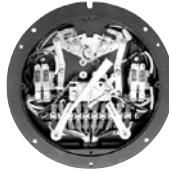




Model 288C



MODELS 288A/288C/290D

DIFFERENTIAL PRESSURE INDICATING-SWITCHES
 (M288C for Industrial Service and
 Barton® brand M288A (non-C) for
 Nuclear Service)

288A uses 224 DPU
288C/290D use 224C DPU

Installation Manual

Part No. 10300, Rev. 01

July 2007

[This manual is for indicating-switch only - see separate
 224/224C DPU manual.]

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Before installing this instrument, become familiar with the installation instructions in Section 2 and in the separate 224/224C DPU manual.

DANGER notes indicate the presence of a hazard which **will** cause **severe** personal injury, death, or substantial property damage if warning is ignored.

WARNING notes indicate the presence of a hazard which **can** cause **severe** personal injury, death, or substantial property damage if warning is ignored.

CAUTION notes indicate the presence of a hazard which **will** or **can** cause **moderate** personal injury or property damage if warning is ignored.

DANGER, WARNING, and/or CAUTION notes that appear on the following pages of this manual should be reviewed before proceeding: **13. (Important! Before installing or operating this instrument, review all safety notices contained in the separate 224/224C DPU manual, per models listed on front page.)**

DPU "C" VERSION DESIGN CHANGE

The 288C and 290D utilize a 224C DPU, which is a redesigned version of the 224 DPU. The "C" version is identical in function, performance, installation, and operation to the previous version - redesign was for improved manufacturing only. This design change does not affect the instrument being actuated. **Barton-brand instruments, using the Model 224 (Non-C) DPU, are for Nuclear service only.**

RECORD OF CHANGES

	DATE	DESCRIPTION
03E08n	5/03	Booklet; Combined 288/290 & 289/291 manuals (replaces ID#10300 & 10310); Assigned unique ID# (10305); Revised Wiring diagrams, Fig. 2-1; Reorganized; Removed explosion-proof "A" Case version information; Add Drive Arm to Torque Tube Locking procedure/Tightness Test; Add Bezel/Lens install/removal procedure; Updated ODD drawings; Updated Parts Drawings; Updated Parts Lists
03H10f	8/03	Combined 288A/288C/290D Versions; Removed 289 and 291 information (Replaces 288/290 portions of (10305) Manual; Rev. Co. Name/Logo to PRIME Measurement Products;
04A05a	1/04	Rev. para. 1-3: ref.: Std. models can have one or two alarm sw.
04C05a	6/04	Corrected version number to 04C05a. No other changes.
06G08a	7/06	Rev. pg. 2 statements; Updated to new wire color coding scheme {Add Table 2-1 - Wire Color Coding, Rev. wiring diagrams throughout, and Rev. Section 4 throughout (parts drawings/lists)}; Updated Section 5; Ref. Barton brand for Nuclear Service (cover) ; Non-technical changes throughout
01	7/07	Revised corporate name/logo/contact information to reflect Cameron ownership.

SECTION 1 - INTRODUCTION

1-1. General

The weatherproof Models 288A, 288C, and the explosion-proof Model 290D are DP Indicating Switches. The 288A and 288C have a NEMA-4 watertight die-cast aluminum case (finished with a weather-resistant black epoxy resin paint). The cover lens is secured in the bezel with an elastomer ring to reduce the possibility of accidental breakage. This ring also acts as a seal between the bezel and the case to ensure a moisture, fume and dust-free atmosphere for the indicator and switch mechanism.

Model 290D has an explosion-proof case that is certified for Class I, Division 1, Groups B, C & D service. The large cover lens allows maximum readability of the indicating pointer.

Switches and all adjustments are readily accessible when the cover is removed.

The built-in switches energize either single or dual alarm circuits when the measured differential pressures exceed predetermined limits. These limits may be either maximum, minimum, or both.

1-2. Main Components

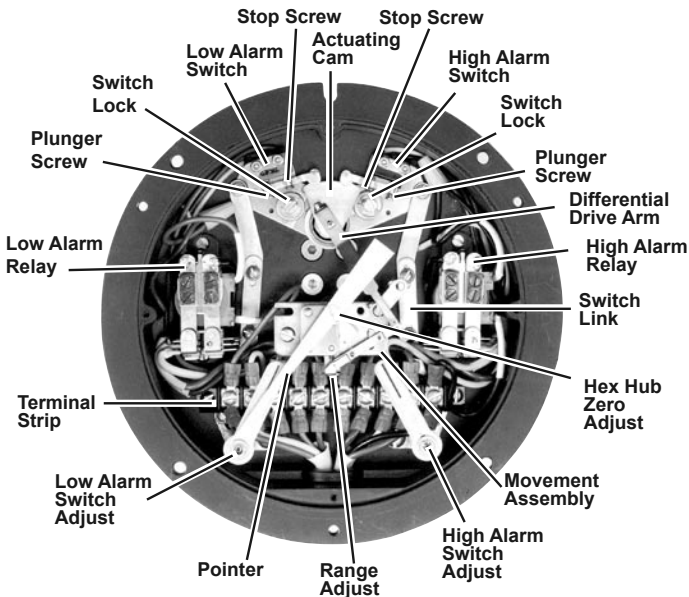


Figure 1-1. Switch Components

- A. Indicating Switch
- B. Differential Pressure Unit (DPU)
 - 288A is actuated by a Model 224 DPU
 - 288C and 290D are actuated by a Model 224C DPU

For detailed information on the DPU, see separate 224/224C DPU manual.

1-3. Indicating Switch (refer to Figures 1-2/2-1 to 2-6 and Table 2-1)

Rotation of DPU torque tube shaft is coupled through connecting linkage within the switch case to move the pointer across the scale plate. An actuating cam, directly connected to torque tube shaft, rotates with the motion of the shaft. Two cam follower roller/actuator arm assemblies, one for each switch, respond to torque tube rotation by opening and closing the switches as they ride on and off the cam. The levels of DP at which the switches actuate are adjustable with high and low alarm switch adjustments on the scale plate.

Standard models can have one or two alarm switches. Each switch can be connected to operate normally-opened or normally-closed. The direct-set switch contacts are adjustable over a scale range of 5-95% nominal.

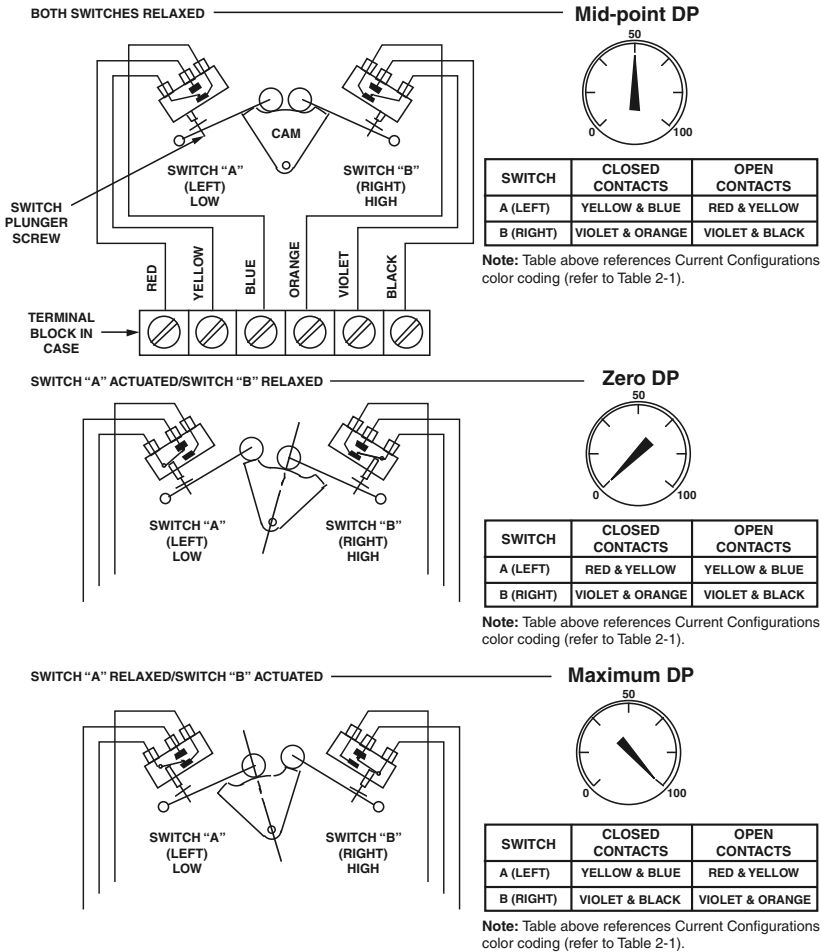


Figure 1-2. Switch Actuation Example
(current configuration color codes - see Table 2-1)

Notes: (1) Cam rotates counter-clockwise with increased pressure; (2) Switches shown w/low at 25% DP and high at 75% DP; (3) To change setpoint: loosen lock screw, move switch plate, tighten screw, and test setpoint; (4) Internal wires use No. 22 AWG and external wires use No. 18 AWG

1-4. Specifications

General:

Actuating Unit (DPU)..... per specific instrument model (refer to page 1 of this manual)
Dial Size 6-inches (150 mm)

Accuracy of Indication $\pm 1\%$ * of full scale DP

Accuracy at

Point of Switch Actuation..... $\pm 1.5\%$ * of full scale differential pressure

***NOTICE:** Accuracy varies with DP range, bellows size, etc.. For general accuracy information, refer to Ind/Switch/Xmtr Product Bulletin (ID#21920). For specific model/configuration accuracy specifications, consult Factory.

Temperature Limits (Ambient)... $-40^{\circ}\text{F}/^{\circ}\text{C}$ to $+180^{\circ}\text{F}$ ($+80^{\circ}\text{C}$)

Switch:

Accuracy of:

Switch Repeatability $\pm 0.25\%$ of full scale

Switch Deadband $\pm 5\%$ (SPDT); $\pm 6\%$ (DPDT)

Switch Type..... Mechanical, Snap-Acting; all switches are SPDT (DPDT switches are stacked SPDT switches with a common actuator)

Contact Type Single Pole, Double Throw (SPDT)
Double Pole, Double Throw (DPDT)

Adjustment All switches are adjustable between 5% and 95% of factory calibrated scale

Activation Switches can be calibrated to actuate either increasing or decreasing scale

Switch Contact Rating:

2.5 Amps @ 250 VAC, 50/60 Hz **1**

5.0 Amps @ 250 VAC, 50/60 Hz

5.0 Amps @ 125 VAC, 50/60 Hz **1**

3.0 Amps @ 30 VDC (Resistive) **1 2**

0.4 Amps @ 125 VDC (Resistive)

0.2 Amps @ 125 VDC (Inductive) **1 3**

0.1 Amp @ 30 VDC (Inductive) **2 3**

See **Notes** on page 6.

