ABBITZ Measurement LLC

Model 338C

DIFFERENTIAL PRESSURE INDICATOR W/ 113C DPU

Installation and Operation Manual

January 2014 Rev.1

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SAFETY **Before installing this instrument, become familiar with the installation instructions in Section 2.**

WARNING:  **This symbol identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.**

CAUTION: ***Indicates actions or procedures which if not performed correctly may lead to personal injury or incorrect function of the instrument or connected equipment.***

IMPORTANT: *Indicates actions or procedures which may affect instrument operation or may lead to an instrument response that is not planned.*

Section 1 – INTRODUCTION

1.1.General

This manual includes the technical information such as procedures, charts, parts lists, diagrams, and illustrations necessary to install, operate, maintain, troubleshoot and repair the Abbitz Model 338C Differential Pressure Indicator and the Abbitz Model 113C Differential Pressure Unit.

The Model 338C is designed to measure liquid flow or liquid level. In flow measurement applications, the instrument is connected to the low- and high-pressure sides of a primary device located in the process run. The primary device may be any pressure drop device such as an orifice plate, venture tube, or flow tube. In liquid level measurement applications, the instrument is connected to monitor changes in hydrostatic pressure caused by variations of liquid height in a vessel.

1.2. Product Description

The Model 338C Differential Pressure Indicator consists of two major components: an actuating Differential Pressure Unit (DPU) and the case enclosed indicating instrument (indicator). The indicator has a 6 inch dial. The indicating pointer traverses a 270°arc (nominal) to measure differential pressure, flow or liquid level. The indicator movement has a micrometer screw for range adjustment. Zero is adjusted by "slipping" pointer on hub, which can be done without removing the scale plate or the pointer. The range can also be adjusted without removing the scale plate or pointer. Linearity adjustments are accessible after removal of the scale plate. The Model 338C is actuated by an Abbitz Model 113C DPU.

1.3. Theory of Operation

The bellows within the DPU moves in response to changes in the differential pressure measured at the primary device installed in the process system. This movement of the bellows is mechanically transferred to the indicator mechanism, which in turn positions the indicating pointer.

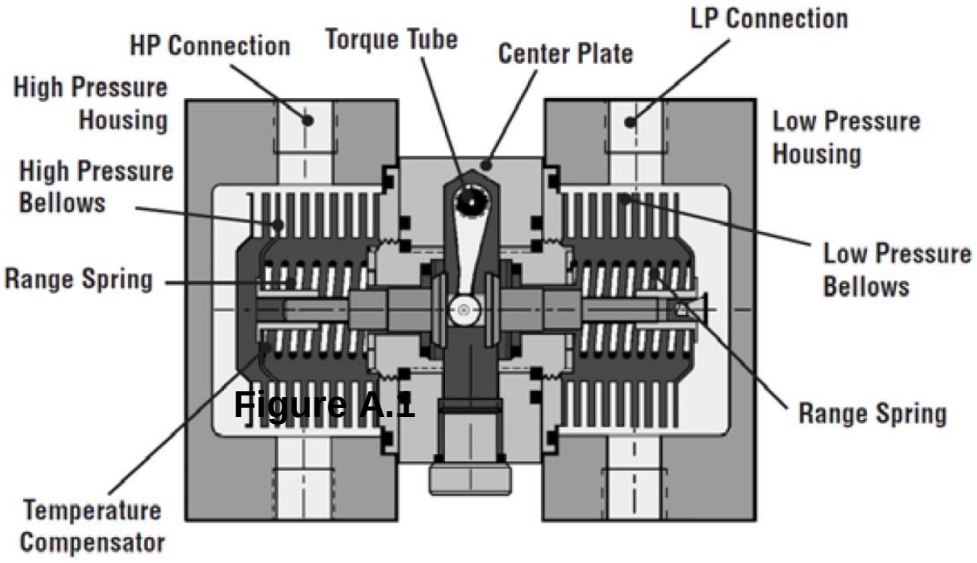


Figure A.1

1.3.1. Differential Pressure Unit (DPU)

The 113C DPU is a dual bellows assembly (one high pressure and one low pressure bellow), which is enclosed by a set of two pressure housings(pressure heads).

This assembly consists of two internally-connected bellows, a center plate, overrange valves, a temperature compensator, a torque tube assembly, and range springs. The bellows and center plate are completely filled with a noncorrosive liquid and then sealed. The pressure housings, located on either side of the center-block, are connected by pipe or tubing to a systems primary device. Variations in differential pressure within the two pressure housing cause the bellows to expand or contract laterally in the direction towards the side of lowest pressure. As the bellows move, the connecting drive arm follows this linear motion, and twists the torque tube. The rotation of the torque tube shaft provides the mechanical motion required to actuate monitoring instruments, such as recorders, indicators, transmitters, controllers and switches.

If the bellows are subjected to a pressure greater than the range of the DPU, they move their normal travel range and a small amount of overtravel until the overrange valve seals against the valve seat. As the valve closes, the fill liquid is trapped in the bellows. Since the fill fluid is essentially noncompressible, the bellows are fully supported and will not be damaged regardless of the overpressure (up to the full rated pressure of the instrument) applied to them. Also, since dual overrange valves are used, full protection against overrange is provided in either direction.

An additional convolution in the high-pressure side of the bellows provides for expansion or contraction of the fill fluid relative to ambient temperature changes. This extra convolution acts as an accumulator permitting the fill fluid to change volume without materially affecting the pressure within the bellows or changing the physical relationship of the two bellows.

1.3.2. Indicator

The indicator is attached directly to the actuating unit (DPU). The indicator consists of a drive arm assembly, linkage, and a movement assembly to which the indicating pointer is attached. Changes in differential pressure are sensed by the DPU bellows and transmitted as rotary motion through the torque tube to the drive arm assembly of the indicator. The linkage and movement assembly respond to the action of the drive arm assembly to position the pointer on the scale to the indication relative to the differential pressure sensed by the DPU.

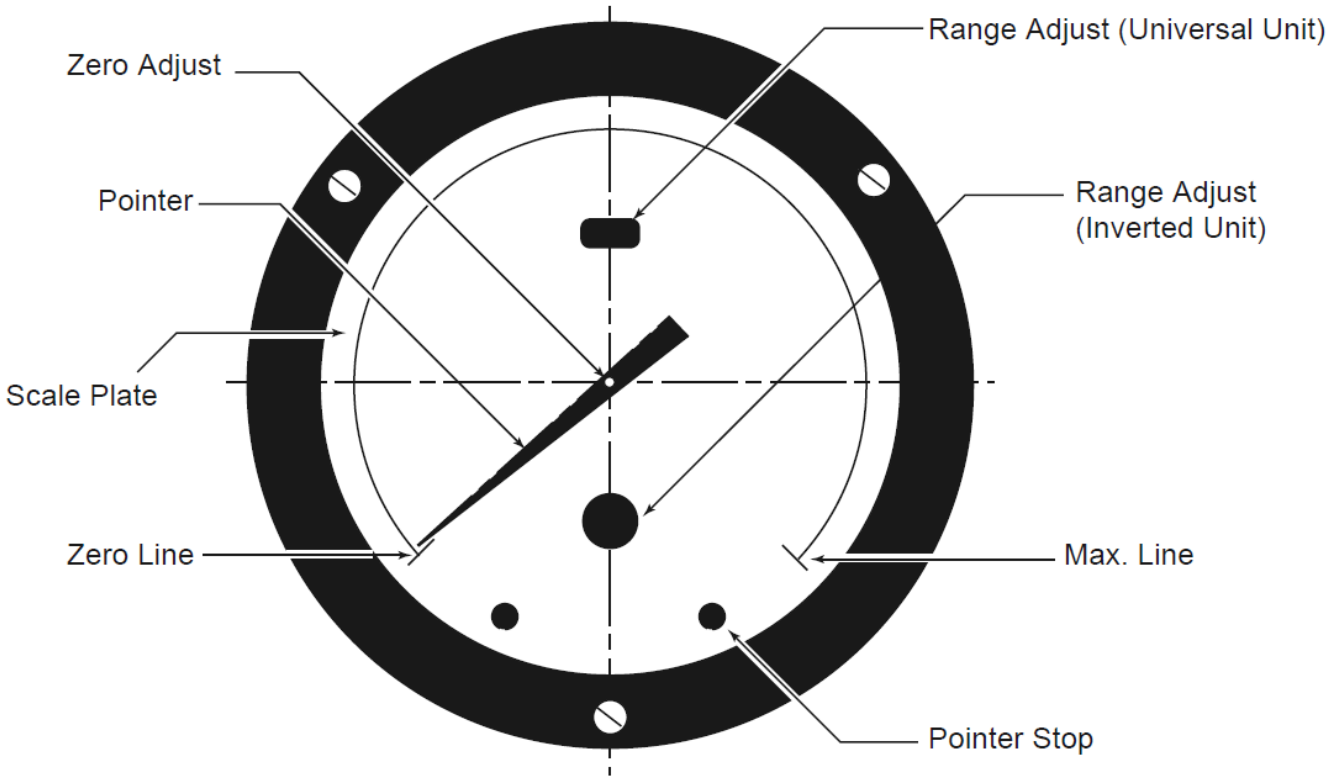


Figure 1.1—Instrument face

1.4. Indicator Specifications

Actuating Unit.....Model 113C DPU
Dial Size.....6 Inches (150mm) Diameter
Temperature Limits.....-40°F/C to + 180°F (+82°C)
(+40°F minimum for water filled units- "D" Fill)
Adjustments..... Zero and Span (Micrometer-type)
Mounting.....Flush/Panel, Wall, and 2"Pipe/Yoke,
Indicator Case.....Aluminum Alloy, Enamel or Epoxy Finish
Lens.....Polycarbonate
O-Rings (Wetted).....Buna-N, Viton, or EPT (Special available upon request)
Overall Dimensions.....per configuration and DPU housing rating see Outline Dimensional Drawings in section 5, page 3.
Weight.....6 to 9.5 lbs (approx.) Weight depends on DPU configuration/materials.
Accuracy (DP Range)

0-30 IN WC to 0-50 IN WC
(0-75 mbar to 0-124 mbar).....±0.75% of full scale

0-51 IN WC to 0-60 psi
(0-127 mbar to 0-4.1 bar)..... ±0.5% of full scale

0-61 psi to 0-150 psi
(0-4.2 bar to 0-10.3 bar) ..... ±0.75% of full scale

0-151 psi to 0-400 psi
(0-10.4 bar to 0-27.6 bar).....±1.0% of full scale

1.5. DPU Specifications

The Model 133C DPU is available in various pressure ratings to measure to specific ranges between 0-30 inches of water column and 0-400 psi, with safe working pressure (SWP) ratings of 500,1,000,1,500,3,000 and 6,000 psi. See Table 1.2, page 7
The Model 335C Bellow Unit Assembly (BUA) is available in two bellows diameters: 1 5/6inch and 3/4 inch.
The BUA with 1 5/8-inch bellows accommodates differential pressures to 30 psi. The range springs are contained within the bellows and do not come in contact with the measured liquid.
The BUA with 3/4-inch bellows accommodates differential pressures up to 400 psi. The range springs are grouped outside of the bellows and must be of a material that is compatible with the liquid being measured.

Table 1.2 - 113C DPU General Specifications Table

SWP psi (bar)		BODY	AVAILABLE DIFFERENTIAL PRESSURE RANGES		PRESSURE CONNECTIONS	
		Housing Material	Stainless Steel or Inconel Bellows 1-5/8" (41 mm) O.D.	Inconel Bellows 3/4" (19mm) O.D.	Top	Bottom
113C	500 (34)	Forged Brass (ASTM-B 124#2)	0-30 IN WC (0-75 mbar) to 0-30 psi (0-2.068 bar)	0-31 psi (0-2.137 bar) to 0-400 psi (0-27.579 bar)	1/4' NPT	1/4" NPT
	500 (34)	Stainless Steel (316)			1/4" NPT	1/4" NPT
	1000 (69)	Copper Nickel (70-30) (MIL-C-15726)	0-60 IN WC (0-149 mbar) to 0-30 psi (0-2.068 bar)		MS-16142-4	MS-16142-4
	1,500 (103)	Stainless Steel (316)			1/4' NPT	1/4" NPT
	3,000 (207)	Stainless Steel (316) Monel			1/2' NPT	1/4" NPT
	6,000 (414)	Stainless Steel (316)			1/2' NPT	1/4" NPT
Net Volume cu. In. (cu. cm)		L P Head	1.66' (27.2 cc)	1 .66' (27 2 cc)	2 51' (41.1 cc)	
		H.P. Head	1.55' (25.4 cc)	1 .55" (25.4 cc)	2.42' (39.7 cc)	
Displacement cu in. (Cu cm) for full-scale Travel			0.14" (2 3 cc)	0 14' (2.3 cc)	0.03" (0.49 cc)	

Performance: Torque Tube Rotation = 8° ±10%, Torque Tube Matenal = Beryllium Copper (BeCu), Temperature Limits = -40°F1 C to +180°F (+82"C); Maximum Non-linearity = per Range. Repeatability = 0.2% of full scale differential pressure

Notes: Zero center or split ranges available on special order (e g . 0-60" w c (0-149 mbar) range may be ordered 30-0-30 IN WC (75-0-75 mbar) or (15-0-45" w c (37-0 112 mbar); Other sizes and types of connections available upon request

SECTION 2 – INSTALLATION

2.1. General

The instrument should be inspected at time of unpacking to detect any damage that may have occurred during shipment.

IMPORTANT: *The DPU was checked for accuracy at the factory – do not change any of the setting during examination or accuracy will be affected.*

For applications requiring special cleaning/precautions, a polyethylene bag is used to protect the instrument from contamination. This bag should be removed only under conditions of extreme cleanliness.

2.2. Zero Check/Adjustment

IMPORTANT: Adjusting the instrument's ZERO in accordance with the following procedure does not invalidate the original factory calibration or warranty.

Before placing the 338C indicator into service check the zero indication, and adjust if necessary. Zero adjustment can be accomplished without removing the scaleplate.

To check the zero indication, perform the following steps.

1. Mount the instrument in an approximately level position, with the top of the DPU level with the horizontal plane.
2. If the zero indication is incorrect, adjust it as follows:
    a. Remove the bezel and lens following the instructions provided in Bezel/Lens Installation and removal, Section 3.3
    b. Using a 1/4" open-end wrench, hold the hexagon pointer hub fixed and rotate the pointer with fingers until the point accurately indicates ZERO on the scale.(refer to Figure 2.1)
    c. Reassemble the unit, attaching the lens gasket, lens, and bezel to the case following the following the instructions provided in Section 3.3.

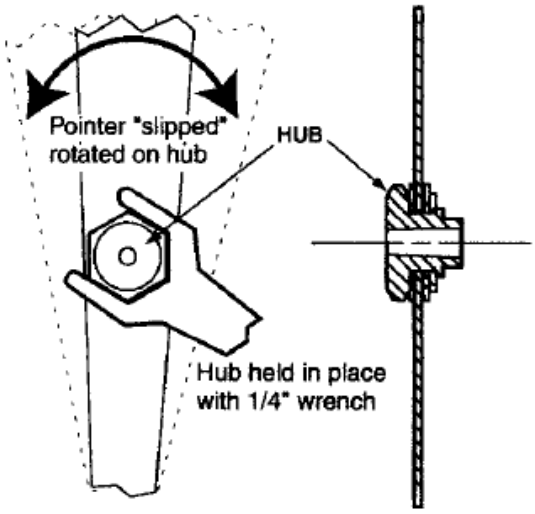


Figure 2.1—"Slipping" pointer

2.3. Mounting

(Refer to the SECTION 5 – INSTALL/DIMENSIONAL DRAWINGS)

A. Flush/Panel Mounting

1. Cut an opening in the panel and drill four holes (17/64”). Per outline dimension Drawing in Section 5.2 – Install Drawings.
2. Pass the instruments through the cutout in the panel (from panel front).
3. Attach the indicator to the panel with four screws.

