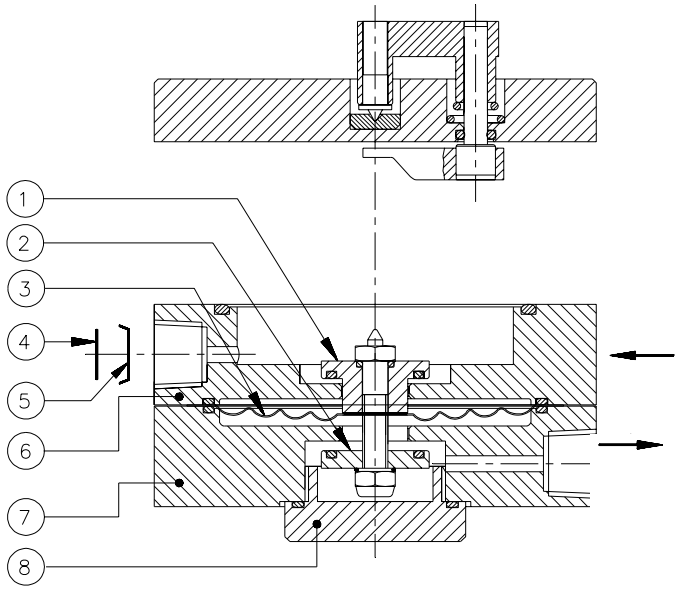
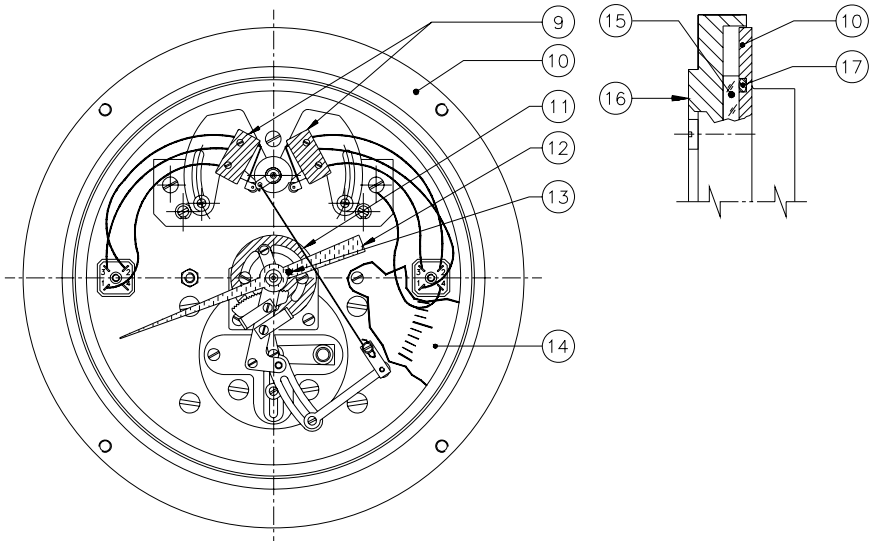
OPERATION & MAINTENANCE INSTRUCTIONS
DIFFERENTIAL PRESSURE INDICATOR 106D

A. DESCRIPTION

SWITZER Differential Pressure Indicator model **106D** is powered by a diaphragm assembly. The pressure sensing diaphragm is held between high & low pressure chambers, and responds to the difference of pressure applied to these pressure chambers. It is fully protected from overranging in both positive and negative direction by a unique built-in bi-directional over range stop. The output of the movement is linked to a motion transfer mechanism which converts the linear diaphragm movement to a rotary movement. The output shaft of the movement drives the pointer to read the differential pressure on a calibrated dial.