(continued on next page...)

1-4. Specifications (continued)

Relay:

Contact Types..... Single Pole, Double Throw (SPDT)
Double Pole, Double Throw (DPDT)

Relay Contact Ratings:

25 Amps @ 150/250 VAC, 50/60 Hz, SPDT
25 Amps @ 300 VAC, 50/60 Hz, DPDT
5.0 Amps @ 600 VAC, 50/60 Hz
13 Amps @ 28 VDC ②
20 Amps @ 15 VDC ②
0.75 HP @ 200/240 VAC, 50/60 Hz
1.0 HP @ 200/240 VAC, 50/60 Hz, SPDT
1.5 HP @ 200/240 VAC, 50/60 Hz, DPDT
10 Amps (Resistive) @ 120 VAC ①
5 Amps (Inductive) @ 120 VAC ① ③
10 Amps (Resistive) @ 26.5 VDC ③ ②
5 Amps (Inductive) @ 26.5 VDC ① ② ③
0.5 HP @ 120 VAC ①
1.0 HP @ 120 VAC ①

Relay Coil Voltages:

6 VAC @ 5VA Max.
12 VAC @ 5VA Max.
24 VAC @ 5VA Max.
120 VAC @ 5VA Max.
230 VAC @ 5VA Max.
6 VDC @ 2W Max.
12 VDC @ 2W Max.
24 VDC @ 2W Max.
110 VDC @ 2W Max.

Switch/Relay Wiring:

Size..... 22 AWG for internal Switch/Relay Coil Wires;
18 AWG for all external wires and relay contacts

Insulation..... Standard (CSA) - PVC;
Radiation Resistant - Tefzel

Notes:

- ① **CSA Approved**
- ② **CE Approved** (Voltage limited to **less than** 50 VDC or 35 VAC for CE applications)
- ③ Arc suppression recommended for inductive loadings.

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. **Note:** *The unit was checked for accuracy at the factory — do not change any of the settings 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. Mounting/Piping/DPU Installation

Refer to the appropriate DPU Manual for the Model being installed.

2-3. Electrical Connection (Switches/Relays)

Units are supplied with either single or dual alarm switches and/or relays (depending on customer order). The direct-set switch contacts are adjustable over the entire scale range.

Table 2-1 shows switch and relay wiring color coding for legacy and current configurations. Figures 2-1 through 2-6 show switch and relay wiring.

The high switch and low switch set point adjustment procedures are covered in paragraph 3-7, page 16.

For physical location of switches, see page 3.

2-4. Switch Use

Switch contact life is influenced by various application conditions such as temperature, humidity, airborne contamination, vibration, amount of plunger travel, cycling rate, and rate of plunger travel (and others), as well as by the electrical (circuit) characteristics.

NOTICE: Arc suppression for inductive loads will prolong the life of the switch contacts.

Note: Due to their size, subminiature switches have small mechanical clearances; therefore, no rating above 250 VAC has been established.

2-5. Startup

For startup procedures, Warnings, and information, refer to the separate DPU Manual that is appropriate for the indicator-switch model (see front page of this manual).

NOTICE

To ensure the unit calibration is within factory-set calibration tolerances, perform the Calibration Check procedure in paragraph 3-4, page 13.

TABLE 2-1. SWITCH/RELAY WIRE COLOR CODING (4/06c)

LEGACY CONFIGURATIONS 288A, 288C, 289A (prior to Jan. 2005 - No CSA label or prior to Apr. 2006 w/Tefzel insulation)		LEGACY CONFIGURATIONS 290B, 290D, 291B (prior to Aug. 2005)		LEGACY CONFIGURATIONS 290B, 290D, 291B (prior to Aug. 2005)		CURRENT CONFIGURATIONS (Note 2) 288A, 288C, 289A, 290D, 291B, 321, 322, 1512 (290D/291B after Aug. 2005) (288A/288C/289A w/CSA Label after Jan. 2005) (289A/288C/289A w/Tefzel Insulation after Apr. 2006) (All other Models after Jun. 2006 [est.])	
NO	C	NC	NO	C	NC	NO	C
SPDT SWITCHES							
Low	Red	Blue	Red	Yellow	Blue	Red	Yellow
High	Black	White	Black	Violet	White	Black	Violet
DPDT SWITCHES							
Low #1	Red	Blue	Red	Yellow	Blue	Red	Yellow
Low #2	White/Red	White/Blue	White/Red	White/Yellow	White/Blue	White/Red	White/Yellow
High #1	Black	White	Black	Violet	White	Black	Violet
High #2	White/Black	White/Green	White/Black/Gray	White/Black/Violet	White/Black/Blue	White/Black	White/Violet
4-INDEPENDENTLY ADJUSTABLE SWITCHES							
Low #1	Red	Blue	Red	Yellow	Blue	Red	Yellow
Low #2	White/Red	White/Blue	White/Red	White/Yellow	White/Blue	White/Red	White/Yellow
High #1	Black	White	Black	Violet	White	Black	Violet
High #2	White/Black	White/Violet	White/Black/Gray	White/Black/Violet	White/Black/Blue	White/Black	White/Violet
SWITCHES FOR RELAYS							
Low	Red	Blue (Note 1)	Red	Yellow	Blue (Note 1)	White/Brown	Brown
High	Black	White (Note 1)	Black	Violet	White (Note 1)	White/Gray	Gray
RELAYS							
Low #1	Gray	Brown	Gray	Blue	Brown	Red	Yellow
Low #2	White/Gray	White/Brown	White/Gray	White/Blue	White/Brown	White/Red	White/Yellow
High #1	Violet	White	White/Red	White	Orange	Black	Violet
High #2	White/Violet	White/Black	White/Violet	White/Black	White/Orange	White/Black	White/Violet
Coil Wiring:	Legacy Ver.: Low = Red and High = Black						
Current Ver.: Low = White/Brown and High = White/Gray							

Note 1: Wire is NOT connected. **Note 2:** The Current Configurations wiring information does not apply to Model 288C for military service.

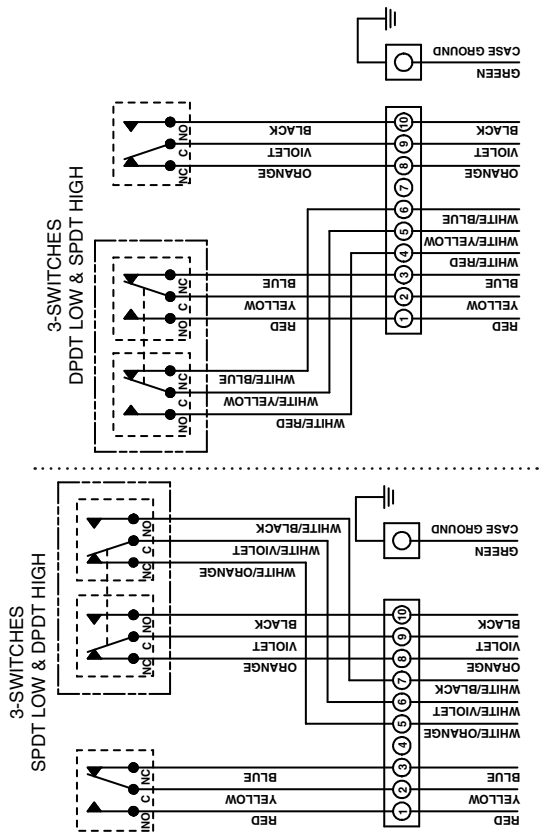


Figure 2-3. 3-Switches

(current configuration color codes - see Table 2-1)

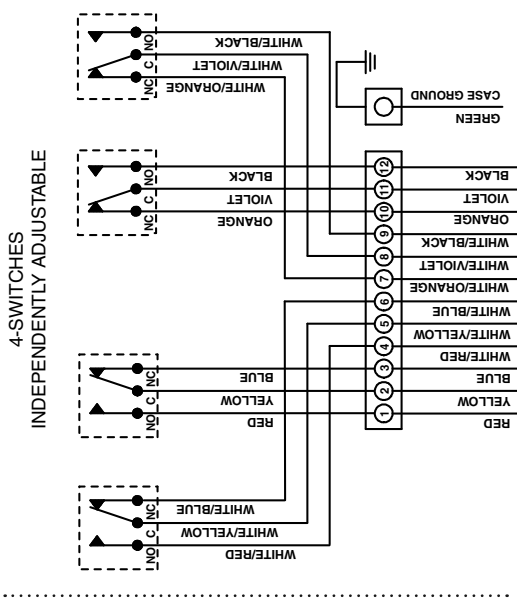


Figure 2-4. 4-Switches, Independently Adjustable

(current configuration color codes - see Table 2-1)

NOTICE: Figures 2-1 through 2-6 show: switch & relay contacts in the relaxed (shelf) condition, the low switch set to trip at a position below the pointer scale position, and the high switch set to trip at a position above the pointer scale position. .NO = Normally Open in (shelf) condition. .NC = Normally Closed in (shelf) condition. C= Common.