B. Wall Mounting

1.Remove the pipe mounting U-bolts from bracket.
2.Drill four holes in the wall to match the bracket mount holes, per outline dimensions drawing.
3. Attach indicator to wall with bolts and nuts.(Not Provided)

C. 2" Pipe/Yoke Mounting

1. Refer to drawing in Section 5.1. The unit must be mounted approximately level for proper operation.

2.4 Piping

Standard Piping Practices(observe when installing piping):

WARNING:
HIGH PRESSURE HAZARD TO PREVENT PERSONAL INJURY OR DAMAGE TO EQUIPMENT, DIRECT ALL PIPING AWAY FROM THE OPERATOR WHILE CONNECTING THE DPU TO THE SYSTEM PIPING.

WARNING:
EXPLOSION HAZARD. NO ORGANIC COMPOUNDS, OIL, GREASE, DIRT, OR SCALE OF ANYKIND CAN BE TOLERATED IN AN OXYGEN INSTALLATION.

WARNING:
FOR INSTALLATIONS WHERE THE PRESSURE COULD EXCEED THE RATED MAXIMUM SAFE WORKING PRESSURE OF THE DPU, THE PIPING SYSTEM MUST INCLUDE PROTECTIVE MEASURES TO PREVENT OVER PRESSURE, IN ACCORDANCE WITH APPLICABLE LOCAL AND NATIONAL PIPING CODES.

WARNING:
THE MODEL 113C DPU IS NOT DESIGNED FOR HIGH STATIC OR DYNAMIC LOADS AT IMPULSE LINE CONNECTIONS. THE IMPULSE PIPING SYSTEM MUST BE DESIGNED WITH ADEQUATE SUPPORTS TO MINIMIZE THE LOADS AT THE DPU.

WARNING:
DO NOT REUSE HOUSING BOLTS. SEE HOUSING BOLT WARNING ON PAGE 34.

CAUTION:

DPU pressure rating has been determined using standard methods without specific considerations for corrosion (internal or external) or Fatigue. The system designer should appropriately derate any DPU . Where these considerations are significant issues. Do not subject DPU to unnecessary shock/overrange pressure during operation.

CAUTION:

DPU bellows protects torque tube from exposure to process fluid. Cyclic conditions can cause undetected bellows failure resulting in exposure of the torque tube to the process fluid.

IMPORTANT
Do not share filling or vapor return lines with DPU piping lines.

- Shorten the distance between the primary device and the DPU as much as possible. Distances exceeding 100 feet are not recommended. For distances up to 50 feet, use 1/4-inch piping or tubing. For runs of 50 to 100 feet, use 1/2-inch pipe or tubing, The recommended limitation does not apply if any air purge or blow-back system is used.
- Slope all piping at least one inch per linear foot to avoid liquid or gas entrapment.
- If process media exceeding +200°F (+93.3°C) must be measured. install two feet of un-insulated piping between the DPU and the primary device for each 100 degrees in excess of +180°F (+162°C),
- Assure that the temperature of the DPU never exceeds 180°F (+162°C). When steam tracing is necessary, the steam pressure should not exceed five pounds per square inch and insulation should not be used. If pressure must exceed five pounds per square inch, limit the length of tubing around the DPU to two turns and do not insulate.
- When severe pulsation is present, install a suitable pulsation dampening device upstream of the DPU; otherwise, accuracy will be affected.
- Mount the DPU on a solid support to minimize vibration. Tighten all points, using a suitable compound; leaks in piping can cause measurement errors.

- Rotate the housing as necessary to place the connection in the proper position. The DPU has connections in the pressure housing to accommodate various pipe sizes (refer to Section 5 – Install Drawings).

- Install a valve manifold connecting the DPU and the source of differential pressure to facilitate operation and checking of the DPU.
- Install all shutoff and bypass valves so they are easily accessible from the front of instrument. Locate block valves at the source of differential pressure.
- For gas service, it is recommended that zero check be performed with both block valves closed. If the gas flow is pulsating, there may be a standing wave effect in the process line which can displace the indicator and appear as a zero error.

2.5. DPU Piping/Startup Examples

"Typical" piping diagrams and startup procedures are presented on pages 9-17. Review all WARNINGS, CAUTIONS, AND NOTICES (pages 9 and 10) before installation or startup.

- **Flow Applications** (HP = High Pressure) Ensure DPU HP housing is connected to the primary device upstream tap.

IMPORTANT:
To prevent overheating DPU during blow-down operator should monitor temperature by placing his hands on pipe between DPU and the manifold pip .containing the vent valves.

- **Liquid Level Applications**
  The process media may be used as a reference leg seal fluid when it is of a type that will condense in the reference leg under all conditions. If the process or process media characteristics are such that the above conditions cannot be met, a special reference leg seal fluid will be required. If special seal fluid media characteristics are such that the above conditions cannot be met, a special reference leg seal fluid will be required. The special seal fluid must not be volatile and must not be miscible with the process media. The difference in densities (special seal fluid vs process media) will require compensation in calculating differential pressure range of the DPU.

- **Liquid Specific Gravity Applications**
  This method of piping is used for determining specific gravity changes in a process media using differential pressure instruments.

2.5.1. Gas Flow , DPU Above Run

Recommended for use whenever possible as the DPU is self-draining. However, NOT recommended when hydrates are present.

1. Open bypass valve(s) and close vent valve.
2. Open both shutoff valves and one block valve to pressurize DPU, then close block valve.
3. Close one bypass valve and check system for leaks. If output travels upscale, check for low-pressure piping leaks. If output travels downscale check for high-pressure piping leaks
4. Repair piping if necessary and repeat steps 1 through 3 until output remain stationary at zero
5. Close both shutoff valves and open bypass valve(s).
6. Open both block valves and slowly open both shutoff valves.
7. Close bypass valves and if two bypass valves are used, open vent valve.

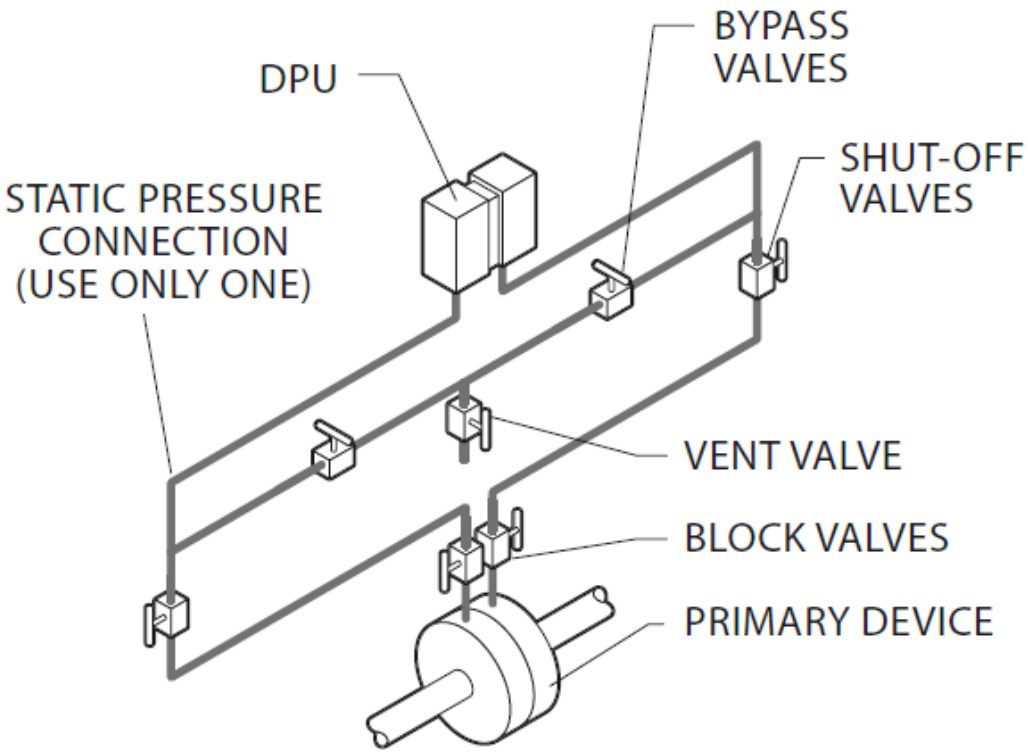


Figure A.3—Gas Flow, DPU Above Run

2.5.2. Gas Flow , DPU Below Run

Used only when necessary to mount the DPU below run. Drip pots are required when wet gas is present.

1. Open bypass valve(s) and close vent valve.
2. Open both shutoff valves and one block valve to pressurize DPU, then close block valve.
3. Close one bypass valve and check system for leaks. If output travels upscale, check for low-pressure piping leaks. If output travels downscale check for high-pressure piping leaks
4. Repair piping if necessary and repeat steps 1 through 3 until output remain stationary at zero
5. Close both shutoff valves and open bypass valve(s).
6. Open both block valves and slowly open both shutoff valves.
7. Close bypass valves and if two bypass valves are used, open vent valve.
8. If drip pots are used, open drip valves and blow out accumulated liquid

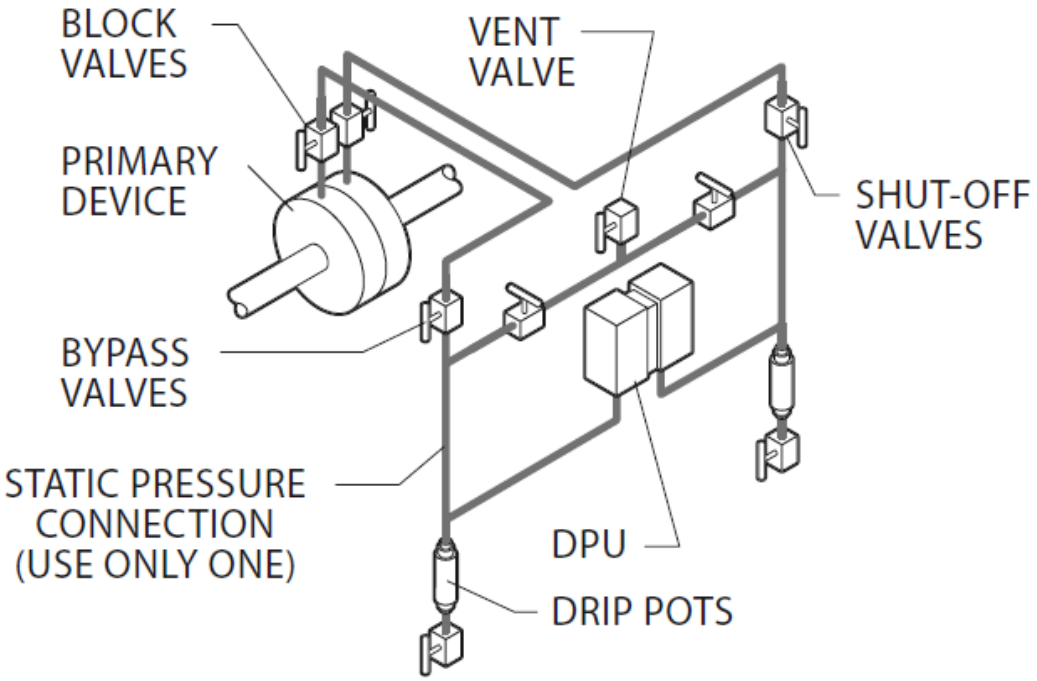


Figure A.4—Gas Flow, DPU Below Run

2.5.3. Gas Flow, Hydrates Present

The following is used if hydrates or heavy solids are present, piping and shutoff not less than 1/2-inch in diameter. Bypass the manifold above to isolate the meter from connecting piping. Drip pots prevent plugging.

1. Open bypass valve(s) and close vent valve.
2. Open both shutoff valves and one block valve to pressurize DPU, then close block valve.
3. Close one bypass valve and check system for leaks. If output travels upscale, check for low-pressure piping leaks. If output travels downscale check for high-pressure piping leaks
4. Repair piping if necessary and repeat steps 1 through 3 until output remain stationary at zero
5. Close bypass valves and if two bypass valves are used, open vent valve.
6. Drain drip pots of hydrates at regular intervals.

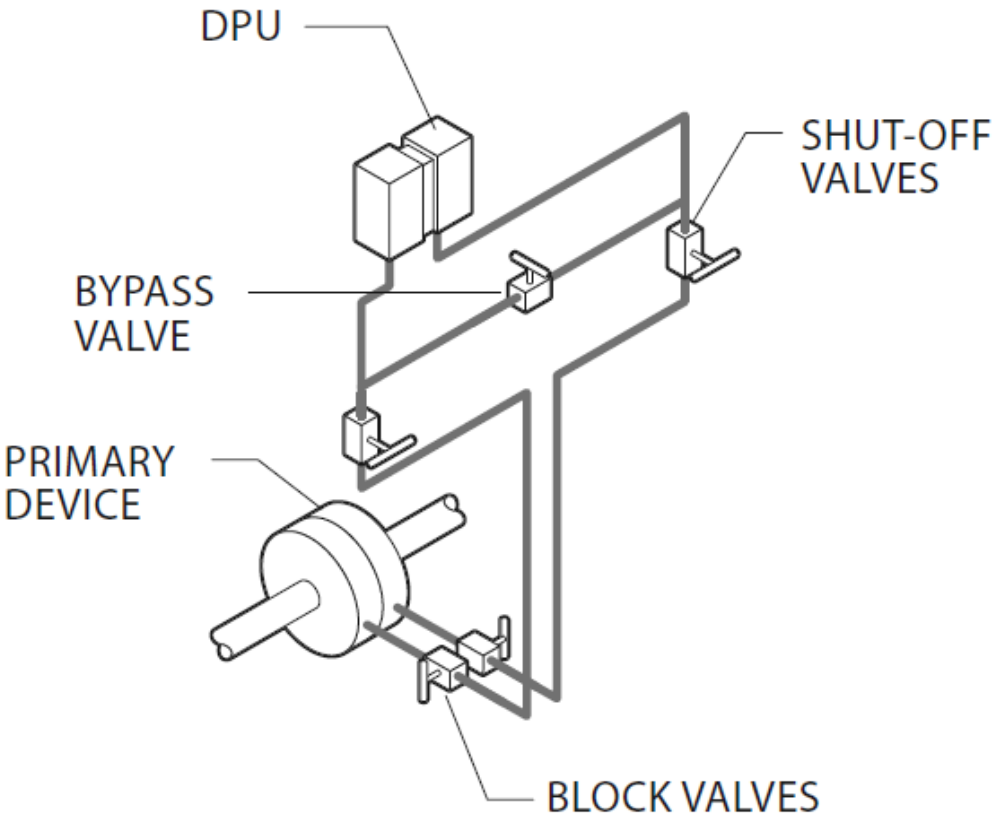


Figure A.5—Gas Flow, Hydrates Present

2.5.4. Steam Flow, DPU Below Run

For this application, condensing reservoirs and piping to orifice taps must be level. Assure that the reservoir and steam lines are at the same level. Two-inch pipe crosses may be used as seal pots.

1. Close vent valves if used, open bypass and shutoff valve.
2. Remove condensing reservoir side and fill plugs.
3. Pour water into both reservoirs until piping and DPU housings are filled. Piping and housings chambers shall be free of bubbles. The pointer will rest at zero then the DPU and piping are completely filled.
4. Install side and fill plugs in reservoirs.
5. Close shutoff valves and open block valves.
6. Slowly open both shutoff valves simultaneously and check for leaks
7. Close bypass valves.