1. TOP OVER RANGE STOP
2. BOTTOM OVER RANGE STOP
3. DIAPHRAGM
4. FILTER RETAINER
5. FILTER
6. LOW PRESSURE HOUSING
7. HIGH PRESSURE HOUSING
8. SEALING PLUG



9. MICRO SWITCH ASSEMBLY
10. DIAL HOUSING
11. MOVEMENT
12. POINTER
13. POINTER ZERO ADJ.
14. DIAL
15. LENS
16. BEZEL
17. GASKET

B. SPECIFICATIONS FOR Model 106D

Pressure Housing	316 SS	**Bezel Lens**	Shatter Proof Glass
Sensing Element	316 Ti. SS Diaphragm	**Pointer**	Narrow Tip
Dial Housing	Die Cast Aluminium (Std.)	**Zero Adjust**	Micrometer pointer adj.
	304 SS (Optional)	**Switching**	One or Two SPDT micro switches
Dial size	6" Nominal	**Mounting**	Panel or 2" Pipe or Wall
Dial colour	White with Black letters	**Process Ports**	1/4" NPTF at side

C. OPERATING LIMITATIONS

Our **Warranty** for the Differential Pressure indicator will not apply if the specified maximum temperature and pressure (MWP) limits are exceeded :

Pressurisation

Sudden pressurisation can cause severe damage to the sensing element. Therefore it is always recommended to use a three way manifold to avoid damages to the sensor.

Pulsation

Severe pulsation will affect the accuracy of the instrument. If the instrument is to be subjected to pulsation, where process pressure pulsations are very rapid (i.e., change in pressure occurring fast enough to drive an instrument over its full range in less than a second), make sure that an external adjustable pulsation dampener (Snubber) is connected to the pressure line and suitably trimmed to dampen the pulsation and thus prevent damage to the instrument. Snubbers must be provided at both ports.

Vibration and Shock

Do not subject instrument to severe mechanical vibration or hydraulic shock, unless the instrument has been specially ordered for such severe operating conditions.

D. INCOMING INSPECTION

UNPACKING : Check for shipping damage to cartons and contents. Check contents against shipping order. If damages are noticed, immediately report it to your Insurer and lodge a claim.

IMPORTANT : When called for on order, the gauge is pre-cleaned for special application and sealed in a clear plastic bag. Check for special installation instructions before breaking the seal on the bag.

E. LOCATION

- Locate the gauge such that it is easily accessible from floor level.
- Select a reasonably vibration-free location where ambient temperature also does not exceed operating temperature limits.
- Do not locate the instrument near vents or bleed holes discharging corrosive vapour or gases.
- For liquid measurement locate the gauge below the primary element to permit entrapped air or gas to be vented into the flow line.
- For steam and gas measurement place the gauge above the flow line to facilitate condensate / entrained liquid draining.
- The distance between the primary device and the gauge shall be as short as possible. For distances up to 50 feet use 1/4" or 3/8" pipe or tubing. For runs 50 to 100 feet use 1/2" pipe or tubing. Distances exceeding 100 feet are not recommended. The recommended distance limitation does not apply if an air-purge system is used.

F. MOUNTING

The Instrument is adapted for mounting as : (a) Panel Mounting (b) Pipe Mounting for 2" Pipe or (c) Wall.
The mounting bracket is suitable for both wall & 2" Pipe mounting.
The instrument must be approximately leveled for proper operation.

Wall Mounting

Drill four mounting holes on wall to match the 71.5 mm pitched holes of the mounting bracket. Secure instrument with bolts and nuts.

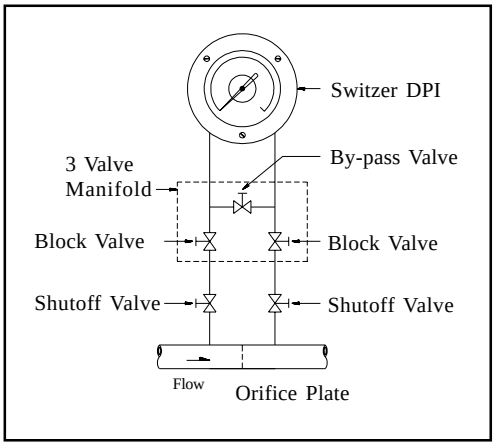
Pipe Mounting

Mount the instrument onto a 2" Pipe using the pair of "U" bolts & nuts and secure the instrument & orient the gauge as required and tighten the bolts firmly. Ensure rigidity.

Flush or Panel Mounting

Provide a cutout in the panel as per the mounting dimensions (Refer page 9). Remove the bezel and mount the gauge with the four M5 mounting studs & nuts. Tighten the retaining nuts. Replace the bezel and tighten screws evenly to avoid overstressing lens window on the gauge.