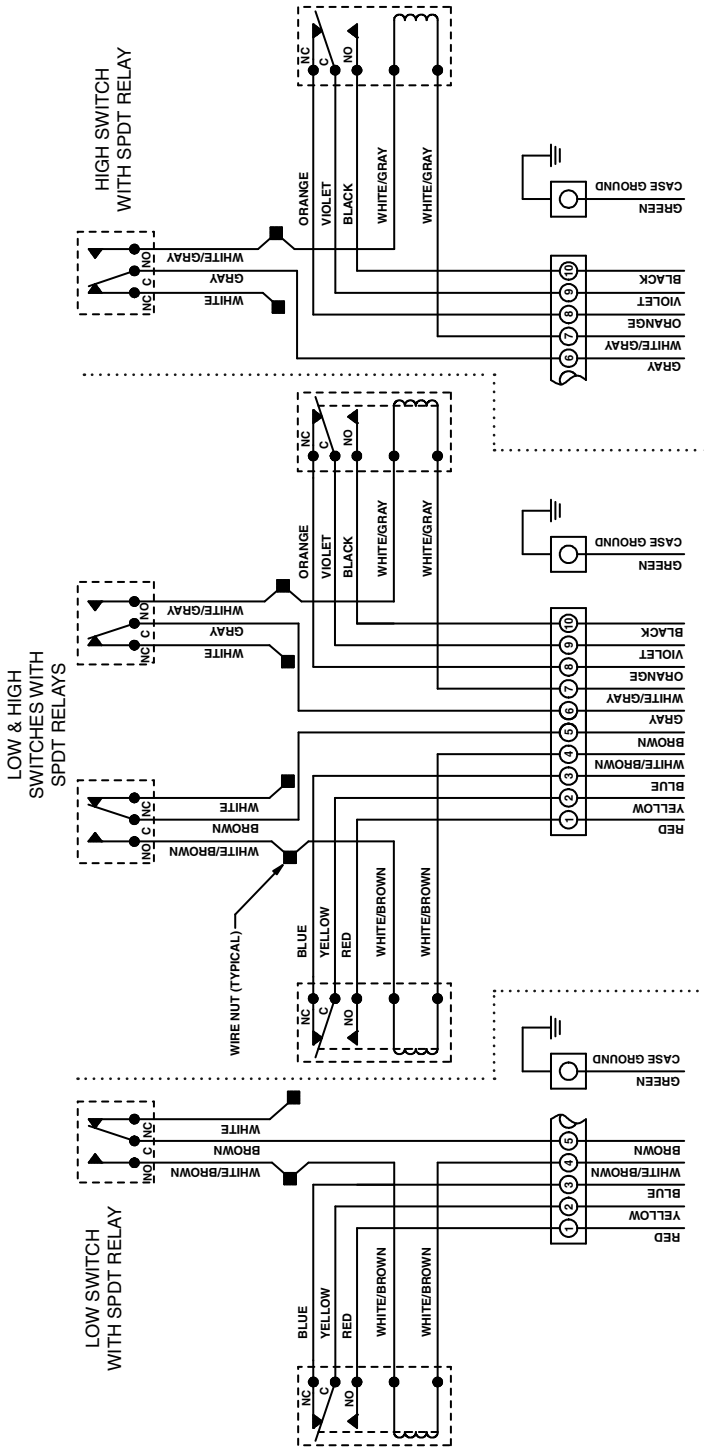


Figure 2-5. Low/High Switch(es) w/SPDT Relay(s) Diagrams (current configuration color codes - see Table 2-1)

NOTICE: Figures 2-1 through 2-6 show: switch & relay contacts in the relaxed (shelf) condition, the low switch set to trip at a position below the pointer scale position, and the high switch set to trip at a position above the pointer scale position. NO = Normally Open in (shelf) condition. NC = Normally Closed in (shelf) condition. C= Common.

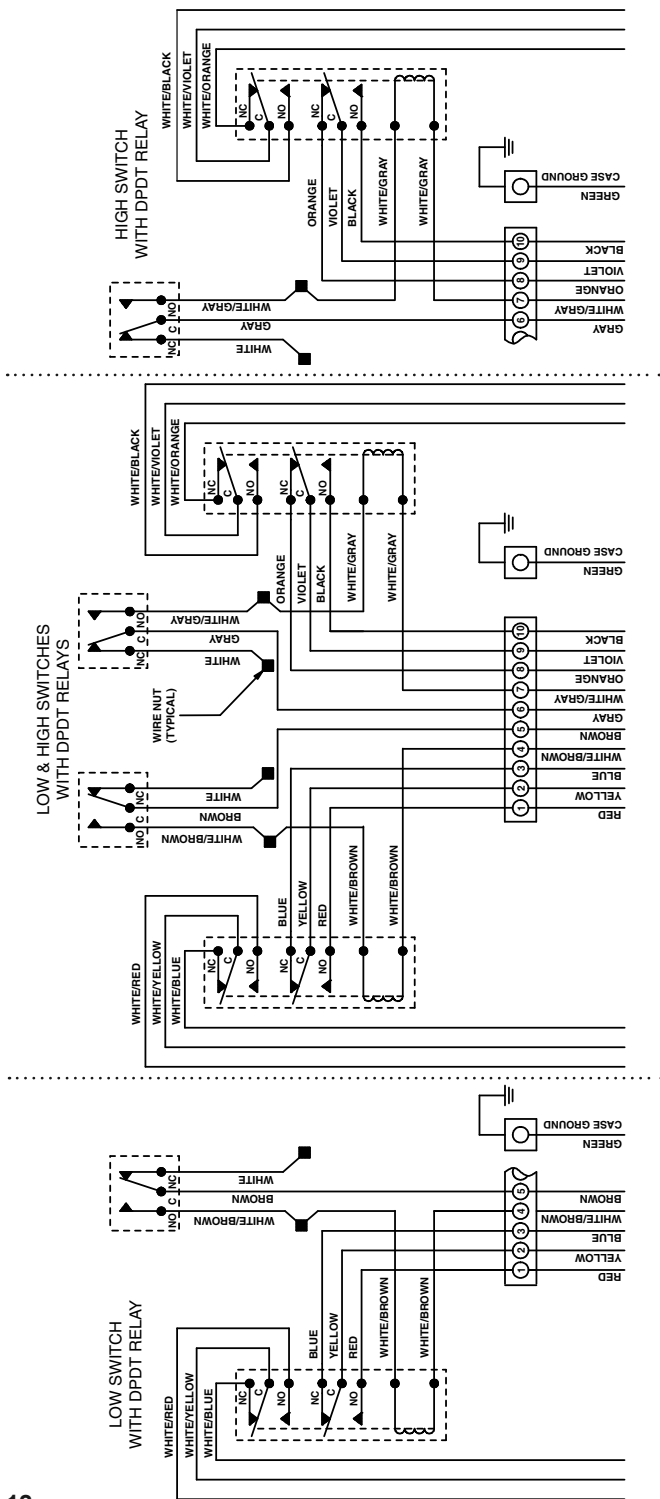


Figure 2-6. Low/High Switch(es) w/DPDT Relay(s) Diagrams (current configuration color codes - see Table 2-1)

NOTICE: Figures 2-1 through 2-6 show: switch & relay contacts in the relaxed (shelf) condition, the low switch set to trip at a position below the pointer scale position, and the high switch set to trip at a position above the pointer scale position. NO = Normally Open in (shelf) condition. NC = Normally Closed in (shelf) condition. C = Common.

SECTION 3 - MAINTENANCE AND CALIBRATION

3-1. DPU Installation/Maintenance/Repair

DPU inspection, cleaning, service, repair, range change, and BUA replacement procedures (along with applicable **WARNINGS**, **CAUTIONS**, and **NOTICES**) are presented in the **separate 224/224C DPU manual**.

3-2. Tools

Table 3-1. Tools

Equipment	Purpose
Pointer Puller	Pointer Removal
Small Screwdriver	Calibration Adjustment
Medium Screwdriver	Bezel Removal and Replacement
1/4" and 1/8" Open-end Wrenches	Zero (1/4") and Range (1/8") Adjustments
1/8 Hex Allen Wrench	Switch Setpoint Adjustment

3-3. Bezel/Lens (or Cover) Installation and Removal

WARNING

(EXPLOSIONPROOF UNITS)



PRIOR TO LOOSENING ANY ATTACHING HARDWARE, HOUSING BOLTS, OR COVER ASSEMBLY, ASSURE SURROUNDING AREA IS, AND REMAINS, WELL VENTILATED.

PRIOR TO LOOSENING OR REMOVAL CASE/COVER ASSEMBLY, ALL ELECTRICAL POWER SUPPLIES MUST BE TURNED OFF.

THE COVER MUST BE REMOVED TO CALIBRATE THE INSTRUMENT.

BEFORE ANY MAINTENANCE/CALIBRATION, REVIEW THE APPROPRIATE (SEPARATE) DPU MANUAL.

For non-SST/non-explosionproof units, the bezel gasket (p/n 0277-0026C) must be installed as shown below (also ref. Fig. 4-1):

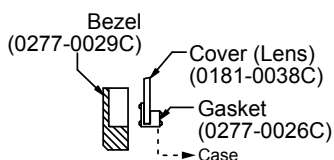


Figure 3-1. Bezel/Lens

To remove the bezel and cover lens on non-SST/non-explosionproof units:

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

The two snubbers (p/n 0266-0028C) on the scaleplate should not be compressed against the lens cover and the pointer should not touch the lens.

(Continued on next page...)

3-3. Bezel/Lens (or Cover) Installation and Removal (Continued)

NOTICE

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.

For 288C SST Version units, refer to Fig. 4-2, page 31.

For Explosionproof units, cover is unscrewed to gain access to the internal components. When re-installing cover, tighten cover securely and inspect lens for cracks or other defects that may affect the explosionproof rating. Refer to Fig. 4-3, page 32.

3-4. Calibration Check

To ensure the unit calibration is within factory-set calibration tolerances, perform the following procedure. **NOTICE: Review all procedures, WARNINGS/NOTICES** in the separate **224/224C DPU** manual **BEFORE** performing this procedure.

1. Mount instrument in an approx. level position and connect to a standard pressure source (see separate 224/224C manual).
2. If the zero indication is incorrect, remove bezel/lens assembly (cover on explosionproof units) and re-adjust zero, per the following:

With a 1/4" open-end wrench (included in calibration kit 0288-1032B), hold the hexagon pointer hub fixed and rotate the pointer with fingers until the pointer accurately indicates ZERO on the scale. See Figure 3-2. Replace bezel/lens or cover.

3. To test for reverse travel, connect pressure source to LP housing and vent HP housing. Apply pressures approximately 150% of the DP range. The pointer should move approximately 5% to 10% below zero.
4. To test for overtravel, connect pressure source to HP housing and vent LP housing. Apply pressures approximately 150% of DP range. The pointer should move approximately 5% to 10% above full scale.
5. Apply 0, 50, and 100% of full scale pressure. If indication is within specified limits, no adjustments are necessary. If indication is not within specified limits, perform a complete calibration, per paragraph 3-7, page 16.
6. Make sure instrument zero indication is correct; otherwise, repeat step 2.
7. Verify switch set points (refer to paragraph 3-8, page 18).