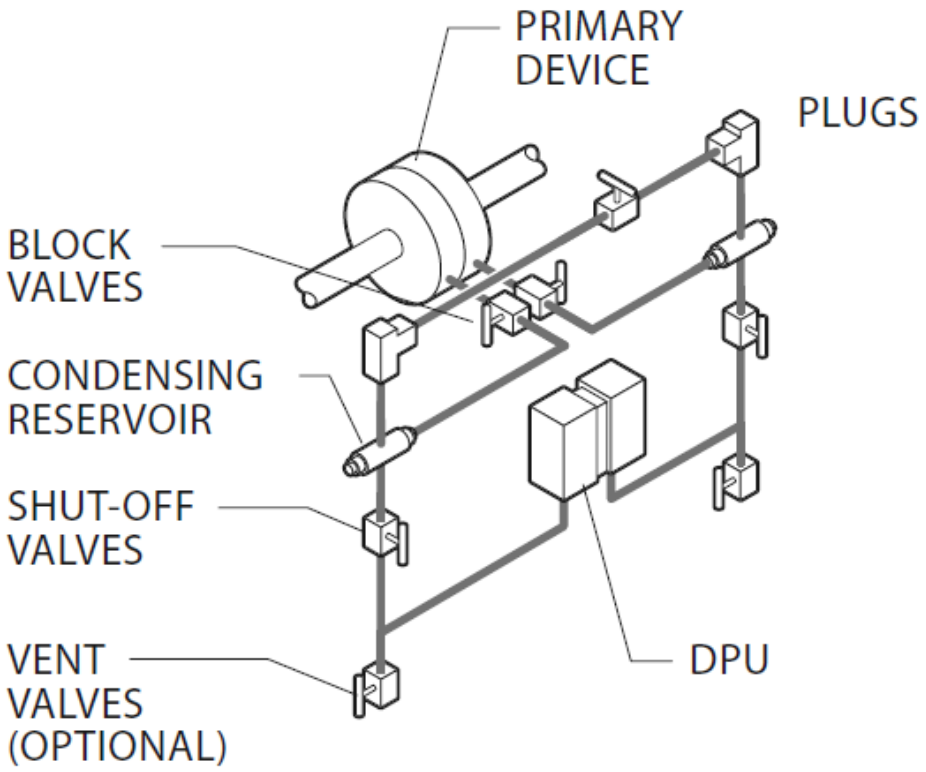


Figure A.6—Steam Flow, DPU Below Run

IMPORTANT:
Ensure that plugs are used and never valves on the DPU

2.5.5. Liquid Flow, DPU Above Run

The following steps should be used if sediments may be present. Inspect piping periodically. Not recommended for hot or gassy liquids.

1. Close both shutoff valves and open both block valves.
2. Open bypass valve. Crack vent valves or loosen plugs from top ports of DPU pressure housings. .
3. Crack and close shutoff valves alternately until liquid is free of bubbles and spills out of both upper housing ports.
4. Close vent valves or tighten plugs. Close block valves and open shutoff valves.
5. The pointer will rest at zero. If not and no leaks are detected, the housing and/or piping are not completely filled with liquid. Repeat steps 1 through 4 until pointer remains stationary at zero.
6. Slowly open both block valves and close bypass valve.

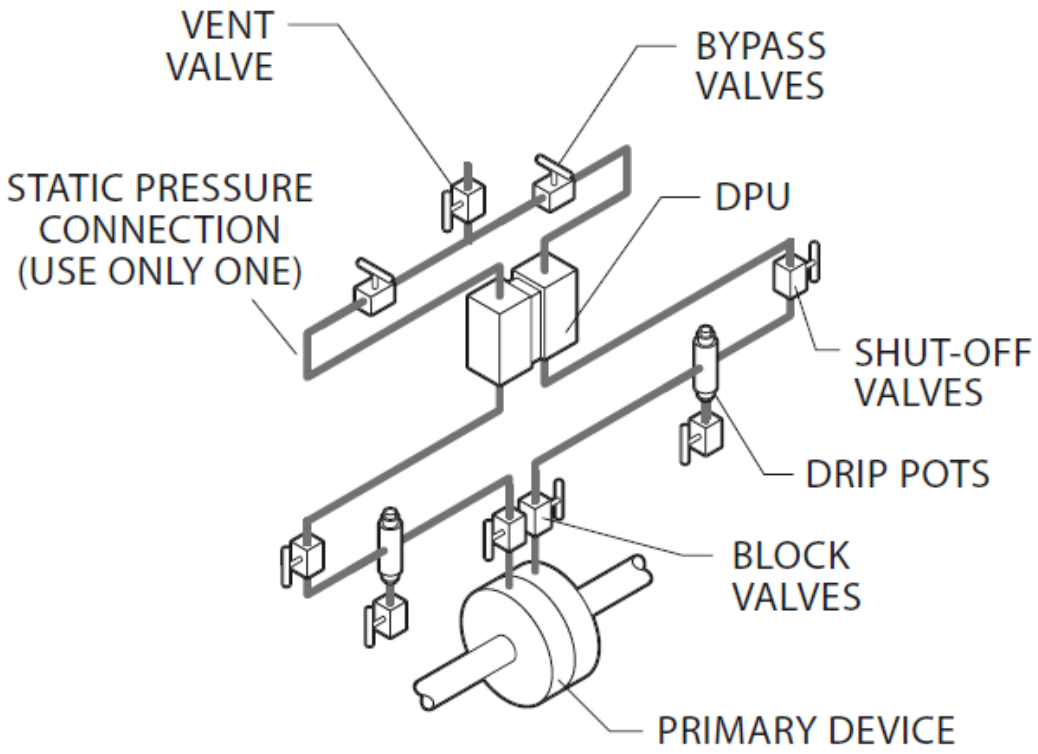


Figure A.7— Liquid Flow, DPU Above Run

2.5.6. Liquid Flow, DPU Below Run

The following steps are recommended for hot or gassy liquids. Periodic inspections of piping are recommended..

1. Close both shutoff valves and open both block valves.
2. Open bypass valve. Crack vent valves or loosen plugs from top ports of DPU pressure housings.
3. Crack and close shutoff valves alternately until liquid is free of bubbles and spills out of both upper housing ports.
4. Close vent valves or tighten plugs. Close block valves and open shutoff valves.
5. The pointer will rest at zero. If not and no leaks are detected, t he housing and/or piping are not completely filled with liquid. Repeat steps 1 through 4 until pointer remains stationary at zero.
6. Slowly open both block valves and close bypass valve.
7. For service with hot or gassy liquids, fill both sides of the manifold through the fill tee, with the liquid to be measured cooled to +200°F(+93°C) or less, expel gas bubbled from DPU and piping.
8. Open vent valves in the bypass valve. Tighten the fill plug when bubble free liquid flows.

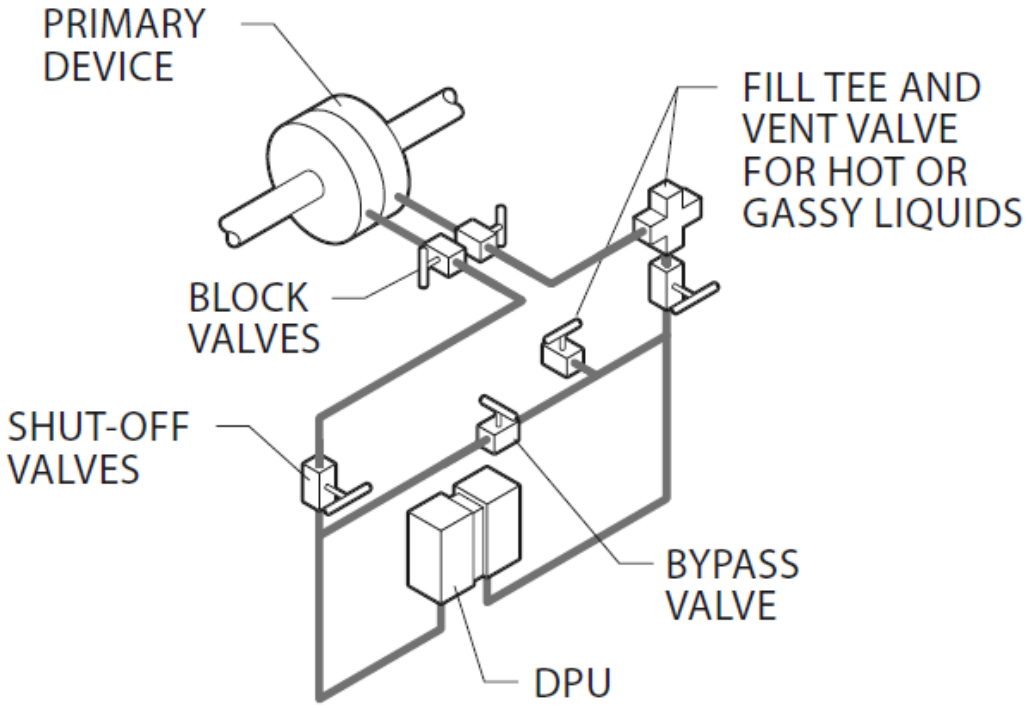


Figure A.8—Liquid Flow, DPU Below Run

2.5.7. Corrosive Liquid Flow

1. Close shutoff valves and open block valves.
2. Open bypass valve and close DPU drain plugs.
3. Remove fill and side plugs from seal pots.
4. Fill seal pots, piping and DPU housing with immiscible seal fluid by pouring into upper fill ports. DPU housing tubing and scale pots must be filled to seal pot side ports with bubble-free liquid. The pointer will indicate zero when high and low pressure housings are filled with liquid.
5. Install side plugs.
6. Slowly open each shutoff valve alternately, until bubble-free line liquid sills from both upper fill plugs.
7. Replace fill plugs.
8. Open and close block valves. Check for piping leaks. (repair as needed).
9. Close shutoff valves and open block valves.
10. Slowly open both shutoff valves and close bypass valve.

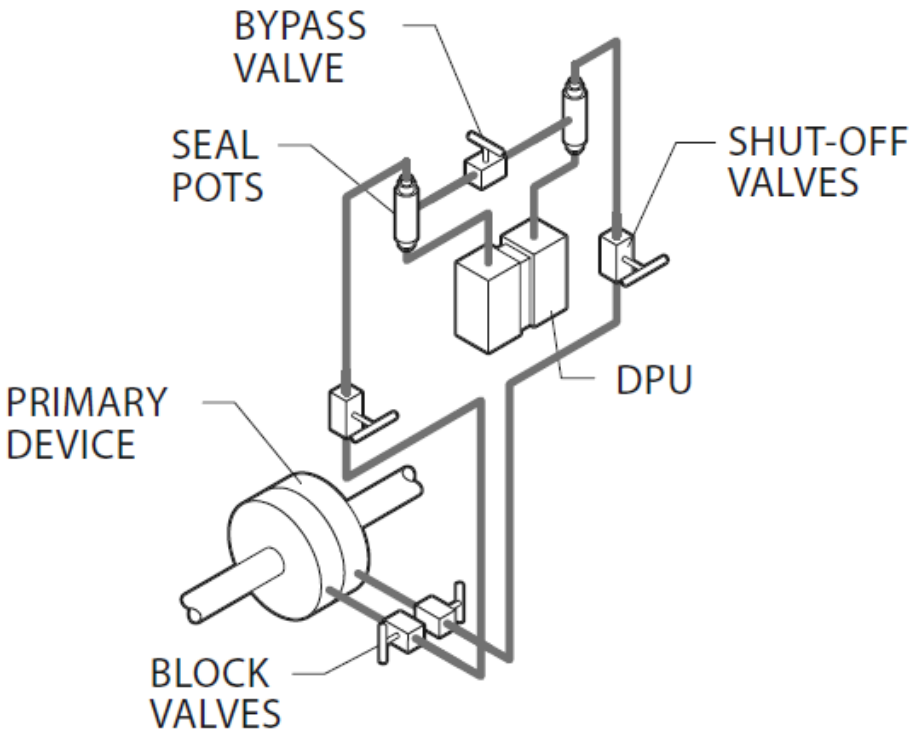


Figure A.9—Corrosive Liquid Flow

2.5.8. Cool Non-Condensing Liquid, DPU Level with Tank Bottom.

High-pressure side of DPU is connected to bottom outlet of tank. The low-pressure side is connected to top or gas outlet of tank. The following steps are suitable for piping layout for water, oil, or other media that will not condense in low-pressure piping.

IMPORTANT:
Do not share filling or vapor return lines with DPU piping.

1. Close both shutoff valves, open lower block valve and crack vent valve.
2. Slowly open lower shutoff valve. When bubble-free liquid spills from vent, close vent valve.
3. Open upper block valve and slowly open shutoff valve.
4. Crack drain valve to remove any condensation and close drain valve.

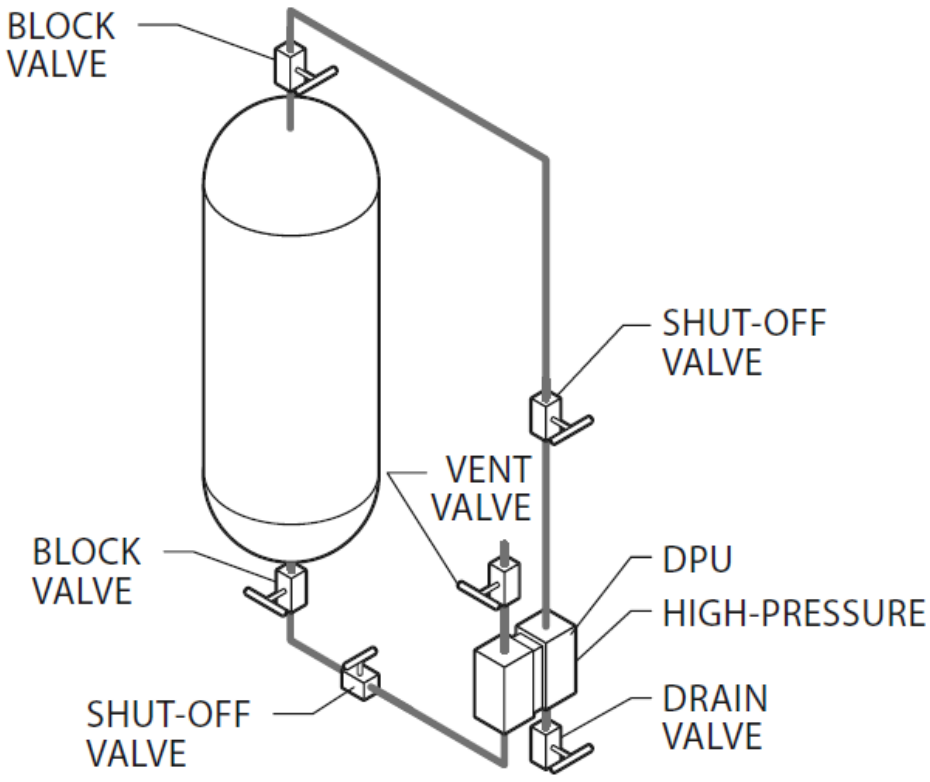


Figure A.10—Cool Non-Condensing Liquid, DPU Level with Tank Bottom

2.5.9. Cool Non-Condensing Liquid, DPU Below Tank.

High-pressure side of DPU is connected to bottom outlet of tank. The low-pressure side is connected to top or gas outlet of tank. The following steps are suitable for piping layout for water, oil, or other media that will not condense in low-pressure piping.

IMPORTANT:
Do not share filling or vapor return lines with DPU piping.

1. Close both shutoff valves, open lower block valve and crack vent valve.
2. Slowly open lower shutoff valve. When bubble-free liquid spills from vent, close vent valve.
3. Open upper block valve and slowly open shutoff valve.
4. Crack drain valve to remove any condensation and close drain valve.

