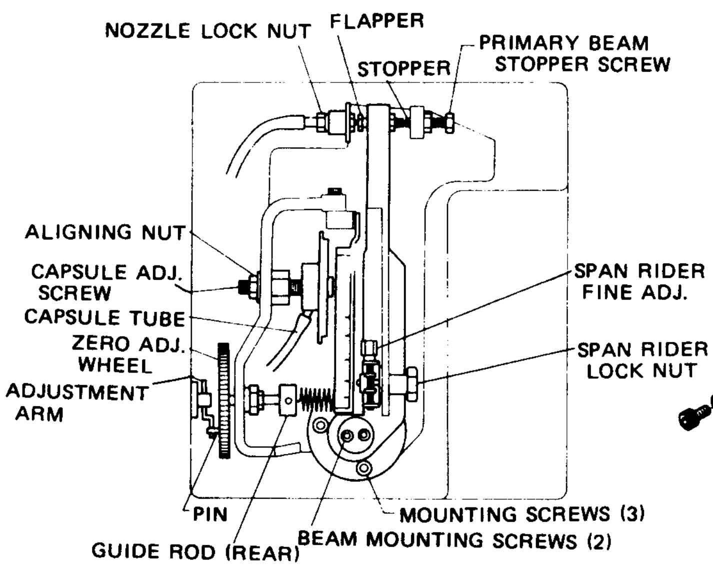
1. Loosen the screw holding the case to the meter body.
2. Turn the thumbweel until the screw is clear of the meter body.
3. Turn entire case on the threaded neck of the meter body until parts separate.

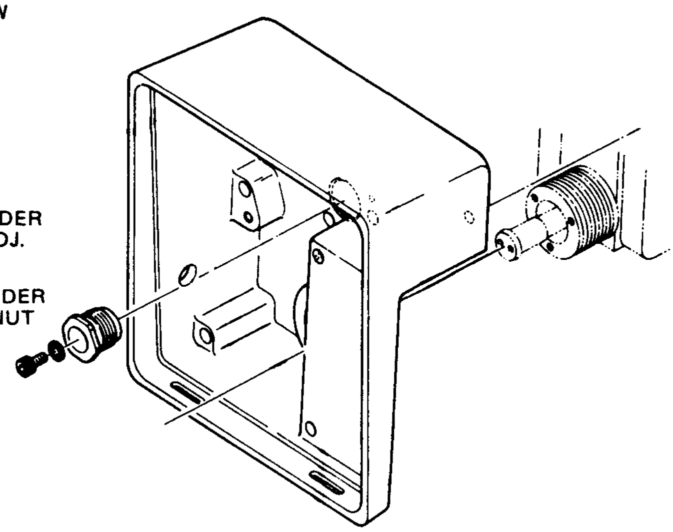
(2) To replace meter body:

(a) Reattach case by reversing procedures in (g) above.

(b) Position transmitter base (with nozzle, stop, secondary beam, rebalancing capsule, zero adjustment in place) on neck of meter body. Make sure that the pin of zero adjusting knob is properly in mesh with adjustment arm groove.

(c) Fasten base in place with bearing housing by tightening the three mounting screws.





4. ALIGNMENT PROCEDURE (EQUILIBRIUM ADJUSTMENT)

First, remove elevation and suppression spring (remove four socket screws).

(a) Connect supply air of 1.4 kg/cm^2 to Ⓢ on instrument manifold, and mercury manometer to Ⓞ. Separately provide a supply air source (available up to 200 mm Hg). Remain the input not applied.

(b) Remove the tube of the capsule and clog the end of the tube. Then apply a pneumatic pressure of 100 mm Hg to the feedback capsule.

(c) Turn the zero adjustment so that the zero adjustment guide rod is positioned at the center of the guide slot.

(d) Set the span rider on the primary beam to the center travel of the secondary beam and fasten the locknut on the span rider temporarily.

(e) Loasen the socket screw for locking the primary beam and the locknut of fixing the feedback capsule.