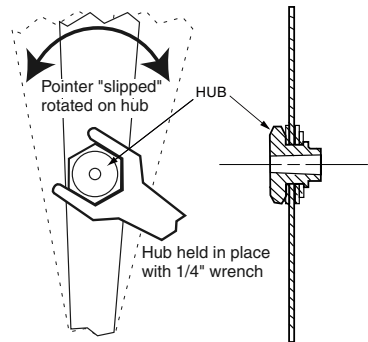


Figure 3-2. "Slipping" Pointer

3-5. Pointer Installation and Removal

During adjustment and calibration of the unit, it may be necessary to remove and reinstall the pointer, per the following procedures:

A. Pointer Installation

1. Position pointer on movement shaft with pointer set at zero scale. It may be necessary to enlarge the hub hole, using a tapered broach (included in the toolkit (p/n 0288-1032B).
2. Lightly tap pointer hub with a hand-set or other flat-end tool. Use perpendicular blows to avoid bending shaft.
3. Check indicating switch for calibration over its entire range (refer to Switch Calibration in this section). If indicating switch is correctly calibrated, secure pointer to movement shaft by tapping hub with a hand-set or other flat-end tool.

B. Pointer Removal

Pointer is removed with Pointer Puller (included in the calibration toolkit 0288-1032B), see Figure 3-3.

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

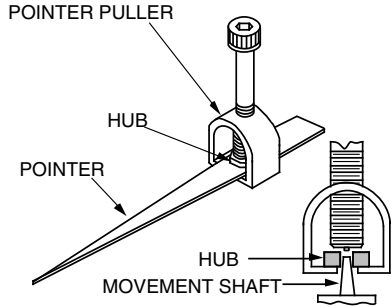


Figure 3-3. Pointer Puller
(p/n 0163-0005B)

3-6. Indicator Calibration

1. Securely mount instrument in an approx. level position and connect DPU into the test setup, as described in the appropriate (separate) DPU manual.
2. Align linkage between drive arm and movement, per Figure 3-4.
3. Check pointer for zero indication. If necessary, set pointer to zero, by slipping pointer on hub, per paragraph 3-4, step 2.

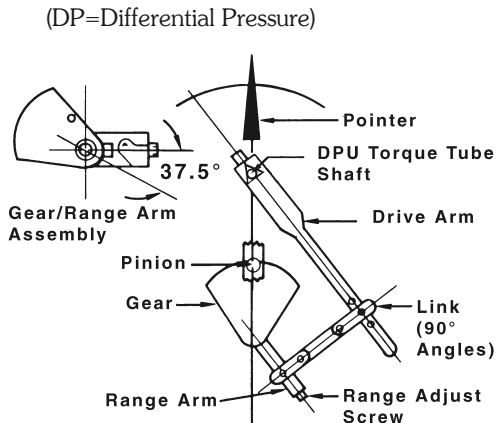


Figure 3-4. Range/Linearity Adj. (50% DP)

3-6. Indicator Calibration (Continued) (DP=Differential Pressure)

4. Apply 100% pressure. If pointer exceeds full-scale, lengthen movement range arm.
5. Release pressure. Set pointer to zero, by slipping pointer on hub, per paragraph 3-4, step 2.
6. Repeat steps 4 and 5, as necessary, to obtain correct zero/full-scale.
7. Apply 50% DP. If pointer does not indicate 50% scale, a linearity adjustment is necessary. Loosen drive arm screw and move arm to shift pointer in direction of error a distance of about 10 times linearity error. Tighten drive arm screw.
8. 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 7), slip range arm along gear approximately 5 degrees from normal 37.5 degree angle to approximately 43 degrees (see step 2). 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.
9. 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. Pointer should accurately indicate each applied pressure.
10. Test instrument repeatability by applying 0%, 50%, 0%, 50% of full-scale differential pressure. Indicator should accurately indicate each applied pressure.
11. Set stops to prevent pointer from striking snubbers on scale. Test setting by moving pointer from zero position to 50% position manually and then letting pointer return freely. If necessary, tap pointer hub to tighten it to shaft.

3-7. Complete Calibration (See **Warning** on page 13)

Before performing complete calibration procedure, verify that instrument is out of calibration, by performing calibration check procedure (para. 3-4, page 14). If instrument is out of calibration, before performing complete calibration procedure, remove bezel/lens and inspect switch mechanism to verify the following:

- The roller rotates without wobble or binding.
- The cam does not touch the roller side shields.
- The actuator arm moves freely on its pivot.
- All switch mounting screws are tight.
- Linkages are straight and do not bind at the pivots.

Correct any problems that are encountered.

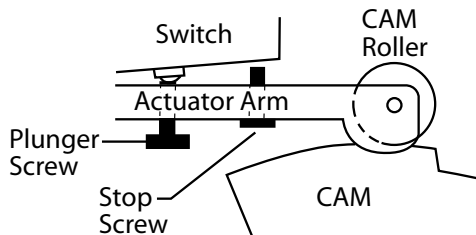


Figure 3-5. Cam/Follower Position

B. Calibration Procedure (Cont.) (see Fig. 3-6) (See **Warning**, page 13)

To calibrate switch linkage (required when unit is rebuilt):

8. (Cont.)

The high switch is usually set to actuate at increasing pressure — when calibrating high switch, apply test pressure in an increasing direction. This amount of loading will prevent cam-runout of a similar condition. Excessive plunger loading (more than 3 flats) may cause roller to drag on cam. Cam friction will be apparent by excessive hysteresis, erratic pointer readings and inconsistent switch operation.

9. Check switch deadband, (actuate to reset) by applying differential pressures in a decreasing then increasing (opposite for high switch direction). Observe pressures. To reduce deadband, advance plunger screw (two flats maximum).

10. Adjust high switch to actuate at desired pressure. The procedure is the same as for the low switch.

3-8. Changing Switch Setpoint

(Tools: Screwdriver, 1/8 Hex Allen wrench) (See **Warning** on page 13)

Set Point — The measured pressure at which the snap-switch actuates and thereby changes the states of the N.O and N.C. contacts. For example, the set point of the low switch is 24 psid with decreasing pressure.

Deadband — The difference in measured pressures between switch-actuation and switch-reset. Deadband is usually expressed as percent of full scale (% of F.S.). Deadband is not adjustable. For example, the switch above was found to reset at 26.4 psid with increasing pressure. The deadband was 2.4 psi, or 4% of the full scale (0 to 60 psid).

A. In-Service Instruments (calibration pressures cannot be applied)

1. Remove bezel/cover. **Do not remove pointer or scale.**
2. Insert hex wrench in switch adjust post, (item A, Fig. 3-7).
3. Loosen switch lock-screw, (item B), 1/2 to 1 turn.
4. With hex wrench, move index pointer (item C) to new set point as indicated on switch index (item D).
5. If possible, check set point by varying process pressures and observing pointer readings when switch actuates. (Open manifold bypass valve slowly and watch for “pointer-jump” at set point or by electrical signal.) Improve setting if necessary, repeat test several times to verify stability.

Note: Switch index has 10 div., marked 0, 5, and 10. These match markings on outer edge of scale.

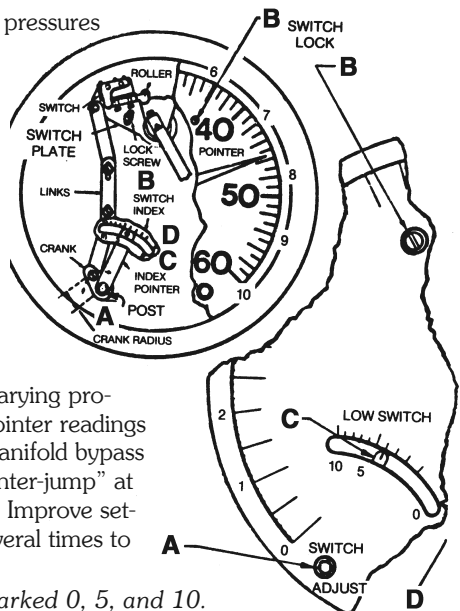


Figure 3-7.
Setpoint Adjustment

3-8. Changing Switch Setpoint (Cont.) (See **Warning** on page 13)

A. In-Service (Continued)

Example: Scale has range of 0-60 psid. Set point is 24 psid, with decreasing pressure, $(24/60 \times 10 = 4)$. Move index pointer (item C) to division 4. Start from bottom of switch index (0 on low, 10 on high). Tighten switch lock (Item B) snug plus 1/4 turn. Do not overtighten. This will place set point within $\pm 2\%$ of full scale.

B. Out-of-Service (Disconnected from process lines or mounted on bench)

1. Drain and vent housings.
2. Attach calibration pressure source (air or N₂) to HP housing.
3. Apply pressures and observe pointer readings for accuracy. Use a pressure standard (Heise gage or equiv.) for reference. Change pressures slowly in discrete steps. A “bleed-pressure” method may cause errors.
4. Change switch set point as described in Part A.
5. Check set point by changing measured pressure to actuate switch.
For Example: To verify low-switch set point to 24 psid, apply approximately 30 psi. Then reduce pressure to approximately 25 psid, hold for a few seconds, then continue in 1/4 psid steps until switch actuates. If set point is incorrect, continue instructions in Part A.
6. To measure switch deadband, reduce pressure to zero, then increase pressure until switch resets.
7. To verify repeatability of set point, repeat step 5 several times. For improved accuracy, use smaller increments of pressure. Allow extra time for slow response gages and for test systems that have long runs of small bore tubing.
8. High alarm switches right side of the scale) are adjusted in a similar manner. Apply increasing pressure to establish the switch set point, decreasing pressure to measure deadband.

C. Notes

1. Always check set point after tightening switch lock screws.
2. Either switch may be set at any point of the scale, except allowance must be made for deadband to enable switch to reset itself. For example, high switch (right side of scale) may be set at 100% of F.S., but should not be set near zero. Also, low switch may be set at zero, but not near full scale. (Observe deadband values for specific models).
3. If switch performance is unsatisfactory (set point does not repeat, deadband is excessive, pointer exhibits hysteresis, contacts are unstable, etc.) remove scale and inspect switch and mechanism. Scale is split for removal without pulling pointer.
4. Switch Variations: **(a)** SPDT: This is the standard model (low, high, or both); **(b)** DPDT: Two switches are stacked and actuated by a single lever (low, high, or both); **(c)** Three (or four) SPDT: Switches have independent switch points - No.1 and 3 are usually low switches set for decreasing pressures. Nos. 2 and 4 for increasing pressures; **(d)** Hermetically Sealed Switch (Micro 11HM41): this switch has wide deadband, case is modified for electrical clearances, amperes are reduced for 60 Hz service.