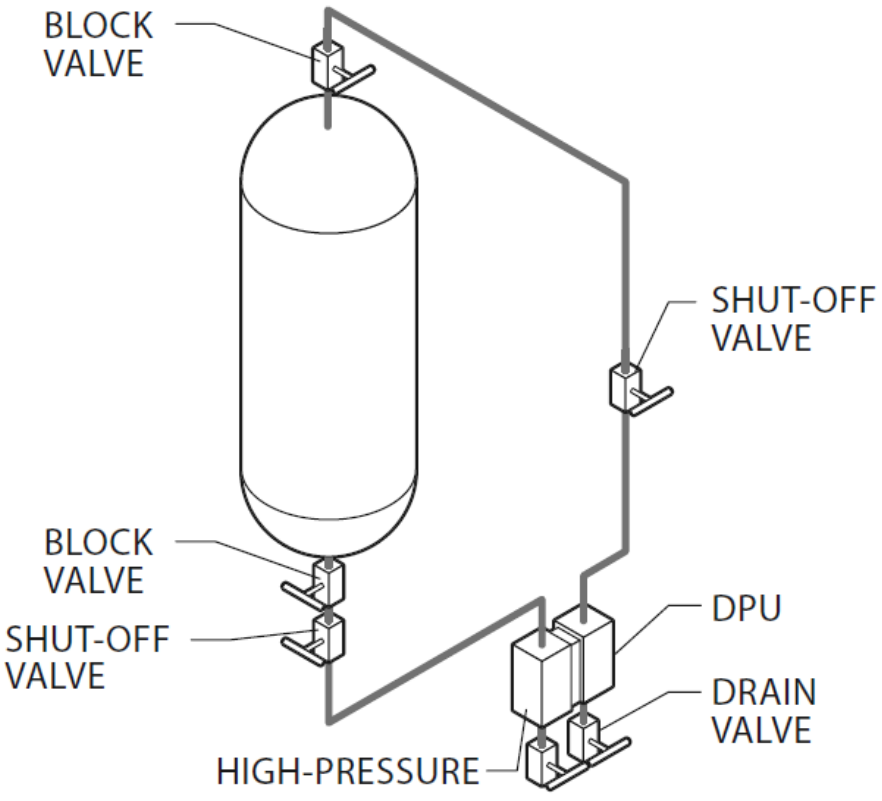


Figure A.11—Cool Non-Condensing Liquid, DPU Below Tank

2.5.10. DPU Below Tank with Reference Leg; Cool Liquids.

Use of reference leg cancels out the "dead leg" (piping from the tank bottom to center line of meter body). Seal fluid in reference leg must not volatilize. Process media can be used as a reference leg seal fluid if it is such that it will condense in reference leg under all conditions. Otherwise, special, immiscible seal fluid must be used. Difference in densities between process media and seal fluid must be considered when computing differential pressure range of DPU.

1. Partially fill reference leg by opening bottom block valve, both shutoff valves, and bypass valve.
2. Crack drain plugs on the DPU housing and vent the valve. Close when clear, bubble-free liquid flows.
3. Close bypass and shutoff valve on reference leg.
4. Remove plug from top port in 2-inch pipe cross connection, and fill the reference leg manually.
5. Open top shutoff valve and crack vent valve until bubbles are expelled. Leave reference leg full.
6. Replace plug in pipe cross and close vent valve.
7. Slowly open upper block valve.

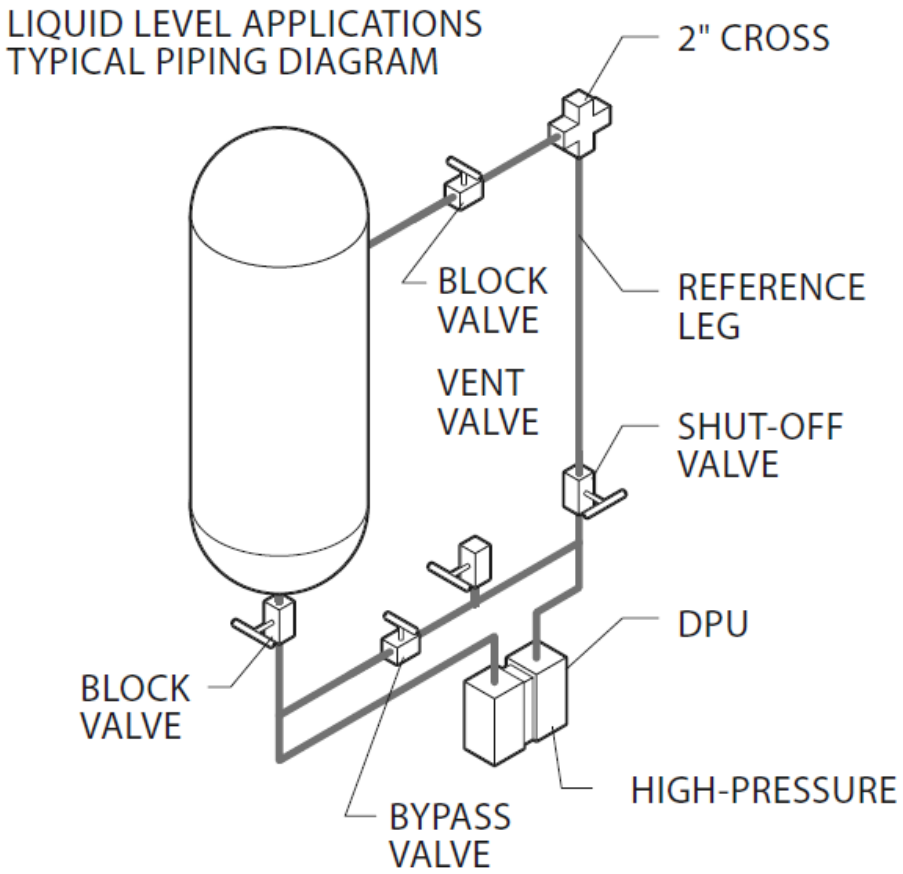


Figure A.12—DPU Bottom Tank with Reference Leg

2.5.11. DPU Below Tank with Reference Leg; Hot Liquids (Volatile)

1. Open both shutoff valves, bypass valve and vent valve.
2. Remove plug from top port in 2-inch pipe cross connection, fill both high and low DPU housings with liquid until it runs out of vent valves. Use liquid to be measured, cooled below +200°F (+93.3°C) or other suitable seal liquid. Expel bubbles in DPU housing.
3. Close bypass and shutoff valve on reference leg.
4. Remove plug from top port in 2-inch pipe cross connection, and fill the reference leg manually.
5. Open top shutoff valve and crack vent valve until bubbles are expelled. Leave reference leg full.
6. Replace plug in pipe cross and close vent valve.
7. Slowly open upper block valve.

IMPORTANT:

Do not share filling or vapor return lines with DPU piping. If bypass valve is opened at any time, the reference leg must be filled again. If no bypass is installed, disregard steps 1,2, and 3. Open the lower block valve in step 6 and shut off valve in step 7.

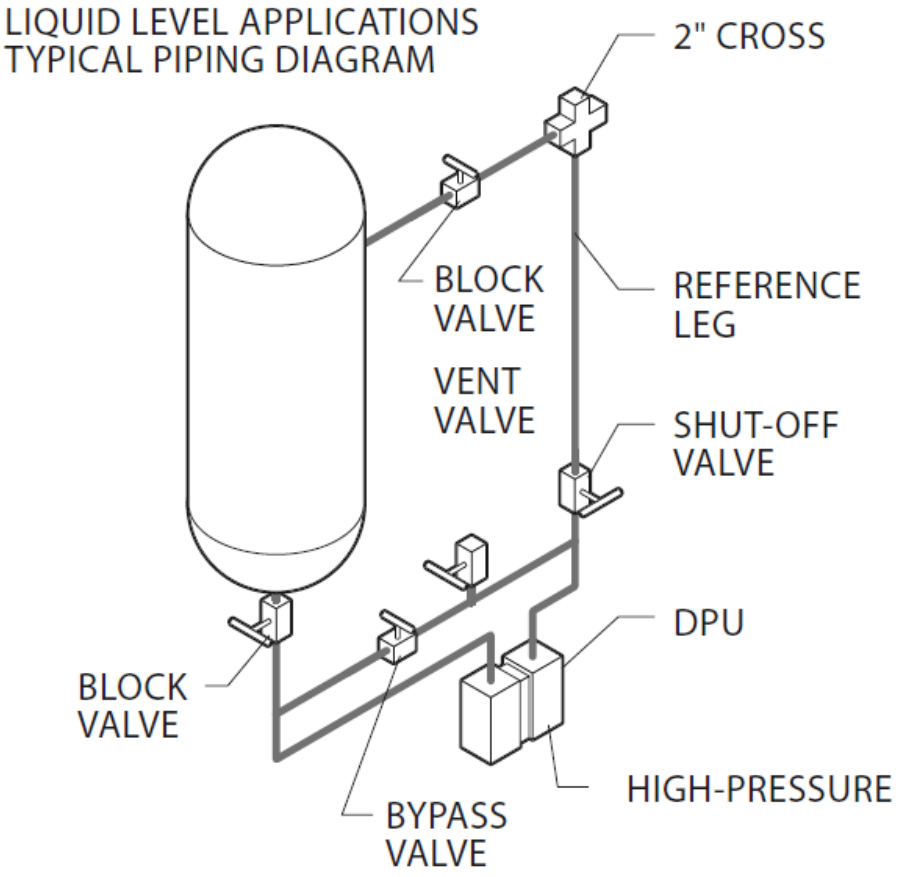


Figure A.12—DPU Bottom Tank with Reference Leg

2.5.12. Liquid CO_2

The instrument may be located above or below the vessel. The recommended vapor generator is a 12-inch length of 1 to 1-1/2-inch diameter pipe. Avoid traps or pockets between the vapor generator and the tank. Install the inverted "U" shaped gas trap inside the vessel.

1. Close shutoff valves.
2. Open drain valve and DPU housing drain plugs to remove all liquid from the system, and close drains.
3. Open bottom block valve slowly to allow liquid to enter gas generator. Assure that vent valve is closed.
4. Open top block valve and shutoff valves.

IMPORTANT:
Do not insulate the piping below the lower block valve. Do not share filling and vapor return lines with the DPU piping lines.

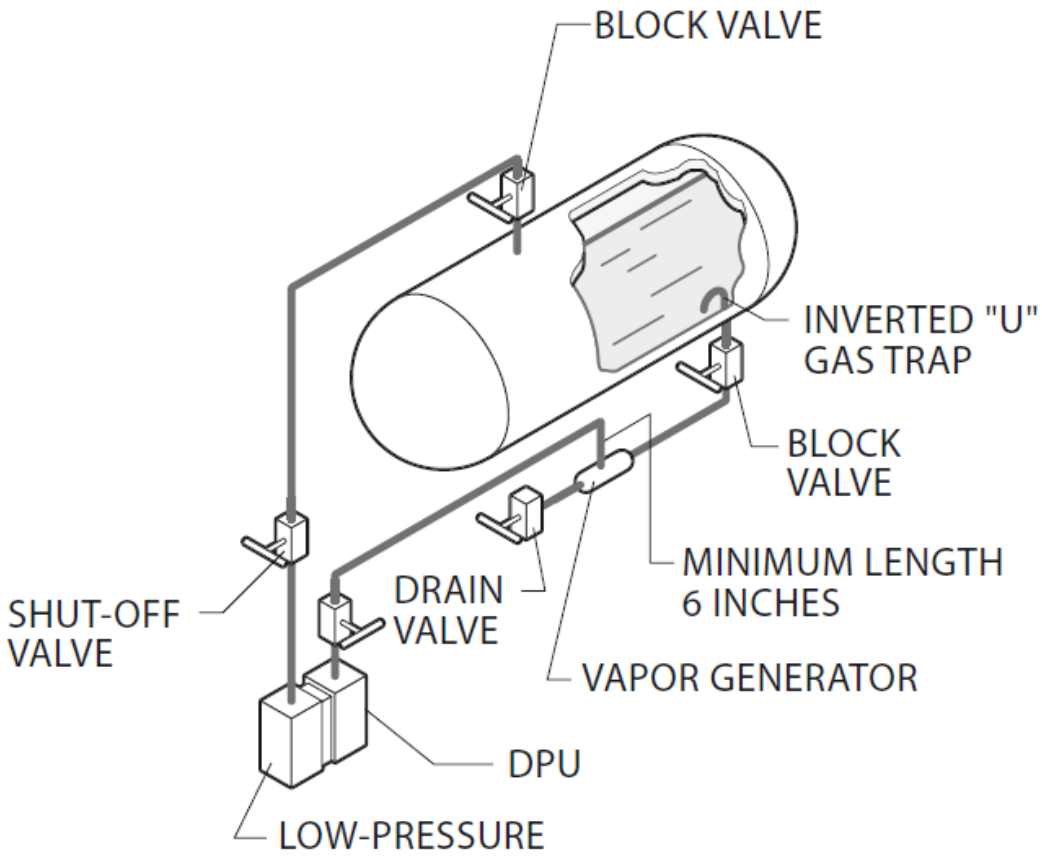


Figure A.13—Liquid CO2

2.5.13. Cryogenic Liquids

The instrument may be located above or below the vessel. The recommended vapor generator is a spiral of 3/8-inch tubing. Install the inverted "U" shaped gas trap inside the vessel. Meters for oxygen service are specially cleaned and packaged in polyethylene bags , and must be kept extremely clean.

1. Close shutoff valves.
2. Open drain valve and DPU housing drain plugs to remove all liquid from the system, and close drains.
3. Open bottom block valve slowly to allow liquid to enter gas generator. Assure that vent valve is closed.
4. Open top block valve and shutoff valves.

IMPORTANT:
Do not share filling and vapor return lines with the DPU piping lines.

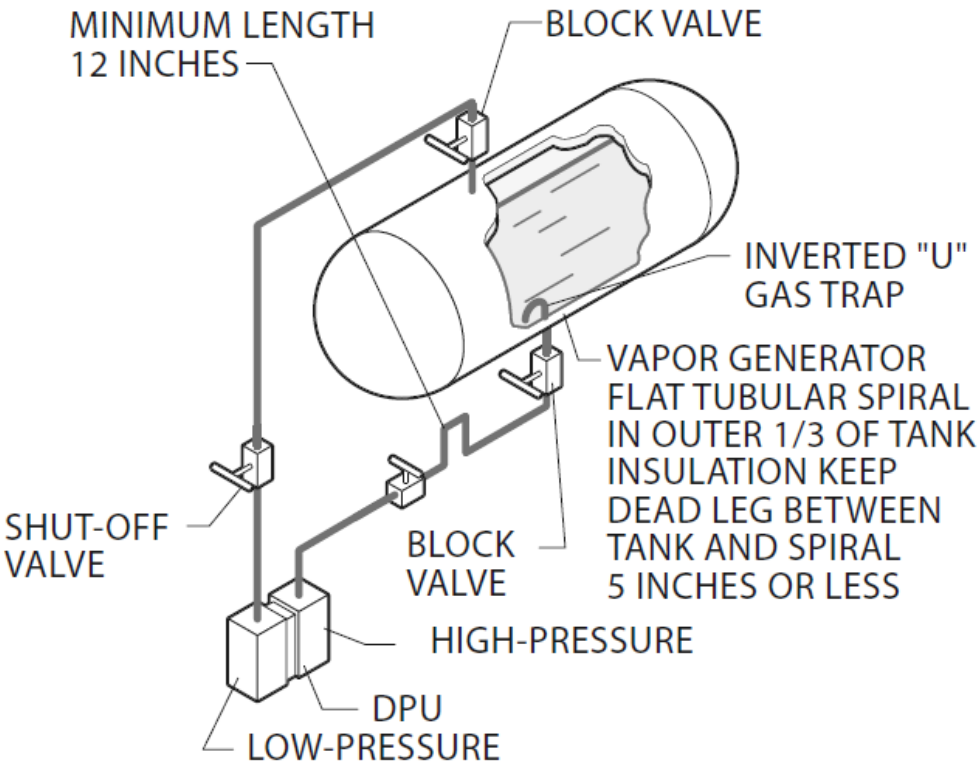


Figure A.14—Cryogenic Liquids

2.5.14. Bubbler System

Recommended when piping connections must be made at the top of the tank or whenever solids or sludge are preset.

1. Set bubbler input gas regulator pressure slightly higher than process vessel pressure.
2. Open block valves and shutoff valves, and close bypass valve.
3. Check sight-flow into bubbler tube.
4. Adjust bubbler system to minimum flow by adjusting input gas regulator

IMPORTANT:
Do not share filling and vapor return lines with the DPU piping lines.