G. CERTAIN PRACTICES SHOULD BE FOLLOWED ON ALL FLOW AND LIQUID LEVEL DIFFERENTIAL PRESSURE INDICATOR PIPING



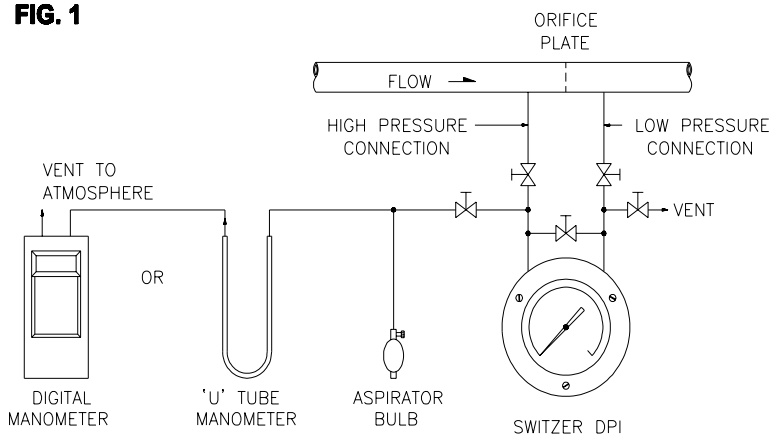
- ❖ Make up all joints using a suitable pipe joint compound to reduce measurement errors caused by leaks in the pipe joints.
- ❖ Slope all piping at least 1 inch per linear foot to avoid liquid or gas entrapment.
- ❖ If process media exceeding 95°C is to be measured, provide 2 feet of un-insulated piping between the primary device and the Differential Pressure Indicator, for each 38°C in excess of 95°C.
- ❖ Install a valve manifold connecting the Differential Pressure Indicator and the differential pressure source to facilitate operation and checking. Locate block and bypass valves to be readily accessible to the operator from the front of the instrument. The shutoff valve should be the first valve from the process line or vessel.
- ❖ Differential Pressure Indicator has two pairs of 1/4" NPTF pressure connections.

H. INSTRUMENT START UP

IMPORTANT : Prior to placing the instrument in service, perform the following operations

- ❑ Open up the Front Bezel and the Dial Lens and **remove the sponge** placed beneath the pointer. Pressurisation without removal will lead to Pointer shift from its original position.
- ❑ Since the diaphragm may have taken a slight "set" due to possible extended periods of storage prior to installation or transhipment, it is advised that prior to actual operation, the instrument be exercised to ensure correct indications. To exercise the instrument, sequentially apply maximum and minimum differential pressure to the high pressure side for at least ten cycles.
- ❑ Although the Differential Pressure Indicator is a rupture-proof diaphragm type instrument, care should be taken not to subject the instrument to unnecessary shock or over range pressure during start-up. Connect a **three valve manifold block.** Make sure that block and bypass valves are closed when beginning start-up procedures.
- ❑ Check manifold and piping for leakage by opening both the block valves, the by-pass valve and the hi-side shut-off valve to pressurise the instrument. Then close the shut-off valve and by-pass valve to lock the pressure. If pointer travels upscale, then it indicates a leak in low pressure piping; and if pointer travels downscale, then it indicates leak in high pressure piping.
- ❑ Zero check the instrument. To do this, close the block valves and open the by-pass valve. This equalises the pressure on both sides of the instrument. Vent any air lock and then bleed. If the instrument does not indicate zero, set pointer to zero by rotating the micrometer adjustment provided on the pointer.
- ❑ ***To Check Calibration***
  - First zero the instrument at atmospheric pressure & connect a calibration instrument such as "Swiscal" Digital Portable Manometer to the high pressure connection of the Gauge. The low pressure connection is vented to atmosphere. With the help of an aspirator bulb or regulated air source, apply increasing pressures of 25, 50, 75 and 100 percent, of full-scale differential to the HP housing. Exercise care to **always** approach the desired scale reading from the lower differential pressure value without overshooting; if you overshoot and drop back to the reading, your calibration will be incorrect. Repeat the procedure, by reducing pressure and stopping at the same scale readings, now taking care to always approach readings from the high Differential Pressure value. Compare Differential Pressure Indicator readings with the Master Gauge.
  - Inconsistent readings may be the result of the pointer dragging against the scale plate. To inspect for this condition, remove the lens. The end of the pointer should be no closer to the scale plate than 1.5 mm throughout its arc of travel. If necessary, bend the pointer away from the scale by gently pulling on the outer end.
  - If indications are within specified tolerances, **no further** calibration is required.
  - If instrument readings are outside specified tolerances, re-calibration is required. Return the instrument to factory.