3-9. Preventative Maintenance

- Indicating Switch — Periodically inspect alarm switch mechanism to verify that all mounting screws are seated properly. Inspect linkage for wear. Inspect integrity of electrical circuits. Tighten as necessary.
- DPU — **Warning/Caution notices**, inspection/cleaning procedures, and maintenance procedures are presented in the appropriate (separate) DPU manual. **Do Not perform any maintenance/repair on the instrument or DPU without first reviewing all procedures and Warning/Caution notices in the separate DPU manual.**

3-10. Locking Drive Arm to Torque Tube

Refer to the appropriate (separate) DPU manual. **For explosionproof units,** refer to Section 4, 290D Detail Drawing, page 33 (See **Warning** on page 13).

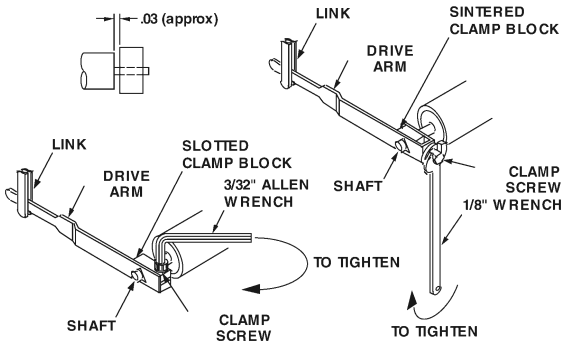


Figure 3-8. Locking Drive Arm to Torque Tube

1. Slip drive arm over torque tube shaft; clear end of torque-tube housing by approximately 0.030-inches before securing to prevent interference.
2. To tighten drive arm assembly onto torque-tube shaft:
 - a. While supporting block/shaft, tighten clamp screw until snug to shaft.
 - b. Still supporting block/shaft, tighten clamp screw an additional:
 - Sintered: 1/3 to 1/2 turn (This screw can normally turn one full revolution before breaking.)
 - Slotted: 1/4 to 1/3 turn (The slot in the slotted clamp block should still be open.)

NOTICE: For Seismic and High Shock Qualified Units, perform Drive Arm Tightness Test, per paragraph 3-11.

3-11. Drive Arm Tightness Test (See **Warning** on page 13)

This procedure tests the drive arm to torque tube attachment for tightness, by applying torque developed by the DPU onto a fixed drive arm. Care should be taken to apply pressure slowly, as torque is being applied to the connection through the torque tube drive shaft.

With pointer at normal 0% torque tube rotation position (max. minimum scale position or 0% on a normal 0 to 100% scale unit), adjust drive arm stop bracket (or use alternate means) to prevent pointer from moving (stop bracket interferes with drive arm movement). Note: On reverse acting/split range units, it will be necessary to pressurize DPU to move pointer to max. minimum scale position, and on suppressed units, it will be necessary to apply pressure to establish a reference point to check for "zero" shift.

Pressurize DPU to full calibrated scale DP (100% of full scale range) to achieve 8-degrees of torque tube drive shaft equivalent torque onto the connection.

Observe shift in the unit "zero" following DPU depressurization (as required) and drive arm stop bracket readjusting (to allow free movement of drive arm and pointer). A downscale (counter-clockwise) shift in "zero" of greater than 1/2% is indicative of drive arm slippage necessitating further clamp block tightening.

3-12. Troubleshooting (See **Warning** on page 13)

Refer to Table 3-1 and the separate 224/224C DPU manual.

Table 3-1. Troubleshooting

Problem	Possible Source	Probable Cause	Corrective Action
Low or No Indication	Primary Element or DPU (Refer to DPU Manual)	Orifice installed backwards or oversized	Replace Orifice
		Flow Blocked Upstream from run	Clean out run or open valve
		Loss of liquid in Reference Leg (liquid level)	Refill Reference Leg
		Density changes in process media or Reference Leg	Refill Reference Leg with same density liquid as process media
	Primary Element to DPU Piping (Refer to DPU Manual)	Pressure tap holes plugged and/or piping plugged	Clean out piping
		Bypass Valve Open or Leaking	Close bypass valve(s) and/or repair leaks
		Liquids or Gases trapped in piping	Vent piping
		Block or shutoff valves closed	Open block or shutoff valves
		Piping leaks on HP side	Repair leaks
	Bellows Unit (Refer to DPU Manual)	Housing filled with solids restricting bellows movement	Clean out housing
		Gas (liquid service) or liquid (gas service) trapped in housing	Vent housing
		HP housing gasket leak	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	Re-route wiring
		Dirty mechanism	Clean mechanism
	<i>Continued on next page...</i>		

3-12. Troubleshooting (Continued) (See **Warning** on page 13)

Refer to Table 3-1 and the separate 224/224C DPU manual.

Table 3-1. Troubleshooting (Continued)

Problem	Possible Source	Probable Cause	Corrective Action	
High Indication	Primary Source	Orifice partially restricted or too small	Clean out or replace	
	Primary Element to DPU piping	Piping leaks on LP side	Repair leaks	
		Bellows Unit (Refer to DPU Manual)	Gas (liquid service) or liquid (gas service) trapped in housing	Vent housing
			LP housing gasket leak	Replace gasket
	Indicator, Alarm Switch Mechanism	Range Spring broken or DPU tampered with	Return BUA for repair with	
		Loose linkage or movement	Tighten or replace	
Erratic Indication	Primary Element	Flow pulsating	Install dampening device upstream of DPU run	
		Primary Element to DPU piping	Liquid (gas service) or gas bubble (liquid service) trapped in piping	Remove
	Vapor generator incorrectly installed		Re-pipe	
	Reference Leg gassy or Liquid vaporizing		See piping instructions in DPU Manual	
	Bellows Unit (Refer to DPU Manual)	Obstructed Bellows Travel	Clean Bellows	
		Gas trapped in DPU HP or LP housing	Remove (see Startup procedure)	
		Linkage dragging or dirty	Adjust or Clean	
		Pointer Dragging on Scaleplate	Adjust Pointer Position	
Inaccurate or No Electrical Alarm	Power Supply	Blown Fuse	Replace Fuse	
		Broken or loose wire	Repair	
	Alarm Switch	Switch not properly Adjusted	Adjust Switch	
		Dirty or Burned	Replace switch contacts	
Continued on next page...				

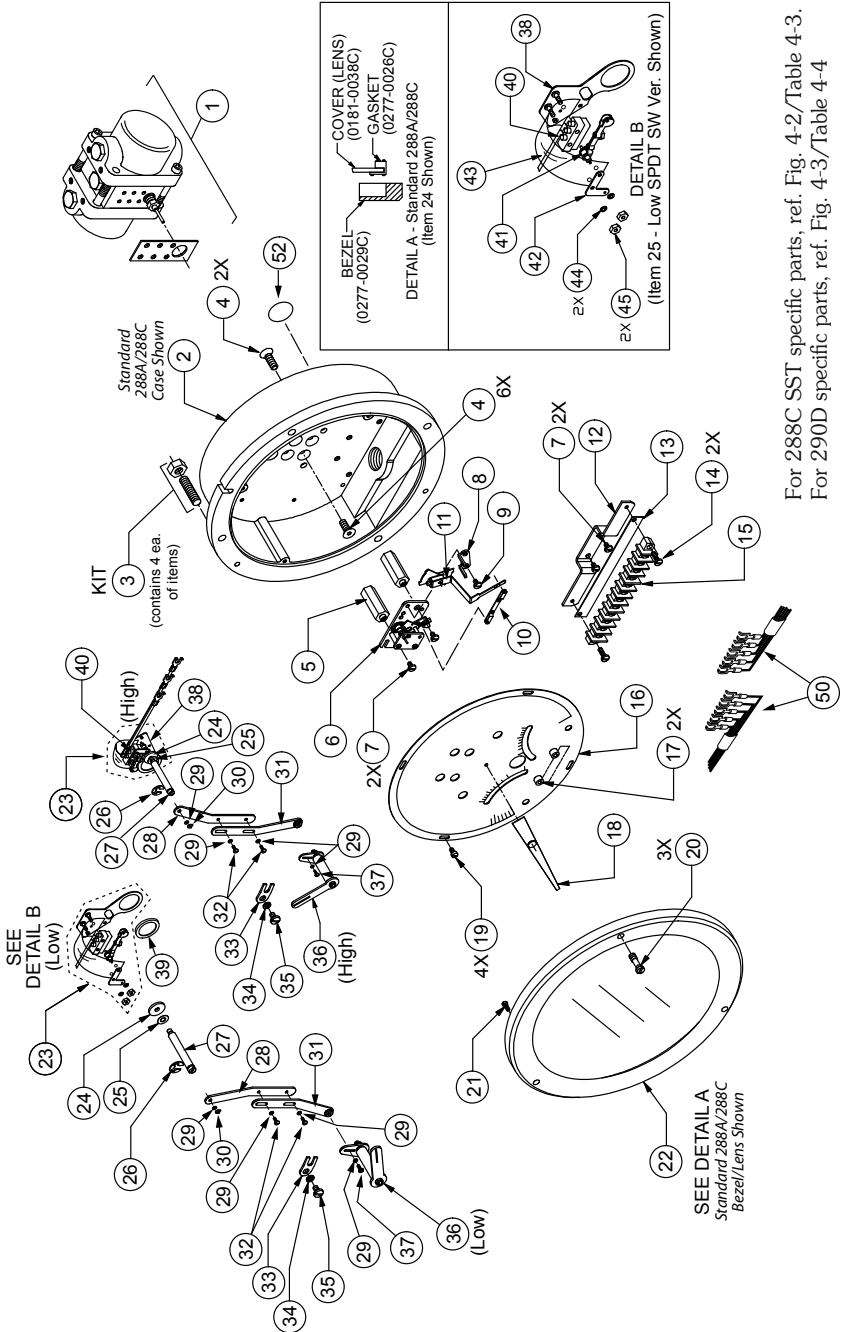
3-12. Troubleshooting (Continued) (See **Warning** on page 13)

Refer to Table 3-1 and the separate 224/224C DPU manual.