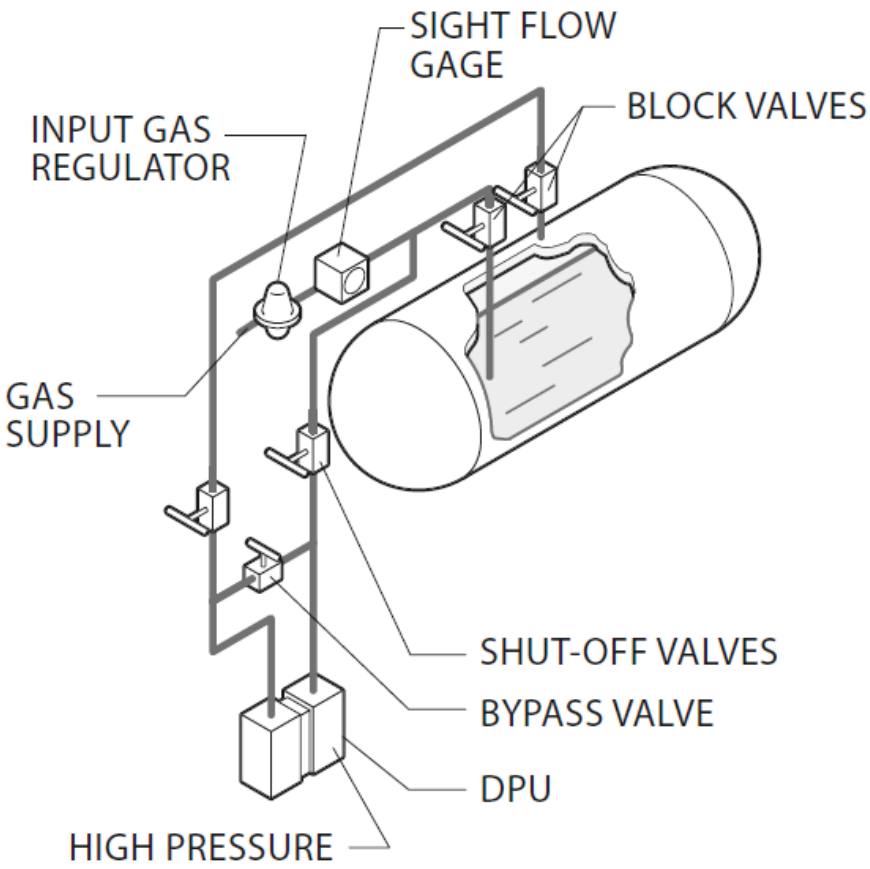


Figure A.15—Bubbler System

2.5.15. Liquid Specific Gravity

This method is for determining specific gravity changes in a process media using a differential pressure instrument.

1. Set bubbler input gas regulator pressure slightly higher than process vessel pressure.
2. Open block valves and shutoff valves, and close bypass valve.
3. Check sight-flow into bubbler tube.
4. Adjust bubbler system to minimum flow by adjusting input gas regulator

IMPORTANT:
Do not share filling and vapor return lines with the DPU piping lines.

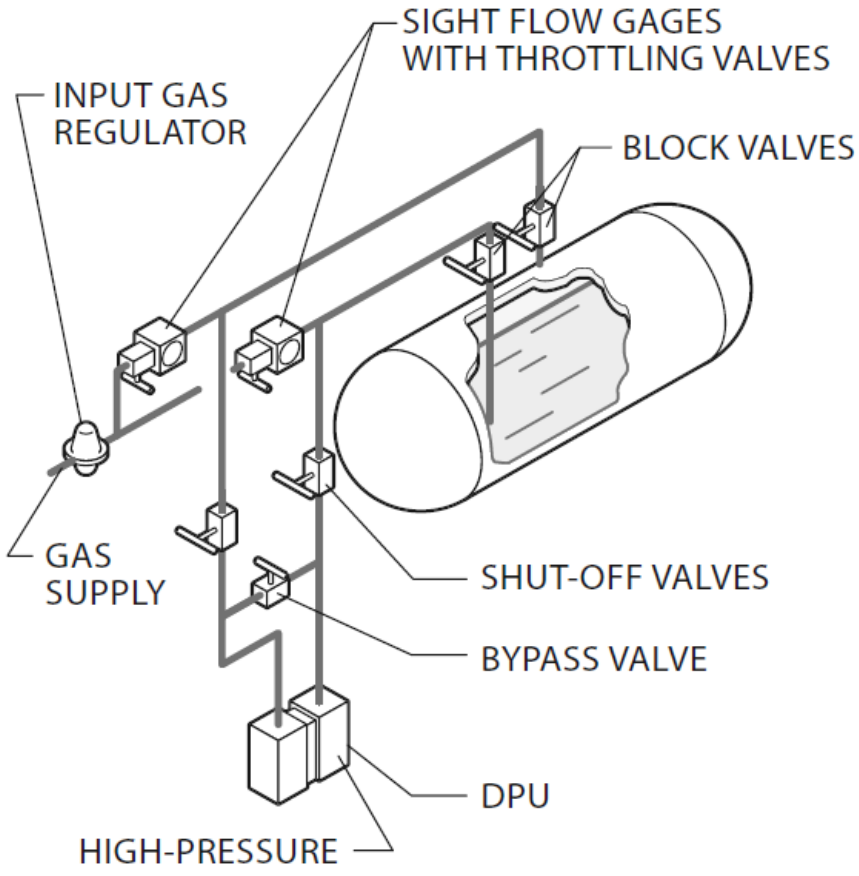


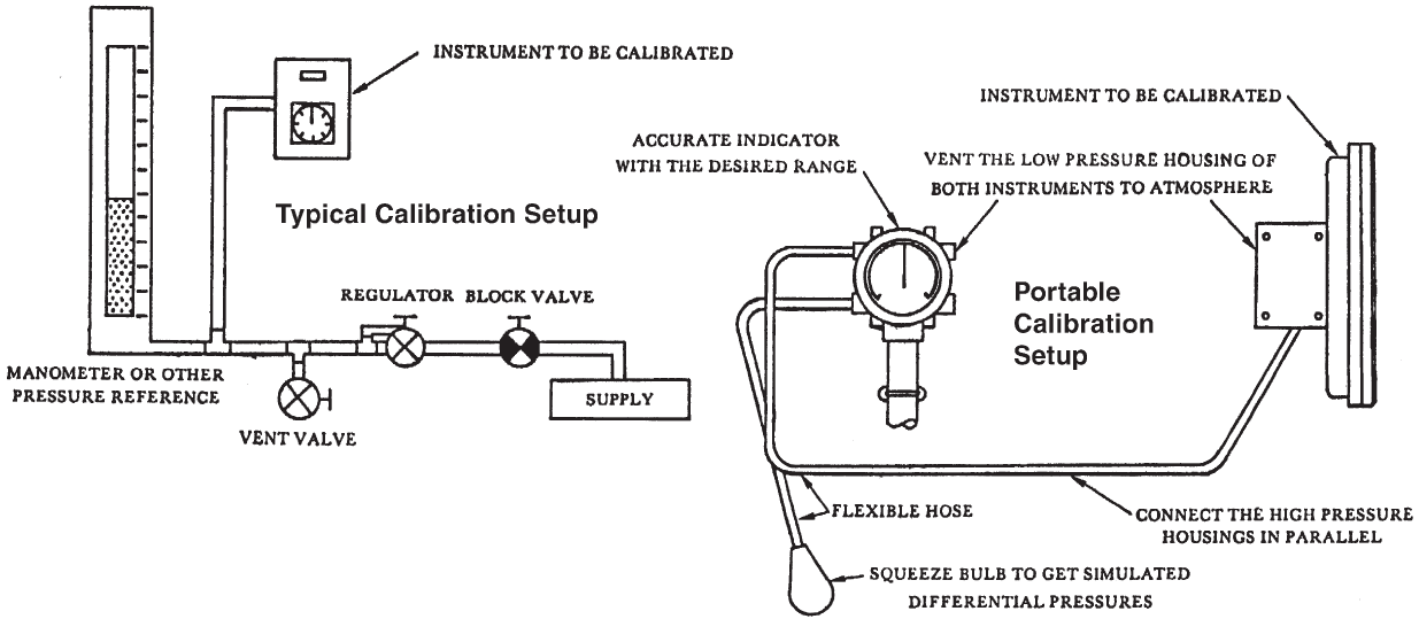
Figure A.16—Liquid Specific Gravity

SECTION 3 – MAINTENANCE/CALIBRATION

3.1.Required Tools

TOOL	PURPOSE
Pointer Puller	Pointer removal
Small screwdriver	Scale plate and Calibration adjustments
Medium screwdriver	Bezel removal and DPU bracket screws
Spanner Wrench	DPU Range Screw adjustment
1/8" Open-end wrench	Range and Linearity adjustments
1/4" Open-end wrench	Zero adjustments
50-lb torque wrench	Pressure housing bolts
3/16" Allen Socket wrench	Pressure housing bolts
5/16" Allen Socket wrench	Pressure housing bolts

3.2 Test/Calibration Set Up



3.3 Bezel and Lens (or Cover) Installation and Removal

To remove the bezel and lens(or cover) perform the following steps.

1. Loosen the three screws on the front of bezel.
2. Tilt the bottom of the bezel and slide the bezel upward.

To reinstall the bezel and lens, assemble the components per Figure 3.1. The two snubbers (Part No. 0500-1139.M) on the scale plate should not be fully compressed against the lens cover and the pointer should not touch the lens.

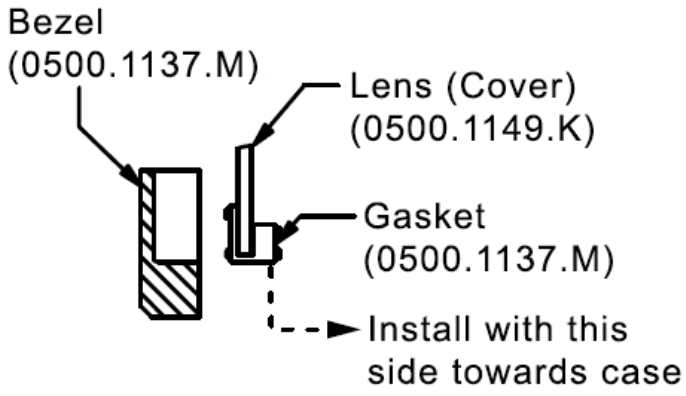


Figure 3.1—Bezel and lens cover

IMPORTANT:

Ensure correct bezel gasket orientation before placing instrument back in service. Incorrect bezel gasket orientation will cause the instrument indicator to jam, resulting in inaccurate readings.

3.4 Pointer Installation and Removal

During adjustment and calibration of the indicator, it will sometimes be necessary to remove the reinstall the pointer. This is done according to the following procedures.

3.4.1. Pointer Installation

1. Position the pointer on the movement shaft with the pointer set at zero scale. Obtain 75% to 90% pointer hub engagement on the movement pinion shaft. The pinion shaft must not extent through the pointer hub. It may be necessary to fit the pointer to the shaft by enlarging the hub hole in the pointer. Do this with a tapered broach in the tool kit. (Part No. 0500.2143.A)
2. Lightly tap the pointer hub with hand-set tool or other flat-end tool. Use perpendicular blows to avoid bending the shaft of the movement.
3. Check the indicator for calibration over its entire range.
4. Test the pointer for tightness by moving the pointer from the zero to the 25% position manually, and then letting the pointer return freely to zero. If the pointer indicated a shift, tap the pointer hub to tighten it to the shaft.

3.4.2. Pointer Removal

The pointer is removed with the Abbitz Pointer Puller shown in Figure 3.2. This tools in included in the calibration toolkit, Part No. 0500.2143.A

1. Slide the pointer puller along the pointer until the pin protruding from the tip of the screw in the pointer puller is directly over the movement shaft and the arms of the pointer puller are directly under the pointer.
2. Gently turn the knurled head of the screw clockwise, pushing the pin against the movement shaft and lifting the pointer with the arms. Finger pressure should be sufficient to pull the pointer free. If more pressure is required, an Allen wrench can be inserted into the head of the screw and use to turn it. However, care should be exercised: too much pressure can cause the pin to break.

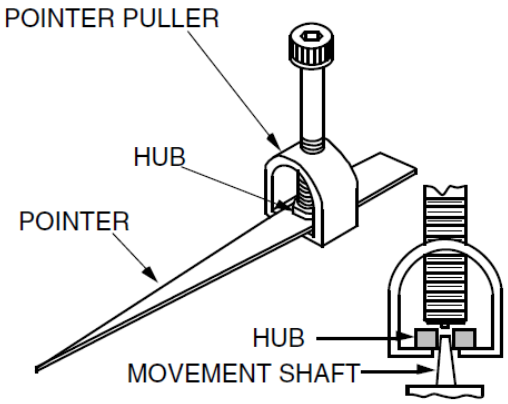


Figure 3.2—Pointer puller

3.5 Calibration Check

To ensure the unit calibration is within factory-set calibration tolerances, perform the following procedure.

1. Securely mount the instrument in an appropriately level position and connect the DPU to a standard pressure source. (See Test/Calibration Set Up Section 3.2)
2. If the zero indication is incorrect, remove the bezel/lens assembly and re-adjust as described in Zero Check/Adjustment, Section 2.2.
3. Apply 0%, 50% and 100% of full scale pressure. If the indication is within the specified limits, no adjustments are necessary. If the indications are incorrect, perform a Complete Calibration (see below).
4. Ensure instrument's zero indication is correct; otherwise, repeat Step 2.

3.6 Accessing Indicator Mechanism

Before attempting to perform calibration of the instrument, remove the bezel assembly, scale plate, and pointer as follows.

1. Loosen the three screws on the front of bezel.
2. Remove the Bezel assembly as described in Section 3.3.
3. Remove the indicating pointer as described in Section 3.4.
4. Remove the scale mounting screws and remove the scale plate.

Disassembly to this point provides full access to all indicator movement part and adjustments.

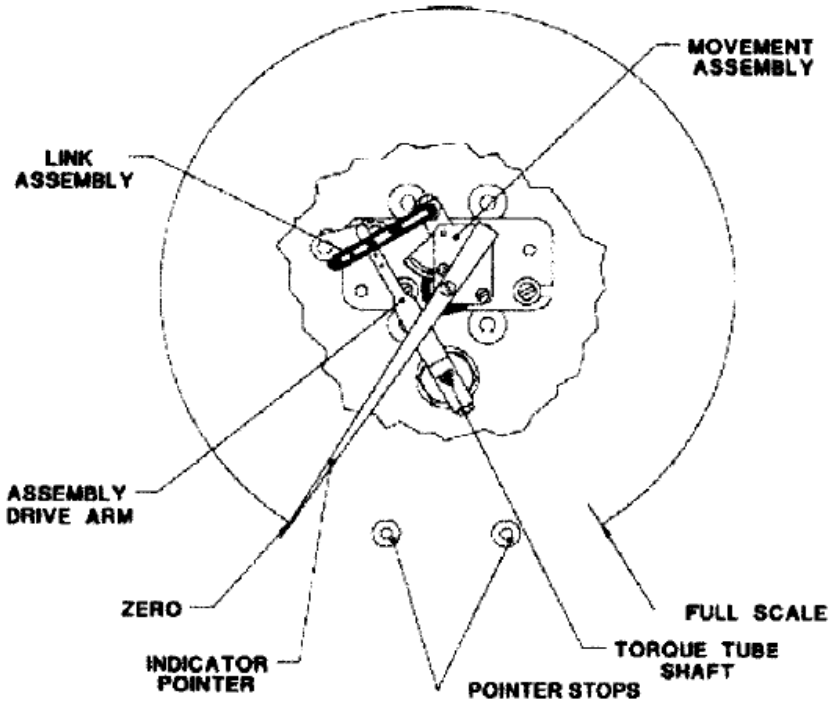


Figure 1.2—Indicator mechanism for universal case

3.7 Complete Calibration

Before performing this procedure, perform the calibration check procedure. A Complete calibration is required whenever a DPU is replaced.