FIG. 1



TYPICAL SCHEMATIC ARRANGEMENT FOR CALIBRATION OF DIFFERENTIAL PRESSURE INDICATOR

- **To Set the Switch Actuation**

The Switch setting is to be done after opening up the bezel. With a screw driver adjust the positioning of the switch in the arrow direction marked on the dial, **after loosening** the lock identified on the dial. Before commissioning, check up the functioning of the switching action during the calibration check explained above tighten the Lock Screws after setting are done.

After instrument has been checked to read correctly, replace the bezel assembly.

SWITCH SETTING

I. INSTRUMENT INSTALLATION RECOMMENDATIONS

- Rapid pressurisation can cause severe damage to the sensing element in all types of pressure instruments. Therefore as explained earlier the simplest method of avoiding this problem in differential pressure instruments is by installation and proper use of a three valve manifold . Opening the equaliser valve, prior to opening one or both the block valves, will ensure that pressure is applied simultaneously to both sides of the sensing element.

- As a general practice, wherever possible, instruments should be located at a higher elevation than the process connections on the equipment, or process device, on which they are being installed. Frequently, when trouble is encountered, it is found that the instrument has been installed at an elevation below the process connections, allowing particulate matter to flow by gravity into the instruments, resulting in erratic performance or complete malfunction. If for viewing purpose or other reasons, the above recommended location is impractical, there is an alternative procedure. Provide either a “pigtail” loop, or a “dropleg” (U-tube manometer configuration) in the tubing between the instrument and the process connections. Since most instruments do not have flow through them, such an installation practice will insure that solids will not be moved by gravitational force into the instrument.

However a more detailed line up procedure for typical & special installations are presented in Figures 2 through 7.

Use the diagram most suitable for specific requirement as a guide.