Table 3-1. Troubleshooting (Continued)

Problem	Possible Source	Probable Cause	Corrective Action
Switch Drifts (set-point not repeat-able)	Process Changes	Transients or surges cause switches to actuate prematurely	Add time delay gages or add time circuit
		Setpoint and/or Deadband are too wide in pressure valves	Specify DP Range as low as practical; set-point repeatability and deadband are percentage of full range
		Electrical overloads affect the spring properties of the leaf actuator in the switch	Examine circuits for Voltage, amperes
		DC inductive loads cause arcing and burning of contacts	Consider arc-suppression devices or relays
		Accumulation of fluids in piping generate artificial signal	Vent gas or drain liquids from signal lines
	Calibration Techniques	Failure to check setpoint after locking	Verify setpoint repeatability after locking switch plate
		Rapid pressure change or venting system	During calibration, make pressure changes in slow, discrete steps
		Pressure application in reverse	Test low-alarm with decreasing pressure and high-alarm with increasing pressure
		Reference Gage Inaccuracy	Suitable pressure standard such as manometer, dead-weight tester, or Heise-type gage may be required
		Damage to Switch Contacts	Adjust plunger Screws carefully to avoid damage to internal parts of switch

SECTION 4 - PARTS DRAWING/LIST



For 288C SST specific parts, ref. Fig. 4-2/Table 4-3.
 For 290D specific parts, ref. Fig. 4-3/Table 4-4

Figure 4-1. 288A/288C Parts Drawing

(Ref. Tables 4-1/4-2 for part numbers)

Table 4-1. 288/290 General Parts List

(For 288C **SST** specific parts, see Fig. 4-2 and Table 4-3)

(For 290D specific parts, see Fig. 4-3/4-4 and Table 4-4)

ITEM	DESCRIPTION	PART NO. (●)=model specific	PER UNIT
1	Differential Pressure Unit 288A uses 224 DPU 288C/290D use 224 C DPU	See separate 224/224C DPU Manual	1
2	Case Assembly:		1
	288A/288C (Standard)	0288-0038B (●)	
	288C Stainless Steel Version	See Fig. 4-2	
	290D	See Fig. 4-3	
3	Panel Mount Kit (<i>Std. 288A/288C Only -not available for SST Ver. or 290D</i>) (4 ea. of items listed below)	0040-1007T (●)	1
	Set Screw, Slotted, 1/4-20x1, STL	0340-0003J (●)	
	Nut, 1/4-20, STL.	0500-0010J (●)	
4	Screw, Flat, Skt Cap, 10-32 x 1/2, SST (Riser/DPU)	0240-0019J	8
5	Movement Riser	0277-0035C	2
6	Movement Assembly	0288-0035B	1
7	Screw, Bd Hd, 6-32 x 3/16, SST	0117-0013J	4
8	Stop Bracket	0288-0028C	1
9	Screw, Bd Hd, 4-40 x 3/16, SST	0117-0012J	1
10	Link Assembly	0288-0036B	1
11	Drive Arm Assembly	0288-0048B	1
12	Bracket, Terminal		1
	10-Position (Standard)	0288-0029C	
	10-Position (For 14 AWG Terminal Blocks)	0288-1161C	
	12-Position	S469-0060Z	
13	Strip, Insulator		1
	10-Position (Standard)	0038-1345T	
	10-Position (For 14 AWG Terminal Blocks)	0038-1379T	
	12-Position	0038-1351T	
14	Screw, Rd Hd, 6-32 x 3/8, BRS, NP	0111-0015J	2
15	Terminal Block:		1
	10-Position (Standard)	0038-0033T	
	10-Position, 14 AWG	0288-1160C	
	12-Position	S469-0061Z	
16	Scaleplate:		1
	288A/288C/290D, White	0288-1014C (●)	
	288A/288C/290D, Black	0288-0031C (●)	
	288C Stainless Steel Version	See Fig. 4-2	
17	Snubber	0226-0028C	2
18	Pointer		1
	White	0288-0030B	
	Black	0288-0031B	
19	Screw, Sl Fil., Hd., 4-40 X 3/16, SST	0114-0023J	4

See notes, page 29.

Table 4-1. 288/290 General Parts List (Continued)

ITEM	DESCRIPTION	PART NO. (•)=model specific	PER UNIT
20	Screw, Bezel		3
	Standard 288A/288C	0181-1001C (•)	
	288C Stainless Steel Version	See Fig. 4-2	
21	Stud, Drive-Lok, Retaining, Bezel (Standard 288A/288C Only)	0004-0005K (•)	1
22	Bezel Assembly (Bezel, Cover (lens) and Gasket)		1
	288A/288C Standard, Bezel Assembly	0277-0018B (•)	
	Bezel (part of 0277-0018B)	0277-0029C (•)	
	Cover (Lens) (part of 0277-0018B)	0181-0038C (•)	
	Gasket (part of 0277-0018B)	0277-0026C (•)	
	288C Stainless Steel Version	See Fig. 4-2	
23	290D	See Fig. 4-3	A/R
	Switch and Plate Assembly:		
	PVC Insulation (CSA)		
	Low, SPDT	290B-1100B	
	High, SPDT	290B-1006B	
	Low, DPDT	S401-0053Z	
	High DPDT	S401-0056Z	
	Low Relay (not available on 288C SST Version)	290B-1101B	
	High Relay (not available on 288C SST Version)	290B-1008B	
	Low #1, Independently Adjustable *	S469-0058Z	
	High #1, Independently Adjustable *	S469-0059Z	
	Low #2, Independently Adjustable *	S469-0020Z	
	High #2, Independently Adjustable *	S469-0043Z	
	Tefzel Insulation (Radiation Resistant)		
	Low, SPDT	S666-0135Z	
	High, SPDT	S666-0137Z	
	Low, DPDT	S401-0110Z	
	High DPDT	S401-0113Z	
	Low Relay (not available on 288C SST Version)	S666-0189Z	
	High Relay (not available on 288C SST Version)	S666-0196Z	
	Low #1, Independently Adjustable *	S666-0135Z	
	High #1, Independently Adjustable *	S666-0137Z	
	Low #2, Independently Adjustable *	S666-0136Z	
	High #2, Independently Adjustable *	S666-0138Z	
	Teflon Insulation (High Temp./Hermetic SW)		
	Low SPDT	0288-1132B	
	High SPDT	0288-1163B	
	* Note: Independently Adjustable Switches - SW#1 LOW (upper left); SW#2 HIGH (upper right); SW#3 LOW (lower right); SW#4 HIGH (lower left)		
24	Washer, 1/2 OD x 0.14 ID, SST (1 per switch)	0317-0019C	A/R
25	Washer, Spring (1 per switch)	0257-0019C	A/R
26	Retaining Ring (1 per switch)	0087-0015T	A/R

Table 4-1. 288/290 General Parts List (Continued)

ITEM	DESCRIPTION	PART NO. (•)=model specific	PER UNIT
27	Screw, Lock (1 per switch)		A/R
	Switch #1 and #2	0317-0012C	
	Switch #3 and #4	S469-0045Z	
28	Link Plate (2 req. when both low and high sw used)	0288-0016C	A/R
29	Washer, Flat, #3, SST (3 per Link Plate)	0003-0045K	A/R
30	Grip Ring (1 per Link Plate)	0087-0011T	A/R
31	Drive Plate Assembly		A/R
	Low Alarm	0288-0026B	
	High Alarm	0288-0027B	
32	Screw, 3-48 x 3/16, SST, Binding Hd. (2 per Link Plate)	0117-0007J	A/R
33	Strap	0288-0017C	1
34	Washer, Split Lock, #8, SST	0003-0036K	1
35	Screw, 8-32 x 1/4, SST, Binding Hd.	0117-0016J	1
36	Switch Adjustment Index Assembly		1
	Low Switch	0288-0028B	
	High Switch	0288-0029B	
37	Screw, Bd. Hd., 3-48 x3/16, SST	0117-0007J	1
38	Switch Plate (1 per switch)		A/R
	Low Switch	0288-0022B	
	High Switch	0288-0023B	
	Low Switch, #1 (3 or 4 SW Config.) (Not Shown)	S469-0056Z	
	High Switch #2 (3 or 4 SW Config.) (Not Shown)	S469-0057Z	
	Low Switch, #3 (3 or 4 SW Config.) (Not Shown)	S469-0033Z	
	High Switch, #4 (3 or 4 SW Config.) (Not Shown)	S469-0035Z	
39	Spacer, Switch Plate (used w/single High SW or 3 Ind. Adj. SWs when #3 position is not used)	0258-0007C	1
40	Switch and Wire Assemblies:		A/R
	Low #1, PVC Insulation (CSA)	290B-1102B	
	Low #1, Tefzel Insulation (Radiation Resistant)	S666-0141Z	
	Low #2, PVC Insulation (CSA)	S401-0016Z	
	Low #2, Tefzel Insulation (Radiation Resistant)	S666-0142Z	
	High #1, PVC Insulation (CSA)	290B-1004B	
	High #1, Tefzel Insulation (Radiation Resistant)	S666-0143Z	
	High #2, PVC Insulation (CSA)	S401-0017Z	
	High #2, Tefzel Insulation (Radiation Resistant)	S666-0144Z	
	Low Relay, PVC Insulation (CSA)	0288-0004B	
	Low Relay, Tefzel Insulation (Radiation Resistant)	S666-0188Z	
	High Relay, PVC Insulation (CSA)	290B-1059B	
	High Relay, Tefzel Insulation (Radiation Resistant)	S666-0197Z	
Low Hermetic SW, Teflon Insulation (High Temp.)	0288-1131B		
High Hermetic SW, Teflon Insulation (High Temp.)	0288-1162B		
41	Alarm Actuator (Arm) (1 per switch)		A/R
	Low Switch	0251-0014B	
	High Switch	0251-0015B	
42	Pivot Plate (1 per switch)	0251-0050C	A/R

Table 4-1. 288/290 General Parts List (Continued)