1. Securely mount the instrument in an appropriately level position and connect the DPU to a standard pressure source. (See Test/Calibration Set Up Section 3.2)
2. Vent the low-pressure housing atmosphere by removing one plug from the housing.
3. Remove the Bezel/Lens Assembly as described in Section 3.3.
4. Remove the Indicating pointer as described in Section 3.4.
5. Remove the scale mounting screws and remove the scale plate.
6. Ensure linkage between drive arm and movement are attached. See Figure 3.3 below for linkage alignment at 50% DP applied. Inspect parts for straightness and pivot-fit without binding.
7. Check the pointer for zero indication. If necessary, set the pointer to zero by slipping the pointer on the hub. (see Section 2.2)
8. Apply 100% DP. If pointer does not indicate 100% on scale, release pressure and adjust span as follows.
   a. If the pointer exceed 100% on scale, lengthen range arm by adjusting the range adjust screw with a 1/8-inch open-end wrench.
   b. If the pointer indicates below 100% on scale, shorten the range arm by adjusting the range adjust screw with a 1/8-inch open-end wrench.
9. Set pointer to zero by slipping the pointer on the hub.(see Section 2.2)
10. Repeat steps 6 and 7, as necessary, to obtain the correct zero/full scale.

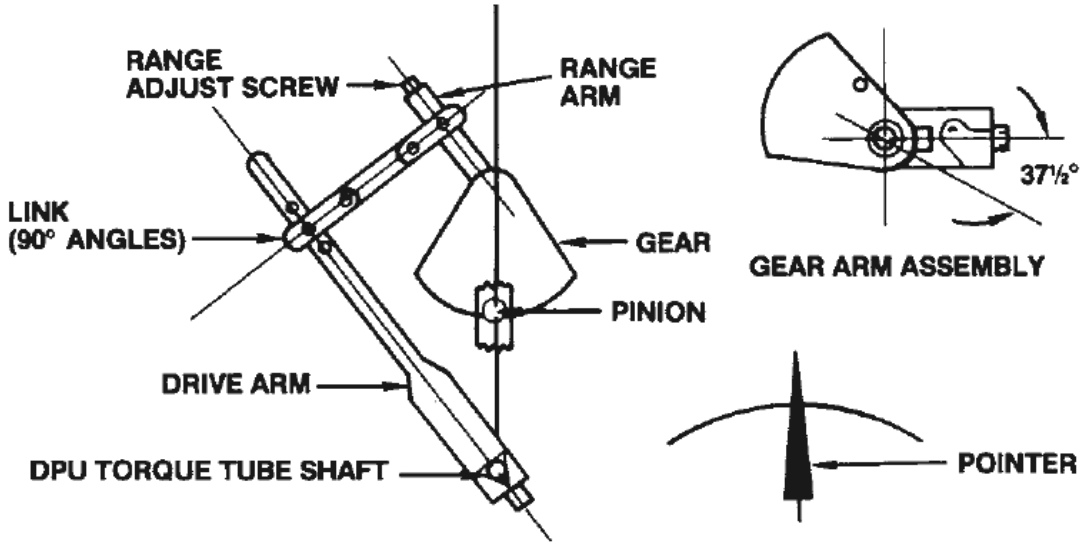


Figure 3.3—Universal range/linearity adjustment (50% DP)

11. Apply 50% DP. If pointer does not indicate 50% scale, adjust linearity as follows.
    a. Loosen drive arm screw (Figure 3.4 Below) and move arm to shift pointer in direction of error a distance of about 10 times the linearity error.
    b. Check to see that the drive arm clears the end of torque tube housing by approximately 0.030 inches before retightening the drive arm screw to prevent interference.
    c. While supporting the block/shaft, until snug to shaft.
    d. Still supporting block/shaft, tighten clamp screw an additional:
        i. Sintered: 1/3 to 1/2 turn (This screw can normally turn one full revolution before breaking.)
        ii. Slotted: 1/4 to 1/3 turn. (The slot in the clamp block should still be open)
12. Release pressure and reset pointer at zero. Check the span. If gear in movement reaches limit of travel as a result of linearity adjustment (step 9), slip range arm along gear approximately 5 degrees from normal 37.5 degree angle to approximately 43 degrees. (Figure 3.3) The range arm is slipped by applying pressure to range arm with thumb, while holding gear firmly in place. Retest pointer response at 50%, 0%, and 100% of full-scale differential pressure, and adjust linkage until readings are acceptable.
13. Apply 0%, 25%, 50%, 75%, 100%, 75%, 50%, 25%, and 0% of full-scale differential pressure consecutively to instrument without overshoot. Lightly tap indicator to overcome friction. The pointer should accurately indicate each applied pressure.
14. Test instrument repeatability by applying 0%, 50%, 0%, 50% of full-scale differential pressure. The indicator should accurately indicate each applied pressure.
15. Test the pointer for tightness per the pointer installation instruction in Section 3.4.1
16. Reassemble the unit per the cover installation instructions in Section 3.3

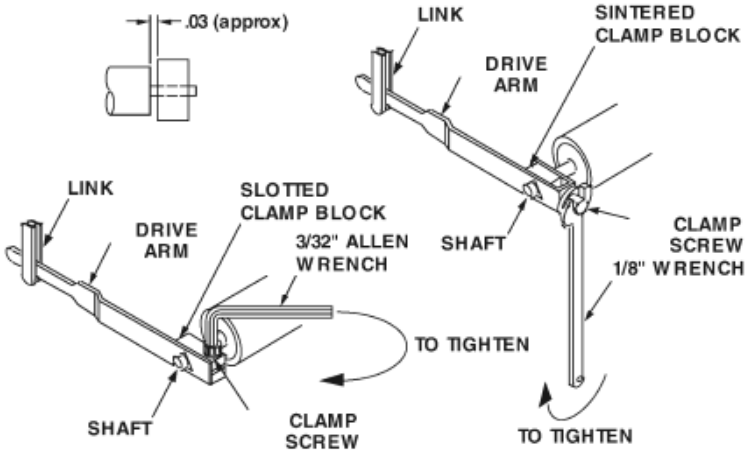


Figure 3-4. Locking Drive Arm to Torque Tube

3.8 Preventative Maintenance

Periodically inspect the integrity of the DPU piping. Tighten all pipe joint as necessary. If the instrument is used in services where solids or semi-solids may accumulate inside the pressure housings, periodically inspect and clean the DPU. DPU Cleaning and Inspection Procedure below.

3.9 DPU Cleaning and Inspection

WARNING:

(High pressure Gas Installations with pressures greater than 200 psig)

HIGH PRESSURE GAS HAZARD ON DISASSEMBLY OF DPU. TO PREVENT POSSIBLE SEVERE PERSONAL INJURY, DEATH, OR SUBSTANIAL PROPERTY DAMAGE DUE TO THE RELEASE OF INTERNAL PRESSURE, PERFORM THE PRESSURE CHECK PROCEDURE THAT FOLLOW (3.9.1) BEFORE REMOVING HE DPU HOUSING BOLTS.

WARNING:

THE DPU MAY BE UNDER PRESSURE. ENSURE THAT THE PIPING SYSTEM IS COMPLETELY DEPRESSURIZED BEFORE MEOVING THE METER FOR MAINTENANCE OR INSPECTION

IMPORTANT

If accumulation of solids or semi-solids is extensive, remove the housing carefully to prevent damage to the bellows.

1) Remove the DPU from service
2) Check for internal DPU pressure as follows:
   a) Back off all housing bolts 4 turns.
   b) Attempt to move the housing in and out along the bolts.
      i) If the housing moves freely – no pressure is present- servicing or repair may continue.
      ii) If the housing does not move freely – the bellows may be pressurized. Immediately stop all disassembly, tighten the housing bolts, and return the unit to the factory or authorized service center for repair Tag the unit and specify “Gas in Bellows”.
3) Carefully remove the pressure hidings form the bellows unit assembly.
4) Remove the accumulation from between the bellows convolutions and from the inside of the housings. Use a solvent is possible. Do not use a sharp instrument to clean between convolutions.
5) Assure that there are no broken range springs.
6) Inspect the O-rings and replace is necessary.
7) Replace the housings and O-Rings.
8) Reinstall housing bolts and apply torque as required. See appropriate values listed in Table 3.1

HOUSING BOLT WARNING

INSPECT HOUSING BOLT CONDITION AND REPLACE IF NECESSARY

REUSE OF HOUSING BOLTS, ESPECIALLY IN CRITICAL APPLICATIONS LIKE HYDROGEN SULFIDE AND SALT WATER EXPOSURES, CAN RESULT IN SEVERE INJUST, DEATH OR SUBSTANTIAL PROPERTY DAMAGE DUT TO BOLT FAILURE

TABLE 3.1

HOUSING		SCREWS		LUBE NOTE 1	TORQUE LB – FT NOTE 2	ROTATION DEGREES NOTE 3
SWP	MATL.	MATL.	SIZE			
500	BRASS	SST	1/4 – 28 X 2	YES	10-12	450
		STEEL	1/4 – 28 X 2	NO	12-14	180
	SST	SST	1/4 – 28 X 2.5	YES	12-14	180
	CU-NI	MONEL	1/4 – 28 X 2.5	YES	9-11	180
1000	CU-NI	MONEL	1/4 – 28 X 2.5	YES	9-11	180
1500	SST	17-4 PH	1/4 – 28 X 2.5	YES	12-14	180
3000	SST	17-4 PH	3/8 -24 X 2.5	YES	35	90
	MONEL	17-4 PH	3/8 -28 X 2.5	YES	45	180
6000	SST	17- 4 PH	3/8 – 24 X 2.5	YES	40	135

Notes: (1) Lubricant: Lightly apply Molykote G-N paste. Lube first thread only. (2) Torque on bolts s accomplished in 3 or 4 steps. Tighten uniformly. (3) Rotation of bolt head is measured after bolt is snug, with approximately 2ft. /lbs. torque. Do not exceed this rotation. To tighten bolts without a torque wrench, use the rotation values.

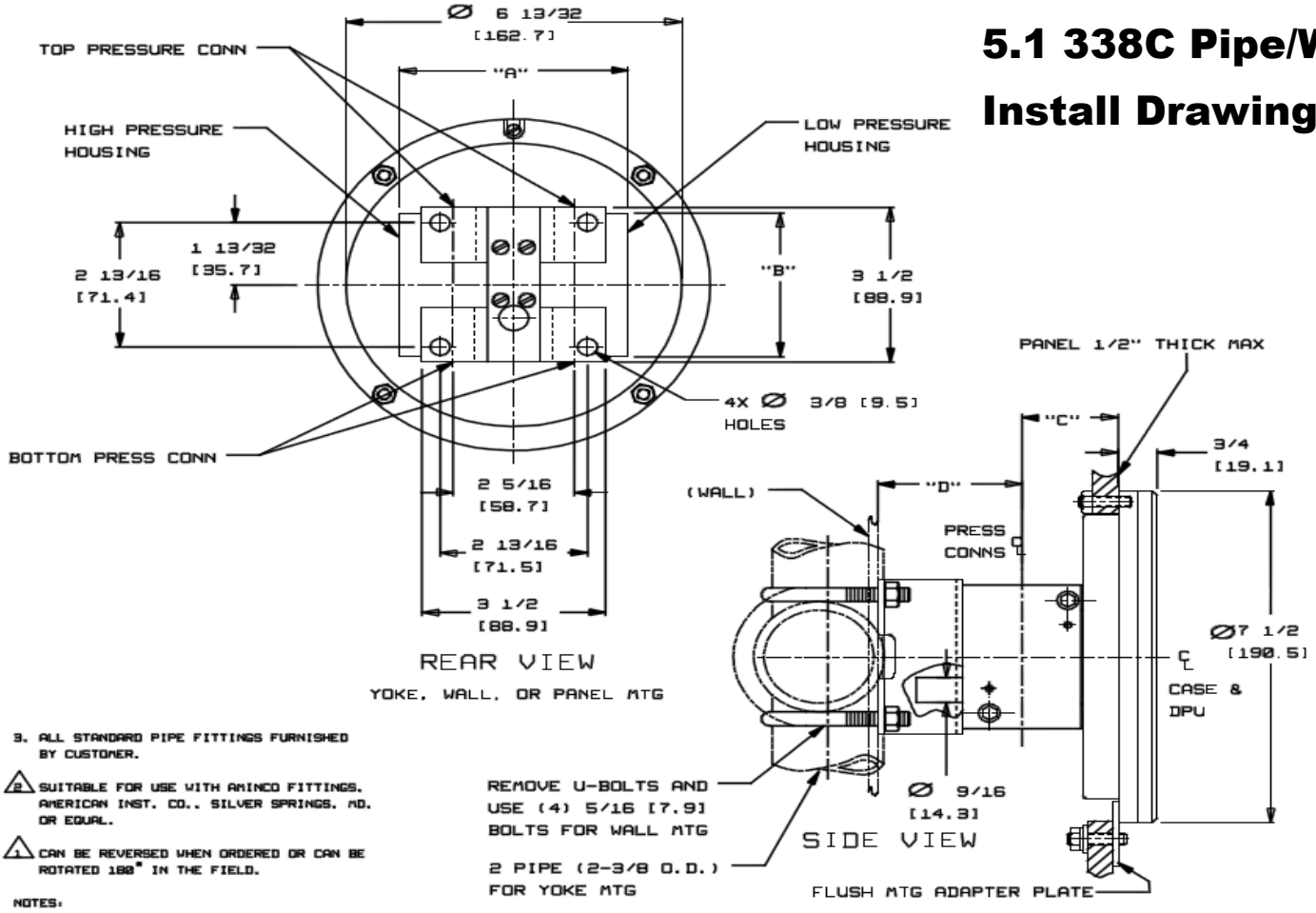
SECTION 4 – TOUBLESHOOTING

TABLE 4.1

Problem	Possible Sources	Probable Cause	Corrective Action
Low or No Indication	Primary Element or DPU	Orifice Installed Backwards or Oversized	Replace Orifice
		Flow Blocked Upstream from Run	Clean Out Run or Open Value
		Loss of Liquid in Reference Leg (Liquid Level)	Refill Reference Leg with Same Density Liquid as Process Media
		Density Changes in Process Media or Reference Leg	Clean Out Piping
	Piping from Primary Element to DPU	Pressure tap holes plugged and/or Piping Plugged	Clean Out Piping
		Bypass Valve Open or Leaking	Close Bypass Valve(s) or Repair Leaks
		Liquids or gases Trapped in Piping	Vent Piping
		Block or Shut-off Valve Closed	Open Block or Shut-off Valve
		Piping leaks on High Pressure Side	Repair Leaks
	Bellows Unit	Housings Filled Up with Solids Restricting Bellows Movement	Clean Out Housing
		Gas Trapped in Housing in Liquid Service or Liquid Trapped in Housing in Gas Service	Vent Housing
		High Pressure Housing Gasket Leaks	Replace Gasket
		DPU Tampered With	Return BUA for Repair
	Indicator, Alarm Switch Mechanism	Loose Linkage or Movement	Tighten or Replace
		Out of Calibration	Calibrate
		Pointer Loose	Tighten Pointer
		Dirty or Corroded Mechanism	Clean or Replace
		Wiring Interfering with Movement	Reroute Wiring
		Dirty Mechanism	Clean Mechanism
High Indication	Primary Source	Orifice Partially Restricted or too Small	Clean Out or Replace
	Piping from Primary Element to DPU	Leak in Low Pressure Side Piping	Repair
	Bellows Unit	Gas Trapped in Low Pressure Housing in Liquid Service or Liquid Trapped in Housing in Gas Service	Vent Housing
		Low Pressure Housing Gasket Leaks	Replace Gasket
Erratic indication	Primary Element	Flow Pulsating	Install Dampening Device Upstream of DPU Run
	Piping form Primary Element to DPU	Liquid Trapped in Gas Piping or Gas Bubble in Liquid Piping	Remove
		Vapor Generator Incorrectly Installed	Repipe
		Reference Leg Gassy or Liquid Vaporizing	See Piping Instructions
	Bellows Unit	Obstructed Bellows Travel	Clean Bellows
		Gas Trapped in DPU High Pressure or Low Pressure Housing	Remove (See Startup Procedure)
	Indicator Mechanism	Linkage Dragging or Dirty	Adjust or Clean
		Pointer Dragging on Scaleplate	Adjust Pointer Position

SECTION 5 – INSTALL/DIMENSIONAL DRAWINGS

5.1 338C Pipe/Wall Install Drawings

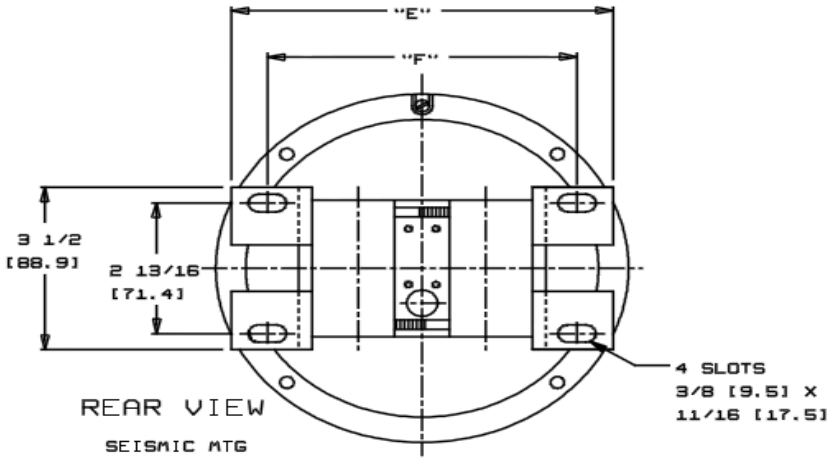


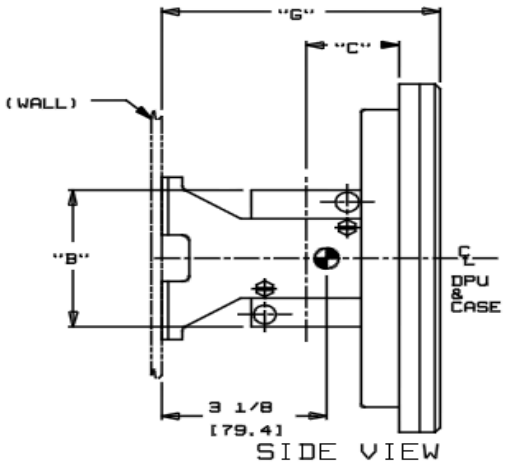
3. ALL STANDARD PIPE FITTINGS FURNISHED BY CUSTOMER.