J. INIDCATOR PIPING DIAGRAMS

FIG. 2

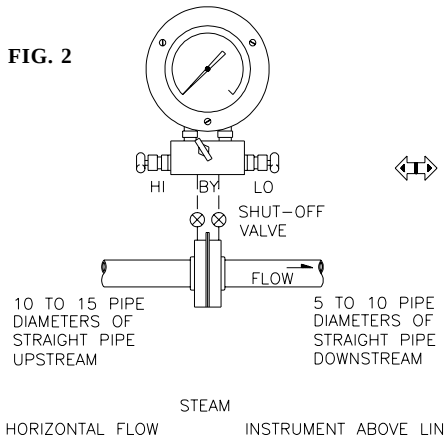


FIG. 3

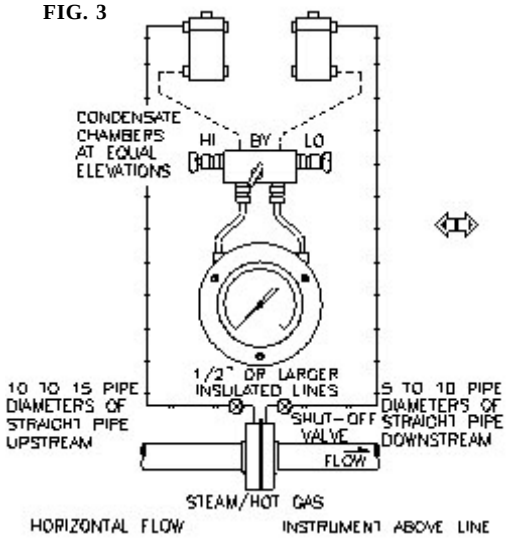


FIG. 4

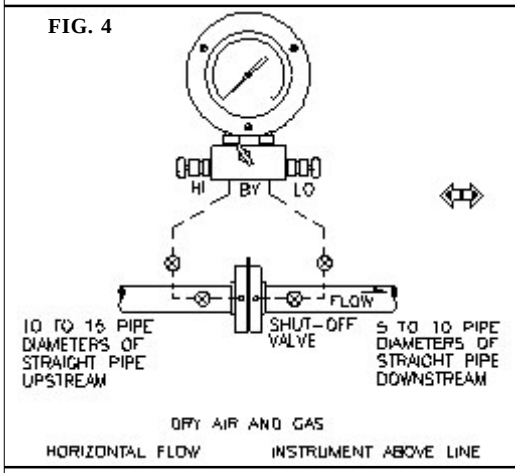
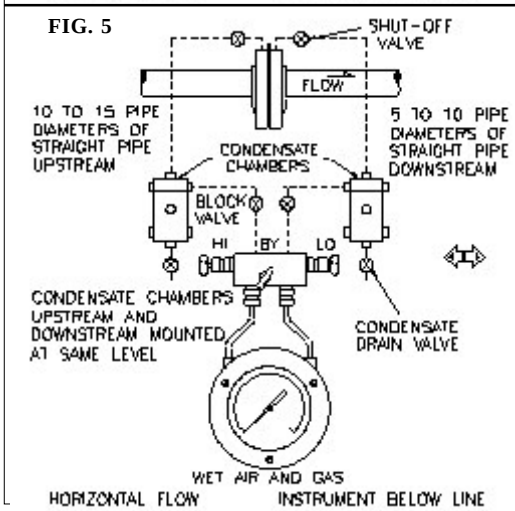


FIG. 5



FOR STEAM SERVICE (FIG.2) – START UP

Recommended when instrument located above primary element and where self draining is possible & for operating temperature upto 95°C

1. Whatever the location of the meter body, make all primary element taps at or near top of pipe
2. Close block valves & vent valves (if used). Open by-pass valve and shut-off valves.
3. Slowly and simultaneously open block valves, then close shut-off valves.
4. Slowly and simultaneously open shut-off valves.
5. Close by-pass valve for D/P reading.

If Indicator to be located below the primary element, see fig 3.

For higher temperatures, see Fig. 3.

FOR STEAM or HOT GASES (FIG.3) - START UP

Recommended when Instrument located above primary element and for operating temperature greater than 95°C

See Clause “G” and then follow steps below.

NOTE : To prevent overheating during instrument blow-down, monitor the temperature by placing your hand on the pipe between the Differential Pressure Indicator and the vent valves.

1. Close shut-off valves and vent valves (if used). Open by-pass valve and block valves.
2. Remove side and fill plugs from condensate chambers.
3. Fill piping and instrument chambers with water by pouring into fill port in both condensate chambers to the level of the side plugs. Instrument chambers and piping must be free of bubbles. When instrument and piping are completely full, pointer will rest at zero.
4. Install plugs in ports of condensate chambers.
5. Slowly and simultaneously open shut-off valves then close.
6. Check for leaks as explained in Clause “H”.
7. Slowly and simultaneously open shut-off valves.
8. Close by-pass valve for D/P reading.

FOR GAS SERVICE (FIG.4) - START UP

Recommended when instrument located above primary element and where self draining is possible. NOT recommended when hydrates are present

1. Whatever the location of the instrument, make all primary element taps at or near the top of the pipe.
2. Open manifold valves and by-pass valve, open one block valve and one shut-off valve to pressurise instrument.
3. Then close block valve and by-pass valve.
4. Check for leaks as explained in Clause “H”.
5. Open by-pass valve, open block valves and slowly open both shut-off valves simultaneously.
6. Close by-pass valve for D/P reading.

   If hydrates are present, or the instrument to be located below the primary element, see fig.5.

FOR GAS SERVICE (FIG.5) - START UP

Recommended when hydrates or heavy solids are present. Piping diameter not less than 1/2". Drain valves are required

1 through 5 of Fig. 5.