ITEM	DESCRIPTION	PART NO. (*)=model specific	PER UNIT
43	Dielectric Shield (1 per switch)		A/R
	SPDT Switches	0290-1020C	
	DPDT Switches	0290-1021C	
44	Washer, #2, Lock, Int. Tooth (2 per switch)	0003-0048K	A/R
45	Nut, Hex, #2 (2 per switch)	0500-0030J	A/R
46	Low Relay Assy., PVC Insulation (● = Non-CE Use Only) (Not Shown) (Relays not available for 288C Stainless Steel version): Note: Consult Factory for relays with Tefzel insulated wires.		1
	Coil Voltage Wired SPDT Wired DPDT 6 VAC 290B-1018B 290B-1038B 12 VAC 290B-1019B 290B-1039B 24 VAC 290B-1020B 290B-1040B ● 115 VAC 290B-1021B 290B-1041B ● 230 VAC 290B-1022B 290B-1042B 6 VDC 290B-1023B 290B-1043B 12 VDC 290B-1024B 290B-1044B 24 VDC 290B-1025B 290B-1045B ● 110 VDC 290B-1026B 290B-1046B		
47	High Relay Assy., PVC Insulation (● = Non-CE Use Only) (Not Shown) (Relays not available for 288C Stainless Steel version): Note: Consult Factory for relays with Tefzel insulated wires.		1
	Coil Voltage Wired SPDT Wired DPDT 6 VAC 290B-1028B 290B-1048B 12 VAC 290B-1029B 290B-1049B 24 VAC 290B-1030B 290B-1050B ● 115 VAC 290B-1031B 290B-1051B ● 230 VAC 290B-1032B 290B-1052B 6 VDC 290B-1033B 290B-1053B 12 VDC 290B-1034B 290B-1054B 24 VDC 290B-1035B 290B-1055B ● 110 VDC 290B-1036B 290B-1056B		
48	Screw, Relay Mount, 4-40 x 3/8, SST, Fl. Hd. (Qty. is per relay) (Not Shown)	0112-1022J	2
49	Wire Nut (Relays Only) (2 per Relay) (Not Shown)	0109-0017T	A/R
50	External Wire Leads	See Table 4-2, on page 30	A/R
51	ID. Tag (Not Shown)	0199-0125C	1
52	Disc, Sealer, 1/2" (w/3M 468 Adhesive)	0192-1035T	1
53	Mounting Bracket (Refer to separate 224/224C DPU Manual.)		A/R
<p>Notes: A/R indicates as required. When ordering parts, specify serial number of instrument. For 288C SST specific parts, see Fig. 4-2 and Table 4-3. For 290D specific parts, see Fig. 4-3/4-4 and Table 4-4.</p> <p>Scaleplate identification: If the plate shows an SCR number, this will identify it. Otherwise, provide the following information: Square root or linear graduations, Scale (e.g., 0-100, 25-0-100, etc.), Number of graduations (linear scales only), and Data (e.g., PSID, inches water column, etc.) If the plate has multiple scales or colors (other than black and white), consult factory for pricing/description.</p>			

Table 4-2. External Wire Lead Part Numbers (Table 4-1, Item 50)

Length (feet)	Low #1	High #1	Low #2	High #2	Low Relay	High Relay	Ground
PVC Insulation (CSA)							
2.5	0288-0021B	S655-0056B	S401-0018Z	S401-0093Z	290B-1083B	290B-1084B	IT10-1063B
4.5	S655-0060B	S655-0059B					291B-1014B
10	S401-0085Z	S401-0086Z	S401-0087Z	S401-0088Z			291B-1015B
15	0288-1153B	0288-1154B	S401-0172B	S401-0173B			291B-1012B
20	S401-0122Z	S401-0123Z	S401-0124Z	S401-0125Z			291B-1016B
40	0288-1156B	0288-1157B					291B-1017B
Tefzel Insulation (Radiation Resistant)							
2.5	S666-0213Z	S666-0140Z	S666-0166Z	S666-0167Z	S594-0137Z	S594-0138Z	S666-0270B
10	S666-0190Z	S666-0191Z	S666-0241Z	S666-0242Z			S666-0271B
15	S666-0194Z	S666-0195Z	S666-0268B	S666-0269B			S666-0272B
20	S666-0201Z	S666-0202Z	S666-0203Z	S666-0204Z			S666-0273B
Teflon Insulation (High Temp./Hermetic Su)							
2.5	S822-0003Z	S822-0004Z					S822-0055B

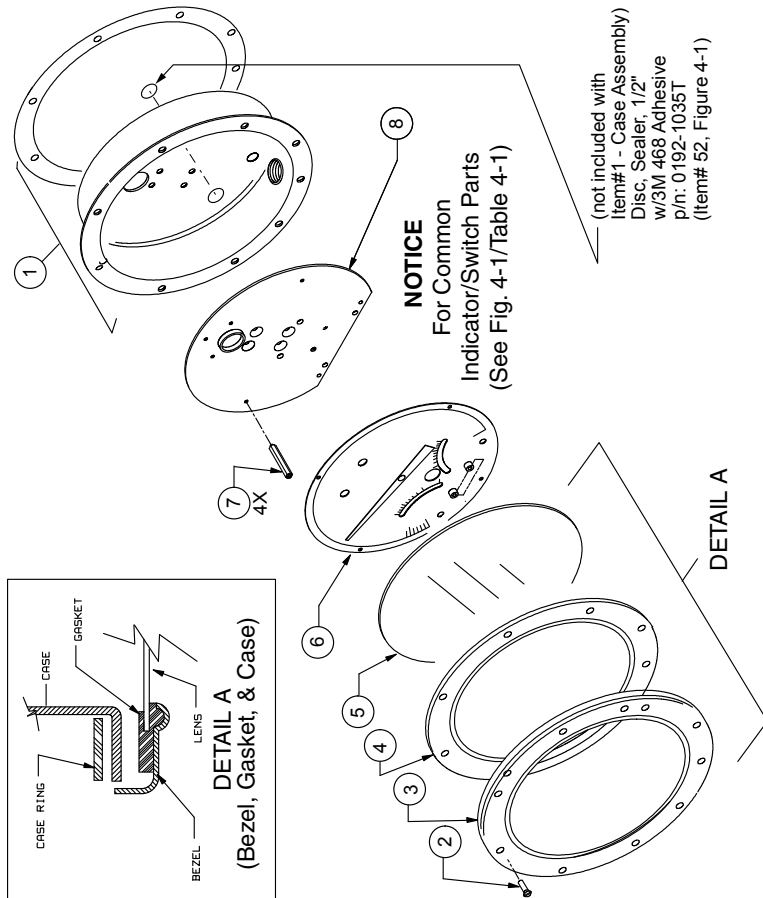


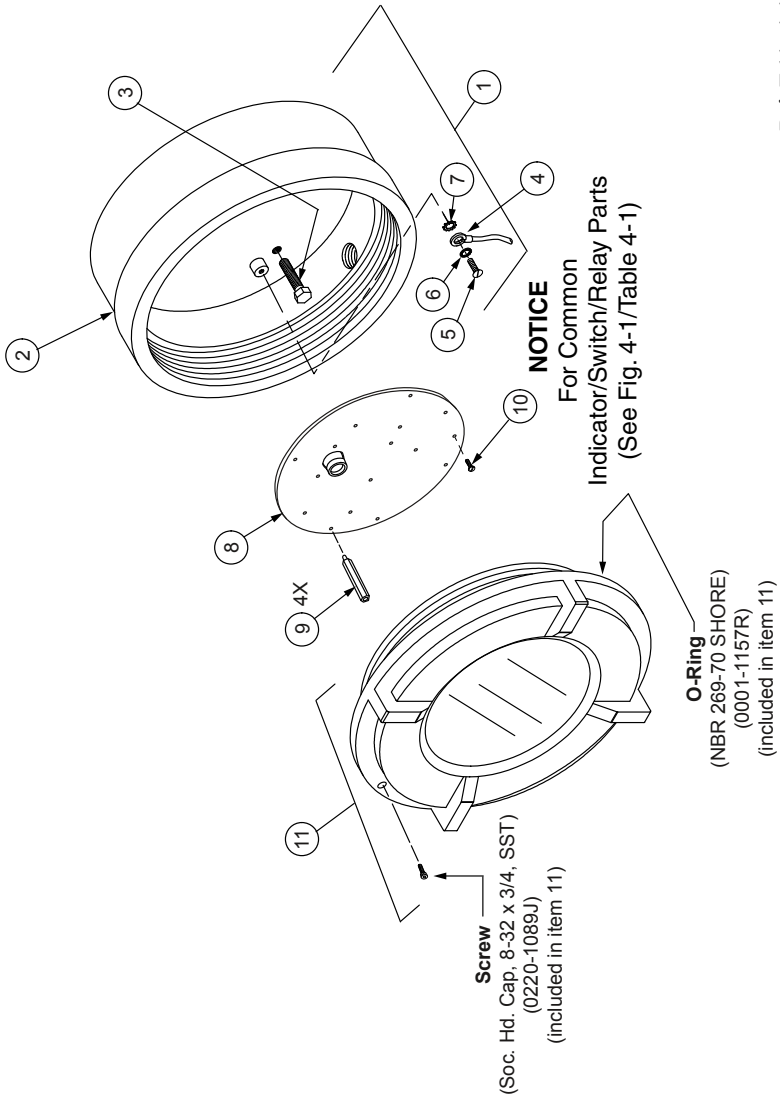
Figure 4-2. 288C (SST Version) Specific Parts Drawing

Table 4-3. 288C SST Version Specific Parts List (Ref. Fig. 4-2)

ITEM	DESCRIPTION	PART NO.	PER UNIT
1	Case Assembly, SST	S961-0052B	1
2	Screw, Bezel	S961-0041C	9
3	Bezel	S961-0037C	1
4	Gasket, Lens	S961-0039C	1
5	Lens	S961-0038C	1
6	Scaleplate		1
	Black	S961-0058C	
	White	S961-0057C	
7	Riser, Scaleplate	0279-0003C	4
8	Mounting Plate Assembly	S961-0059B	1
—	For Common Parts, refer to 288 (Fig. 4-1/Table 4-1)		

Note: When ordering parts, please specify the serial number of the instrument.

Ref. Table 4-3 for part numbers.



Ref. Table 4-4 for part numbers.