2 SUITABLE FOR USE WITH AMINCO FITTINGS, AMERICAN INST. CO., SILVER SPRINGS, MD. OR EQUAL.

1 CAN BE REVERSED WHEN ORDERED OR CAN BE ROTATED 180° IN THE FIELD.

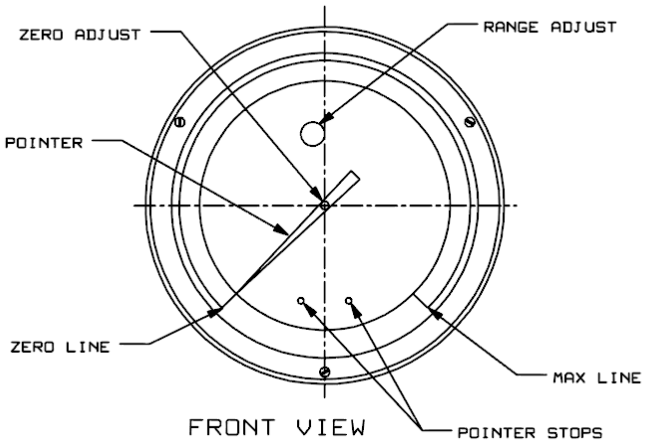
NOTES:



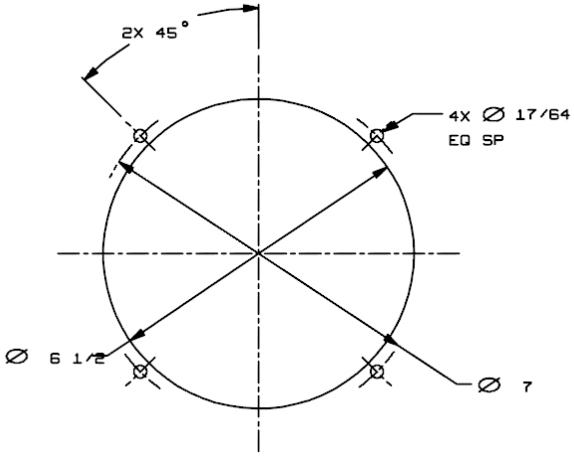


PRESSURE RATING	MATERIAL	DIM A ±.03	DIM B ±.01	DIM C	DIM D	DIM E	DIM F	DIM G	PRESS CONNECTION TOP	PRESS CONNECTION BOTTOM
500 TO 1500 PSI	ALL	4 [101.6]	2-15/16 [74.6]	1-43/64 [42.5]	2-5/8 [66.7]	6-15/16 [176.2]	5-5/8 [142.9]	5-3/16 [131.7]	1/2 NPT 1	1/4 NPT 1
									9/16-18 2 UNF	9/16-18 2 UNF
3000 TO 6,000 PSI	ALL	4-3/8 [111.1]	3-1/4 [82.6]	1-51/64 [45.6]	2-3/4 [69.9]	7-5/16 [187.9]	8 [152.4]	5-19/64 [134.5]	1/4 NPT	1/4 NPT
									1/2 NPT	1/2 NPT
									7/16 M5	7/16 M5
									1/8 NPT	1/8 NPT

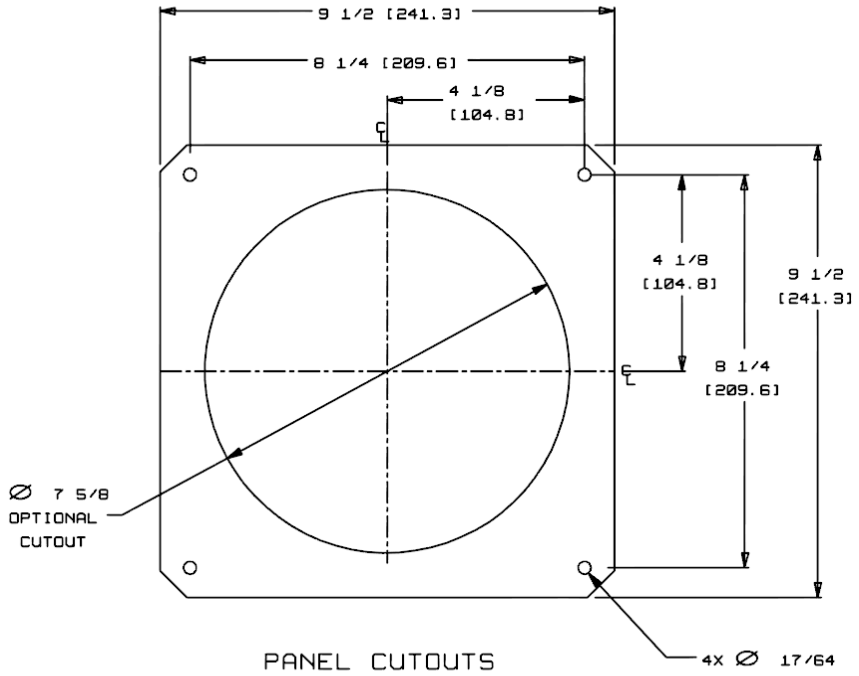
5.2 338C Panel Install Drawings



FRONT VIEW

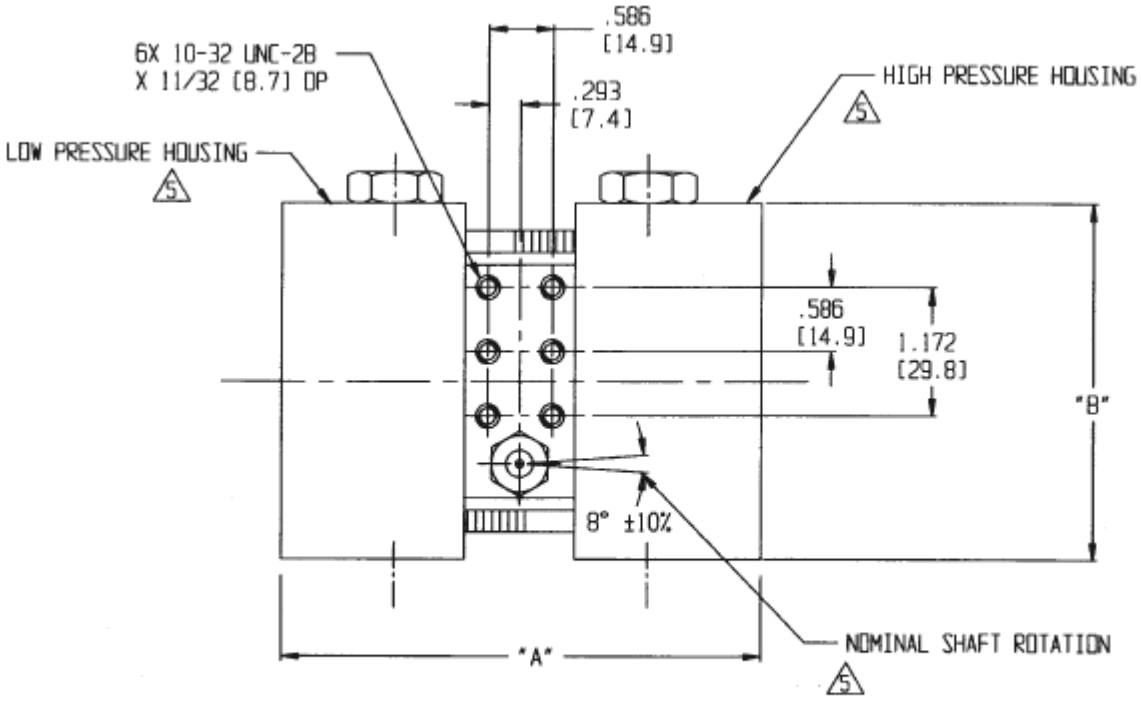


PANEL MOUNTING CUTOUT

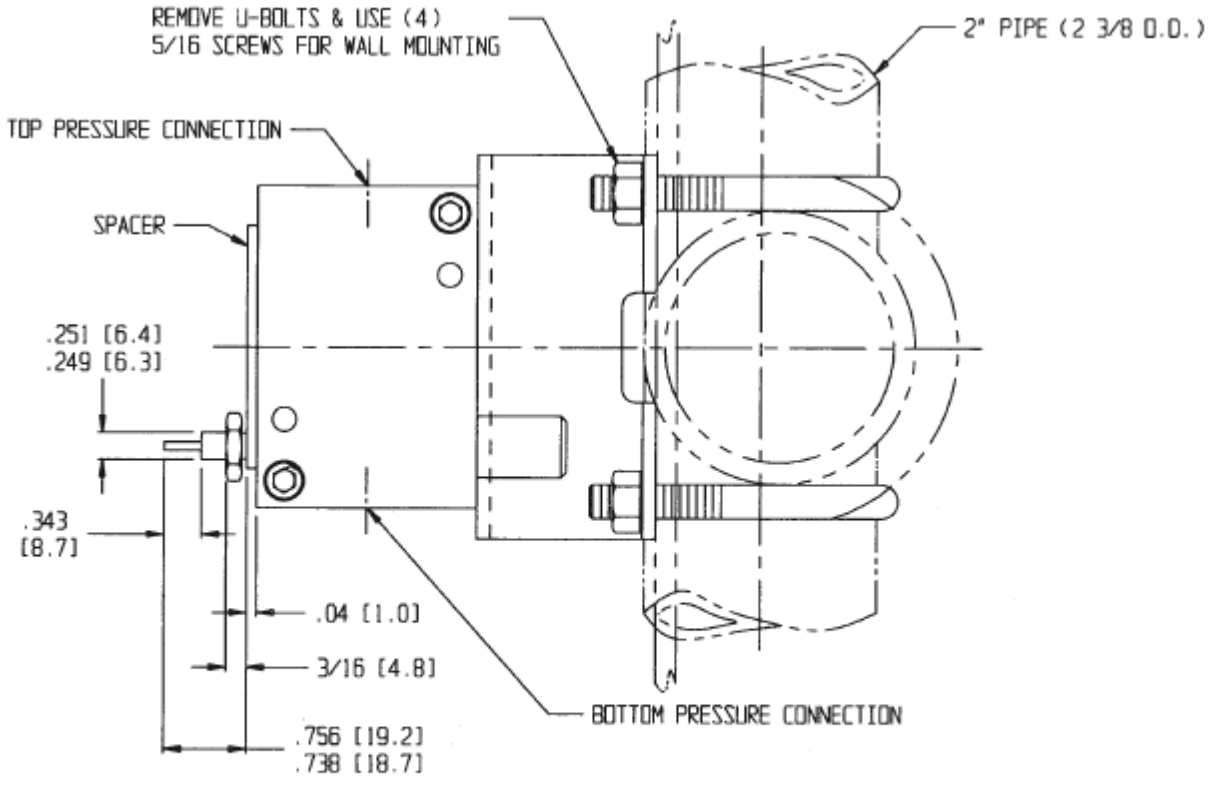


PANEL CUTOUTS
FLUSH MTG ADAPTER

5.3 113C Dimensional Drawing

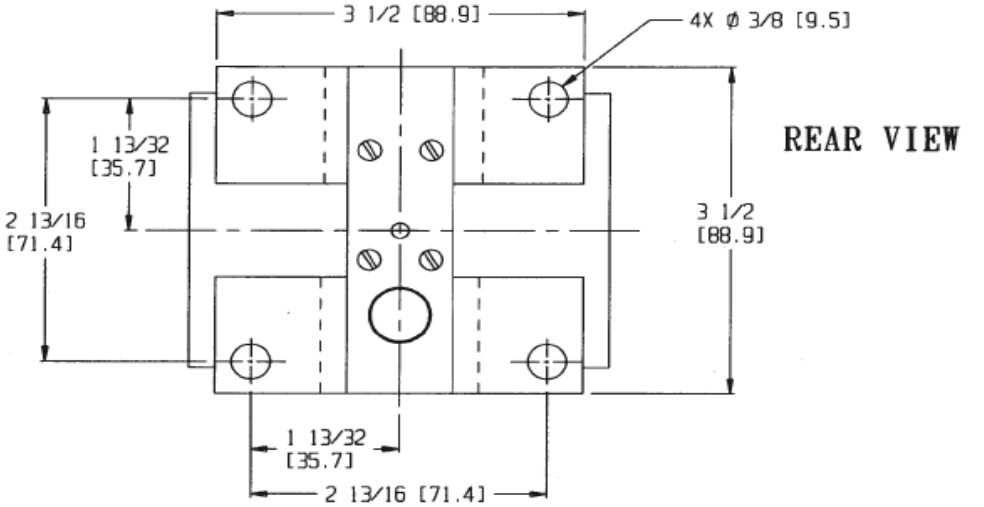


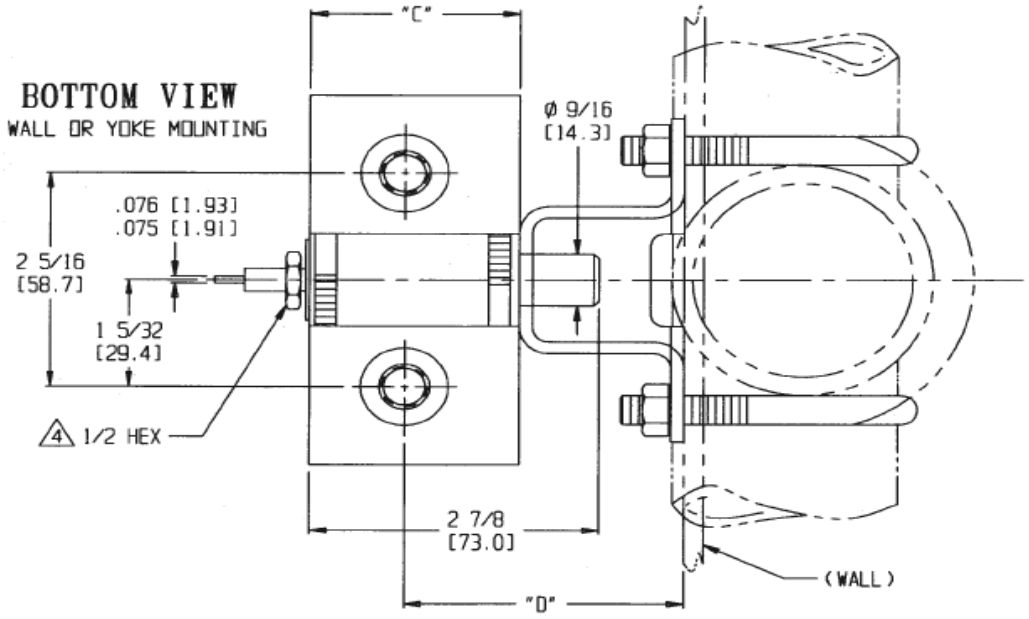
FRONT VIEW



SIDE VIEW
WALL OR YOKE MOUNTING

5.4 113C Dimensional Drawing (Continued)





PRESSURE RATING	MATERIAL	DIM A ±.03	DIM B ±.01	DIM C ±.01	DIM D	PRESS CONNECTION TOP	PRESS CONNECTION BOTTOM
500 TO 1500 PSI	ALL	4 [101.6]	2-15/16 [74.6]	2 [50.8]	2-5/8 [66.7]	1/2 NPT 1 9/16-18 2 UNF	1/4 NPT 1 9/16-18 2 UNF
3000 TO 10,000 PSI	ALL	4-3/8 [111.1]	3-1/4 [82.6]	2-1/4 [57.2]	2-3/4 [69.9]	1/4 NPT 1/2 NPT 7/16 MS 1/8 NPT	1/4 NPT 1/2 NPT 7/16 MS 1/8 NPT

5 SHAFT ROTATION (SPECIFY):
A. STANDARD: COUNTERCLOCKWISE.
B. OPTIONAL: CLOCKWISE UNIT WITH COUNTERCLOCKWISE ROTATION SHOWN. FOR CW ROTATION HIGH & LOW PRESSURE HOUSINGS ARE CHANGED.