(f) Turn the adjustment of the capsule so that the primary beam and the secondary beam are positioned in parallel, and fasten the locknut of the capsule and the socket screw for fixing the primary beam. The socket screw shall be fastened with a torque of 15 to 18 kg-cm.

(g) Set the span rider to the maximum on the scale and apply a pneumatic pressure of 170 mm Hg.

(h) Turn the baffle at the end of the primary beam so that the output becom becomes 250 to 300 mm Hg.

(i) Confirm the position of the baffle with respect to the nozzle as follows: Make sure that the output changes over a range of 0.2 to 1.0 kg/cm^2 (148 to 738 mm Hg) as the pressure applied to the capsule is varied from 165 to 175 mm Hg.

(j) If the change in step (i) is not over 1.0 kg/cm^2, loosen the locknut of the nozzle and align the nozzle position so that the nozzle will touch the baffle vertically.

(k) Connect the tube to the capsule in the reverse order to the step (b) above.

(l) Confirm the equilibrium adjustment as follows:
Slide the span rider from the maximum scale to the minimum on the travel and make sure that the output changes within 150 mm Hg at this time.
If not, repeat the steps from (e) to (l).

(m) Turn the primary beam stopper screw so as to touch the baffle lightly and turn it back by 1/4 turn and fasten the nut.

(n) For model with suppression-elevation spring, fasten the spring with four socket screws.

5. CALIBRATION

a. For Measurement with no Suppression or Elevation

(1) Connect a mercury column capable of measuring an output span of 0.2 ~ 1.0 kg/cm^2 (148 ~ 738 mm Hg) to the output connection of the transmitter. Connect a pressure source capable of supplying 0 to maximum range to the high pressure chamber of the meter body. Vent the low pressure side to atmosphere. Connect 1.4 ± 0.1 kg/cm^2 supply air to supply connection of transmitter.

(2) Alternately adjust zero and span using adjustments described below until desired accuracy is obtained.

(3) Adjustments

(a) Zero: Adjust zero by rotating the large knurled wheel in the lower left corner of the transmitter. Adjust it for 0.2 kg/cm^2 (148 mmHg) output at zero differential.

(b) Span: Adjust span for 0.84 kg/cm^2 (620 mmHg) output at 80% differential.

1. Coarse Span — Adjust by loosening the small (knurled) screw on the primary beam and sliding the entire span rider along the beam. Usually used only for gross changes in range of meter.

2. Fine Span — Trim to the desired accuracy by turning the small hex head screw on the span rider of the primary beam.

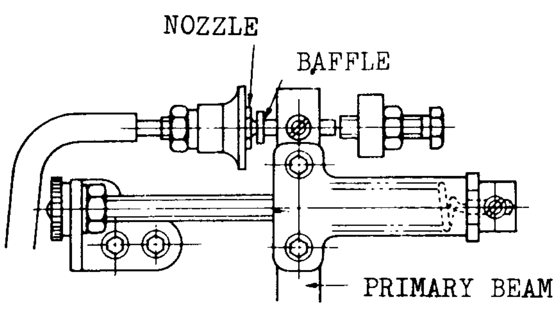


Figure 2. With suppression.

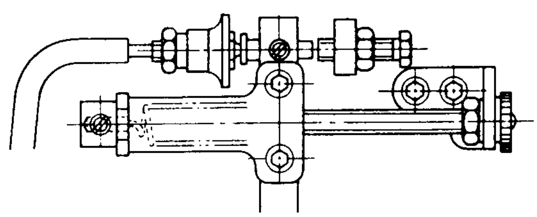


Figure 3. With elevation.

b. For Measurement with Suppression

(1) Connect pressure sources as described in par. a. above.

(2) Connect an additional pressure source to the low pressure chamber of the meter body to supply pressure equal to the suppression pressure required. Suppression pressure must not exceed maximum range.

(3) With the suppression pressure applied to the low pressure chamber of the meter, rezero roughly to 0.2 kg/cm^2 (148 mm Hg) output by turning the (knurled) wheel on the suppression spring assembly. Lock the assembly with the locknut.