6. Drain condensate chambers of hydrates at regular intervals.

FIG. 6

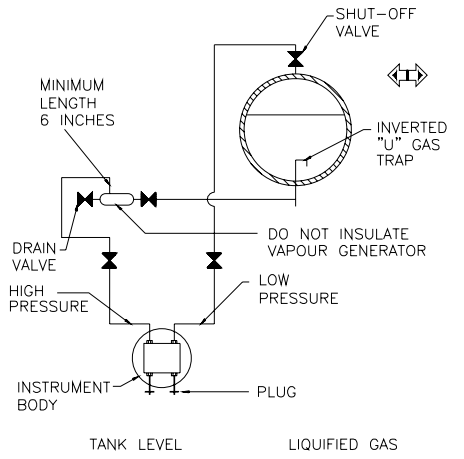
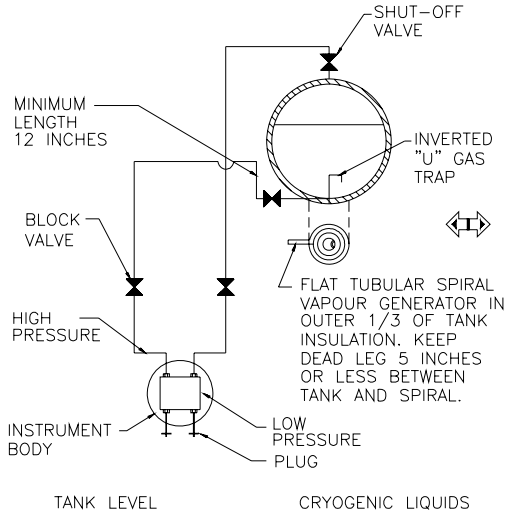


FIG. 7



FOR LIQUIFIED GAS SERVICE (FIG. 6) - START-UP

Recommended for use with CO_2, Butane, Propane, Freon, and other liquified gases warmer than (–100°C). Instrument may be mounted above or below tank.

Vapour generator is a 12" length of 1" to 1½" diameter pipe; avoid traps or pockets between vapour generator and tank. Install inverted "U" gas trap inside tank. Do not insulate piping below lower shut-off valve. Do not share fill or vapour return lines with meter piping.

1. Close block valves.
2. Open drain valve and loosen meter housing drain plugs to remove all liquid from system. Replace plugs.
3. Close drain valve and slowly open bottom shut-off valve to allow liquid to enter gas generator.
4. Open upper shut-off valve and block valves.

FOR CRYOGENIC LIQUID SERVICE (FIG.7) – START-UP

Recommended for use with Oxygen, Nitrogen, and Argon. Instrument may be mounted above or below tank. Vapour generator is a spiral of 3/8" tubing. Install an inverted "U" gas trap inside tank. Do not share fill and vapour return lines with meter piping.

CAUTION : Instrument designed for use with oxygen are specially cleaned and packaged, and MUST be kept clean. No organic compounds, oil, grease, dirt, or scale of any kind can be tolerated in an oxygen installation.

1. Close block valves. Loosen instrument body drain plugs to remove all liquid from system. Replace Plugs.
2. Slowly open HP (bottom) shut-off valve to allow liquid to flow through gas generator.
3. Open LP (top) shuto-ff valve, and open block valves.

K. FINAL ADJUSTMENT

It is advisable **to re-check** instrument zero and to test the operation of the by-pass valve **after** the Differential Pressure Indicator **has been placed** i**n service and fully subjected to differential pressure, line pressure, and process/ambient temperature**.

CAUTION : Never zero check when only one block valve is shut. In gas flow service, **a standing wave effect** in the process line can displace the indicator; the displacement could be assumed to be an erroneous reading.