4 PROVIDE A 19/32 [15.1] DIA CLEARANCE HOLE FOR 1/2 HEX.

3. ALL STANDARD PIPE FITTINGS FURNISHED BY CUSTOMER.

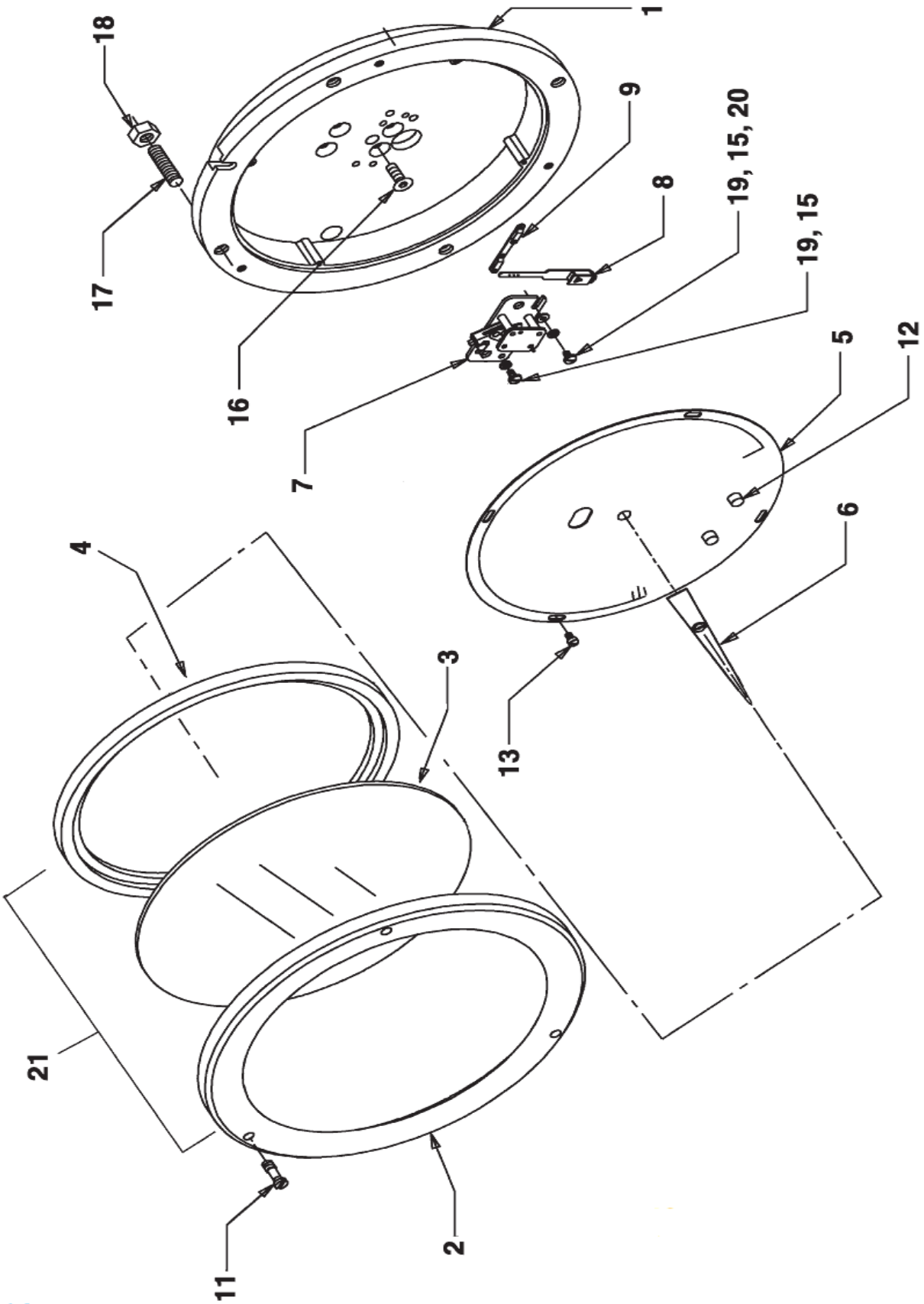
2 SUITABLE FOR USE WITH AMINCO FITTINGS, AMERICAN INST. CO., SILVER SPRINGS, MD, OR EQUAL.

1 CAN BE REVERSED WHEN ORDERED OR CAN BE ROTATED 180° IN THE FIELD.

NOTES:

SECTION 6 – PARTS DRAWING/LIST

6.1 338C Parts Drawing



6.2 338C Parts List

TABLE 6.2 338C PARTS LIST

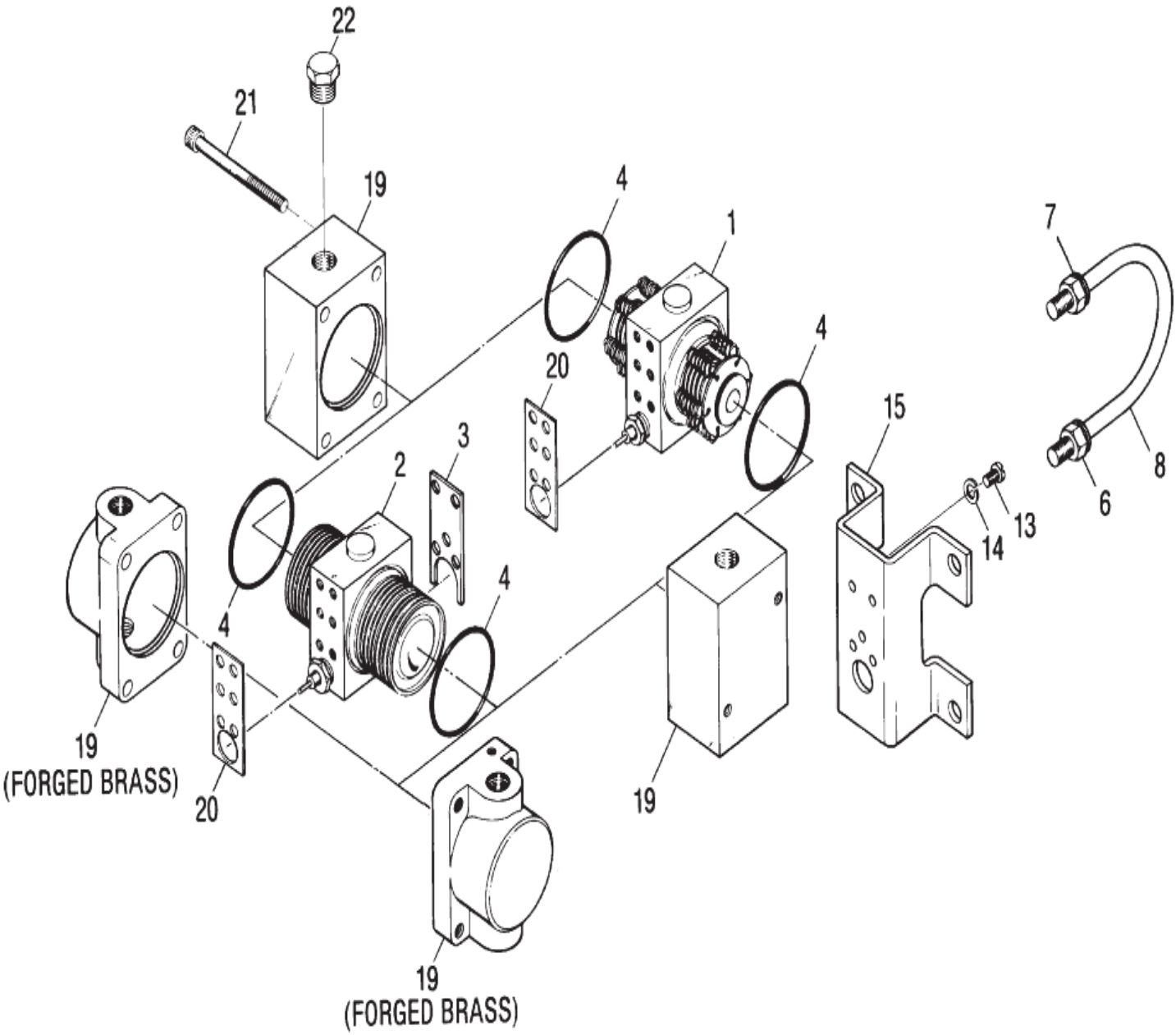
Item	Description	Part No.	Per Unit
1	CASE, INDICATOR 6"	338C.1125.P	1
2	BEZEL (PART OF ITEM#21)	0500.1140.P	1
3*	LENS,COVER (PARTS OF ITEM #21)	0500.1149.K	1
4*	GASKET (PART OF ITEM # 21)	0500.1137.M	1
5**	SCALE PLATE		1
	BLACK WITH WHITE MARKINGS	0500.1124.C-1	
	WHITE WITH BLACK MARKINGS	0500.1124.C-2	
6*	POINTER ASSEMBLY		1
	WHITE	0500.1141.N	
	BLACK	0500.1142.N	
7	MOVEMENT ASSEMBLY	0500.1146.F	1
8	DRIVE ARM ASSEMBLY	338C.1134.B	1
9	LINK ASSEMBLY	338C.1131.F	1
11*	BEZEL SCREWS, SST	0500.1118.B	3
12	SNUBBER	0500.1139.M	2
13	SCREW, DIAL 4-40 X 3/16, SST	0500.1134.J	4
15*	WASHER, SPLIT LOCK #4	0500.1173.J	2
16	SCREW, CASE #10-32 X 1/2"	0500.1130.J	4
17	SCREW, PANEL MOUNT, 1/4-20 X 1"	0500.2112.J	4
18	NUT, PANEL MOUNT	0500.1157.J	4
19	SCREW, MOVEMENT 4-40 X 1/4 SST	0500.0045.J	2
20	WASHER, MOVEMENT #4 FLAT, SST	0500.0207.J	1
21	BEZEL ASSEMBLY (ITEMS 2,3,&4)	0500.0018.B	1
22	MODEL 113C DPU (NOT SHOWN)	SEE DPU PARTS	1
23*	CALIBRATION KIT (NOT SHOWN	0500.2143.A	1

NOTES* Indicates recommended spare part.

** SCALE PLATE IDENTIFICATION:

1. Square Root of Linear Graduations
2. Scale (0-100,25-0-100, etc.)
3. Number of Graduations (linear scales only)
4. Data (PSI, Bar, Inches of water, etc.)

6.3 113C Parts Drawing



6.4 113C Parts List

TABLE 6.4 113C PARTS LIST

Item	Description	Part No.	Per Unit
1	BELLOWS UNIT ASSEMBLY, 3/4"	SPECIFY	-
2	BELLOWS UNIT ASSEMBLY, 1-5/8"	SPECIFY	-
3	SPACER, BRACKET	113C.1413.C	1
4*	O-RING, HOUSING GASKET	SPECIFY	2
6	NUT, U-BOLT, 5/16-18 SST	113C.1144.J	4
7	WASHER, U-BOLT, 5/16 SST	113C.1117.J	4
8	U-BOLT (COMPLETE WITH NUTS)	113C.1112.J	1
13	SCREW, PIPE BRACKET, 10-32 X 1/2" SST	113C.1142.J	4
14	WASHER, PIPE BRACKET, SPLIT LOCK # 10	113C.1143.J	4
15	BRACKET, MOUNTING, U-BOLT TYPE	113C.1114.C	1
19	HOUSING, PRESSURE	SPECIFY	2
20	SPACER, CASE	113C.2658.C	1
21	SCREW, HOUSING	SPECIFY	4
22	PLUG, PIPE	SPECIFY	2
NOTES* Indicates recommended spare part.			

Abbitz Measurement, L.L.C
1619D Diamond Springs Rd
Virginia Beach, VA 23455
(757) 362-0742
Email: sales@abbitz.com
On The Web at: www.abbitz.com

SECTION 7- Product Warranty

Warranty

Abbitz Measurement, L.L.C. warrants that at the time of shipment the products manufactured by Abbitz Measurement, L.L.C. and sold hereunder will be free from defects In material and workmanship for a period of five(5) years, and will conform to the specifications furnished by or approved by Abbitz Measurement, L.L.C..

Warranty Adjustments

If any defect within this warranty appears, Buyer shall notify Abbitz Measurement, L.L.C. immediately.

Abbitz Measurement, L.L.C. agrees to repair or furnish a replacement for, but not install, any product which within five (5) years from the date of shipment by Abbitz Measurement, L.L.C. shall, upon test and examination by Abbitz Measurement L.L.C., prove defective within the above warranty.

No product will be accepted for return or replacement without the written authorization of Abbitz Measurement, L.L.C.. Upon such authorization, and in accordance with instructions by Abbitz Measure, L.L.C., the product will be returned shipping charges prepaid by the Buyer. Replacements made under this warranty will be shipped prepaid.

Exclusions from Warranty

THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDING ALL OTHER EXPRESSED OR IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE.

Components manufactured by any supplier other than Abbitz Measurement, L.L.C. shall bear only the warranty made by the manufacturer of that product, and Abbitz Measurement, L.L.C. assumes no responsibility for the performance or reliability of the unit as a whole.

“In no event shall Abbitz Measurement, L.L.C. be liable for indirect, incidental, or consequential damages nor shall the liability of Abbitz Measurement, L.L.C. arising in connection with any products sold hereunder (weather such liability arises from a claim based on contract, warranty, tort, or otherwise) exceed the actual amount paid by Buyer to Abbitz Measurement L.L.C. for the products delivered hereunder.”

The warranty does not extend to any product manufactured by Abbitz Measurement, L.L.C. which has been subjected to misuse, neglect, accident, improper installation or to use in violation of instructions furnished by Abbitz Measurement, L.L.C..

The warranty does not extend to or apply to any unit which has been repaired or altered at any place other than at Abbitz Measurement, L.L.C.’s factory or service locations by persons not expressly approved by Abbitz Measurement, L.L.C.