(4) Alternately adjust zero and span as described in par. a. above.

c. For Measurement with Elevation

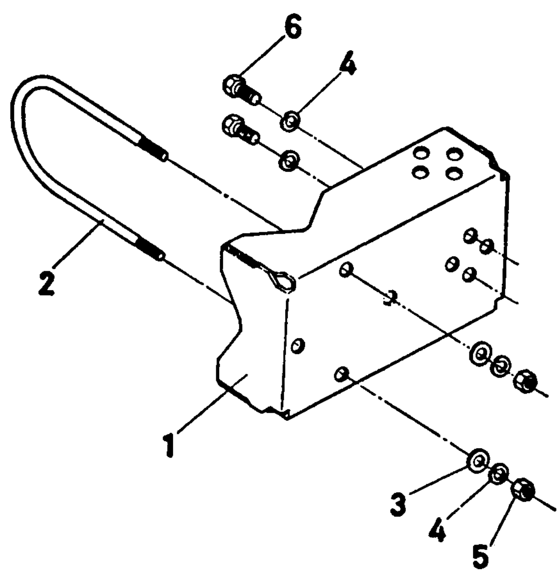
(1) Connect pressure sources as described in par. a. above.

(2) With the elevation pressure applied to the high pressure chamber of the meter body, rezero roughly to 0.2 kg/cm^2 (148 mm Hg) output by turning the knurled wheel on the elevation spring assembly. Lock the assembly with the locknut.

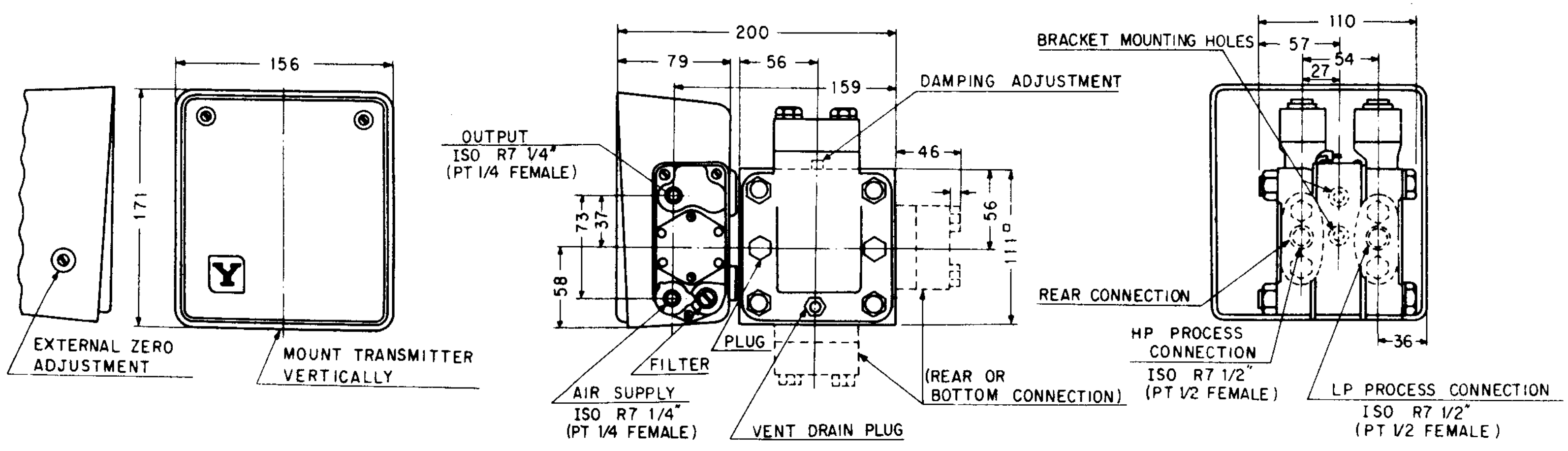
(3) Alternately adjust zero and span as described in par a. above.

6. CHANGE IN RANGE

The range of the instrument may be varied within the limits of 0 to minimum range and 0 to maximum range by following the calibration procedure outlined in par. 5 above, setting the coarse span adjustment at the approximate position for the range desired as indicated by the scale on the secondary beam.



REFERENCE DRAWINGS



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