1. With the instrument subjected to differential pressure and in service, observe the position of the pointer on the scale and use this reading as a reference for checking the effectiveness of the by-pass valve on the instrument piping manifold. Close the H.P block valve. (Note that when checking instrument zero where seal pots are involved, the primary element shutoff valve is used instead of the instrument valve on the piping manifold). If the pointer moves from the reference position towards zero, it indicates that the by-pass valve on the piping manifold is leaking and must be replaced. If the pointer remains in the reference position, the by-pass valve is functioning properly.
2. Open the by-pass valve on the instrument piping manifold. The pointer should go to zero on the scale. If the instrument does not indicate zero, check for gas or liquid entrapment in the lines or in the Differential Pressure Indicator (depending on the orientation of the piping layout and service). If necessary, adjust the pointer by turning the dial to bring the pointer to zero reference.
3. **Adjustment of the Pulsation Dampener**

CAUTION : Never try to remove the pulsation dampener (snubber) adjusting screw. **Serious injury** can result if adjustment screw is removed with the instrument under pressure. When an increase in dampening is required, as **indicated by a quivering** movement of the instrument pointer, turn the damping screw clockwise until the pointer just stops its oscillation. Do not over-adjust. (See "Operating Limitations-Pulsation" explained earlier). **Further damping** will decrease the speed of response and introduce unnecessary time lag into the measuring system. Re-check instrument zero.

L. TROUBLE SHOOTING

If trouble occurs, it is recommended that the routine shown below be followed :

TROUBLE	POSSIBLE SOURCE	MALFUNCTION	REMEDY
Low or No Indication	Primary Element or Differential Pressure Source	Orifice installed backwards, or oversize. Flow blocked upstream from run. Loss of liquid in reference leg (liquid level). Density changes in process medium or Reference leg.	Replace orifice, or install properly. Clean out run or open valve. Refill reference leg. Refill reference leg with liquid of same density as process medium.
	Piping from Primary Element.	Pressure tap holes or piping plugged. By-pass valve open or leaking. Liquids or gases trapped in piping. Block or shut-off valves closed. Piping leaks, high pressure side.	Clean out piping. Close by-pass valve(s). Replace Vent Piping. Open block or shut-off valves. Repair leaks.
	Diaphragm Unit	Pressure chamber filled up with solids restricting diaphragm travel. Process port filter chocked. Gas trapped in housing in liquid service or Liquid trapped in housing in gas service. High pressure port `O' ring leaks. Instrument tampered with.	Clean out chamber and filters. Vent or drain housing. Replace `O' Ring Return bourdon unit assembly for repairs.
	Movement Mechanism	Loose linkage arms or movement. Out of calibration. Corrosion or dirt in mechanism. Pointer loose.	Tighten or replace. Re-calibrate. Clean or replace. Tighten or replace
High Indication	Primary Element Piping from Primary Element to Instrument	Orifice partially restricted or too small. Leak in low presure piping. Incorrect hook-up for tank level indications.	Clean out or replace. Repair. See “Gauge Piping Diagrams” and “Final Adjustment”.
	Diaphragm Unit	Gas trapped in low pressure housing in Liquid service or liquid trapped in high pressure housing in gas service. Low-pressure chamber `O' Ring leaks. Instrument tampered with.	Vent or drain housing. Replace `O' Ring Return bellows unit assembly for repairs.
	Movement Mechanism	Loose linkage arms or movement. Out of Calibration.	Repair or replace. Recalibrate.
Erratic Indication	Primary Element Piping from Primary Element to Instrument	Flow pulsating. Liquid trapped in gas piping or Gas bubble in liquid piping. Vapour generator incorrectly installed. Reference leg gassy or liquid vapourising. Obstructed diaphragm travel.	Adjust pulsation dampener. Remove (See startup instructions) Re-pipe. See piping instructions and diagrams. See “Instrument Inspection and Cleaning”.
	Diaphragm Unit	Gas trapped in high-pressure or low-pressure chamber.	Remove gas trapped (See “Gauge Piping Diagrams”).
	Movement Mechanism	Movement dragging or dirty. Pointer dragging on scale plate.	Tighten and adjust Adjust and clean.

M. MAINTENANCE

Periodic inspection and cleaning of the Differential Pressure Indicator is a standard recommended practice. Re-calibration, unless required because of a defective component or workmanship, is also considered as normal maintenance function.

Removing the instrument from service

1. Close the High primary element shut-off valve.
2. Close the Low pressure primary element shut-off valve.
3. Close the high pressure instrument shut-off valve on the piping manifold.
4. Open the by-pass valve on the piping manifold.