Figure 4-3. 290D Specific Parts Drawing

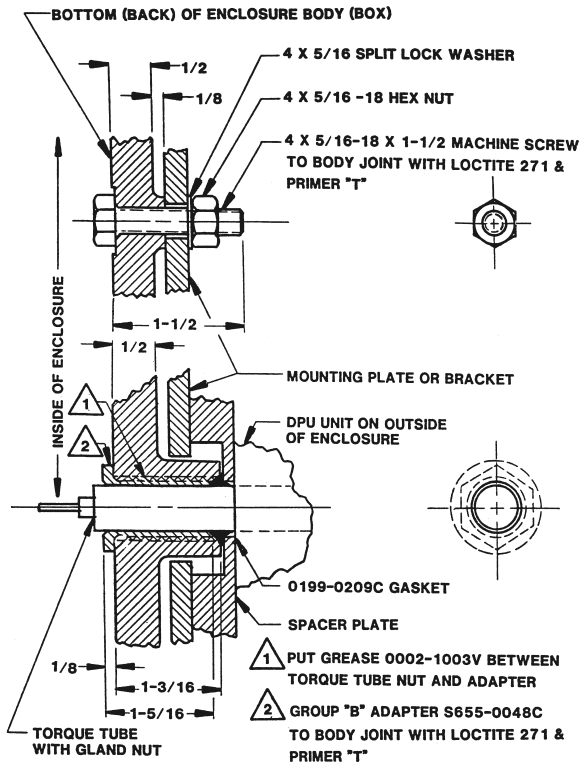
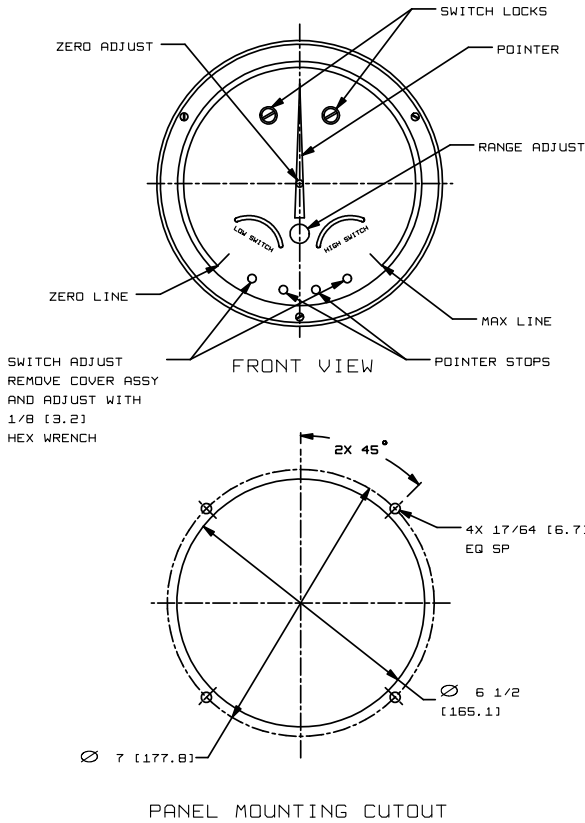


Figure 4-4. 290D Detail Drawing
(Attaching DPU to Instrument)

Table 4-4. 290D Specific Parts List (Ref. Fig. 4-3.)

ITEM	DESCRIPTION	PART NO.	PER UNIT
1	Case Assembly, Explosionproof	IT10-1091B	1
2	Case (Body), Explosionproof (part of item 1)	0290-1018C	1
3	Screw, Hex Hd., 5/16-18 (part of item 1)	0116-1036J	?
4	Ground Wire, Green (part of item 1)	IT10-1063B	1
5	Screw, Sl. Hex. Hd. (part of item 1)	0117-1012J	1
6	Int. Tooth Lock Washer (part of item 1)	0003-0066K	1
7	Ext. Tooth Lock Washer (part of item 1)	0003-0050K	1
8	Plate, Mounting, Assy.	0290-0002B	1
9	Riser, Scale Plate	0279-0003C	4
10	Screw, Mounting Plate, 8/32 x 3/16, Bin. Hd.	0117-0014J	3
11	Cover Assembly, Explosionproof	IT10-1090B	1
12	Adapter, Explosionproof (Fig. 4-4, Note [2])	S655-0048C	1
—	For Common Parts, refer to 288 (Fig. 4-1/Table 4-1)		

Note: When ordering parts, please specify the serial number of the instrument.



(Metric conversions are approximate.)

Figure 5-1. 288A/288C OD Drawing (Part 2 of 2)

Table 5-1. 288A/288C Dimensions ‡							
PRESSURE RATING PSI (MPa)	HOUSING MATERIAL	DIM. A* INCHES (mm)	DIM. B* INCHES (mm)	DIM. C* INCHES (mm)	DIM. D* INCHES (mm)	PRESSURE CONNECTION	
						TOP	BOTTOM
500 to 1500 (3.4 to 10.3)	ALL	4 (101.6)	2-15/16 (74.6)	2-41/64 (67.1)	2-5/8 (66.7)	1/2 NPT** 9/16-18 UNF*** 1/4 NPT	1/4 NPT** 9/16-18 UNF*** 1/4 NPT
3000 to 10,000 (20.7 to 68.9)	ALL	4-3/8 (111.1)	3-1/4 (82.6)	2-49/64 (70.2)	2-3/4 (69.9)	1/2 NPT 7/16 MS 1/8 NPT	1/2 NPT 7/16 MS 1/8 NPT
<p>*Note: Dim. A ± 0.03; Dim. B ± 0.01; Dim. C ± 0.01; Dim. D ± 0.03 **Note: Can be reversed when ordered or rotated 180° in the field. ***Note: Suitable for use with Aminco fittings (American Inst. Co., Silver Springs, MD) or equiv.. All standard pipe fittings furnished by customer. (Metric conversions are approximate.)</p>							

‡ NOTICE: 288A version configurations limited to Nuclear applications; also refer to separate 224/224C DPU Manual. **For dimensions of Stainless Steel version (SST) of 288C, contact Factory.**

(Metric conversions are approximate.)

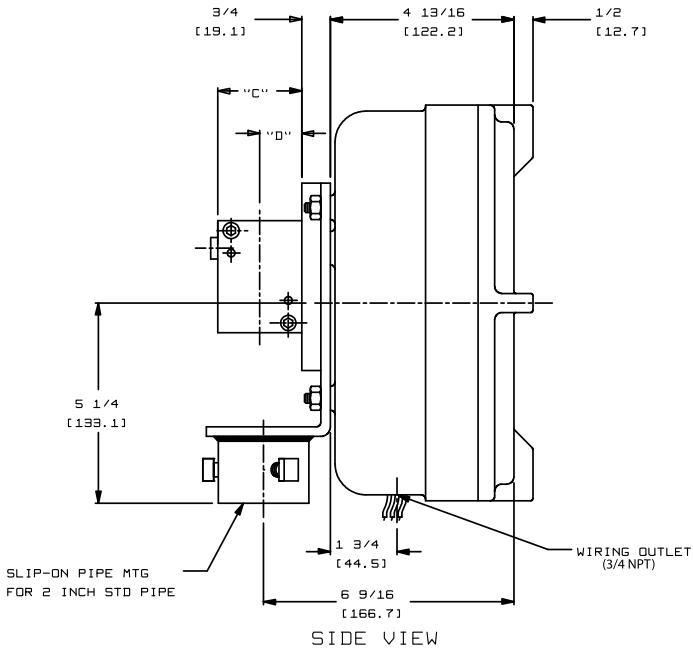
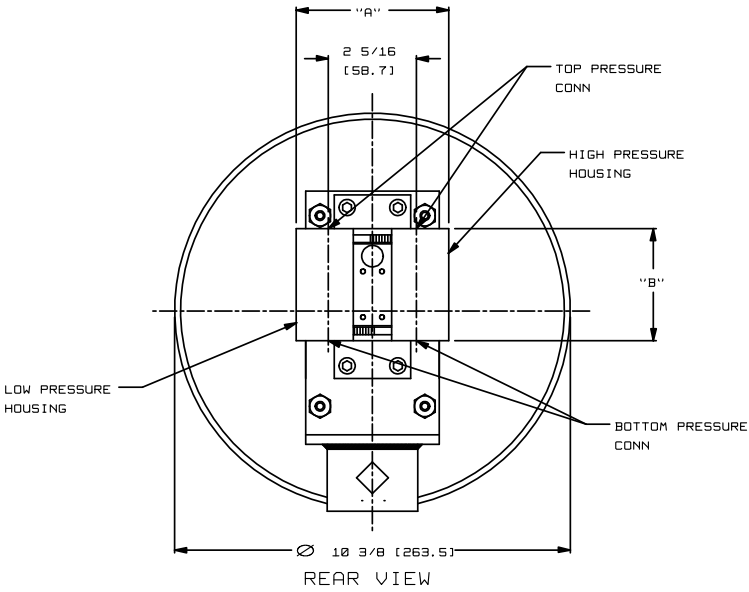


Figure 5-2. 290D OD Drawing (Part 1 of 2)

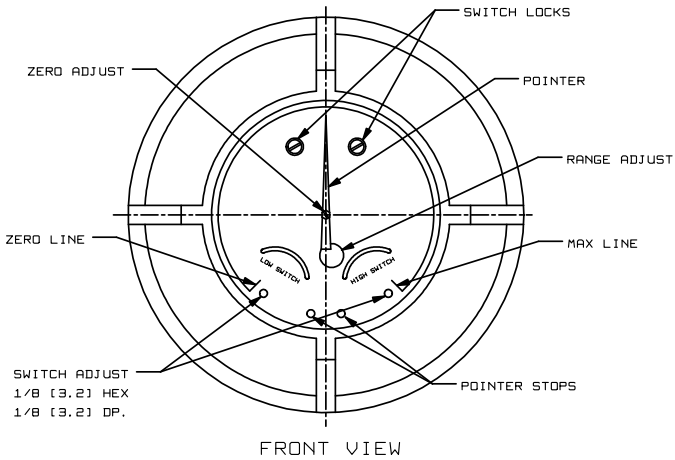


Figure 5-2. 290D OD Drawing (Part 2 of 2)

PRESSURE RATING PSI (MPa)	HOUSING MATERIAL	DIM. A* INCHES (mm)	DIM. B* INCHES (mm)	DIM. C* INCHES (mm)	DIM. D* INCHES (mm)	PRESSURE CONNECTION	
						TOP	BOTTOM
500 to 1500 (3.4 to 10.3)	ALL	4 (101.6)	2-15/16 (74.6)	2 (50.8)	1 (25.4)	1/2 NPT** 9/16-18 UNF*** 1/4 NPT	1/4 NPT** 9/16-18 UNF*** 1/4 NPT
3000 to 10,000 (20.7 to 68.9)	ALL	4-3/8 (111.1)	3-1/4 (82.6)	2-1/4 (57.2)	1-1/8 (28.6)	1/2 NPT 7/16 MS 1/8 NPT	1/2 NPT 7/16 MS 1/8 NPT

***Note:** Dim. A ± 0.03 ; Dim. B ± 0.01 ; Dim. C ± 0.01
****Note:** Can be reversed when ordered or rotated 180° in the field.
*****Note:** Suitable for use with Aminco fittings (American Inst. Co., Silver Springs, MD) or equiv..
 All standard pipe fittings furnished by customer.
 (Metric conversions are approximate.)

(Metric conversions are approximate.)

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