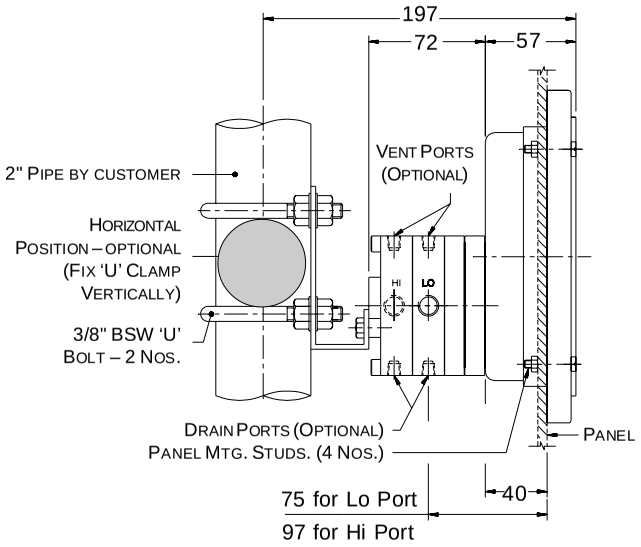
Instrument Inspection & Cleaning

When instruments are used in services where **solids or semi-solids** can accumulate, the instrument pressure chambers and diaphragm unit will require periodic inspection and cleaning. This can be performed as follows.

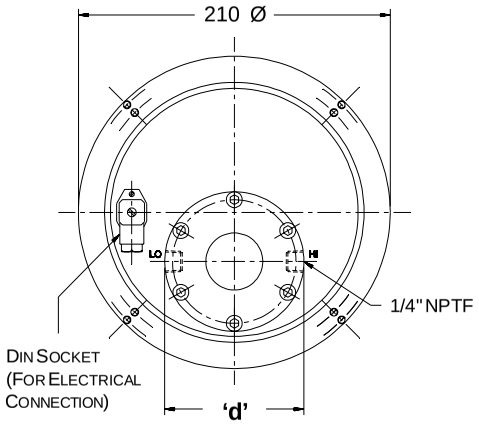
1. Remove instrument from service, as described above.
2. Open up the Dial unit, by removing the bezel and lens. Remove pointer using a pointer puller and then the dial, to access the movement. Air blow the dust out if any. Clean-up the movement gear teeth with acetone to remove greasiness.
3. Remove the filter in pressure ports and clean up.
4. Remove the sealing plug at the bottom of high chamber.
5. Rest the instrument on it's dial housing face, measure the depth of the bottom over range stop from face of the high pressure chamber with the help of a vernier. Then remove the dome-nut, bottom over range stop using tube spanners.
6. Now remove the six - M6 Allen cap screws. The high chamber, low chamber along with the diaphragm unit gets detached from the motion transfer unit.
7. Now remove the lock nut on the diaphragm face and remove the washer. Carefully remove the diaphragm and wash of all the debris by flushing with water. If necessary use a suitable solvent but compatable to the seal material.
8. Flush clean both high and low chambers and their pressure ports.
9. After cleaning up, re-fix the diaphragm unit assembly in the same reverse order of dis-mandling, ensure that the depth specified in Clause 5 above is maintained after re-assembly or else the instrument functioning will not be correct.
10. Ensure that all screws, nuts, bolts etc., are re-tightened properly retaining all pressure seals in position in it's original place.
11. Then re-calibrate the instrument after re-assembly.

OVERALL DIMENSIONS

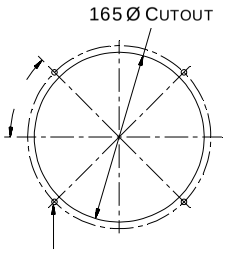
2" PIPE MOUNTING



REAR VIEW
(Without Mounting Accessories)



FLUSH PANEL MOUNTING CUTOUT DIMENSIONS



d – **88 mm** for 0–600 mbar to 0–2.5 bar ranges
145 mm for 0–40 to 0–400 mbar ranges

Notes :
1. For wall mounting drill 2 Nos. 10.5Ø holes. Use 3/8" × 40L Coach Screws for fixing the instrument.
2. S.S. Gauge case dimensions are different. Ask factory for drawing.
3. All dimensions have a tolerance of ±2.0 mm

ALL DIMENSIONS ARE IN mm

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